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AN EXPERIMENTAL STUDY ON THE EFFECT OF TOPICAL APPLICATION OF STANNOUS FLUORIDE TO THE STRIPPED ENAMEL SURFACE

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弗素가 削除된 琺瑯質 表面에 주는 影響에 關한 實驗的 硏究

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盧 泰 來

國文抄錄

本 著者는 削除된 琺瑯質表面에 8% Stannous Fluoride (SnF_2)를 局所的으로 表面塗布하여 1 mol의 lactate buffer solution에 넣어 比較標本과 脫灰程度를 比較 觀察하였으며 그 結果는 다음과 같다.

1. 一次 弗素塗布한 48時間後의 脫灰程度는 比較標本과 差異는 보였으나 兩種標本 모두 심한 脫灰狀態를 보여주었다.
2. 二次 弗素塗布한 48時間後는 점차 그 脫灰度는 減少했다.
3. 一次, 二次 弗素塗布한 288時間後의 脫灰度의 差는 0.24±0.03 mm인 弗素處理 標本에 比해서 比較標本에서는 0.66±0.03 mm의 差異를 나타냈다.
4. 結果的으로 琺瑯質表面 削除部位에 弗素塗布를 週期的으로 실시하면서 弗素가 含有된 齒藥을 계속적으로 使用하므로서 虫齒 發生率을 저하시킬 수 있다는 結論을 얻었다.

INTRODUCTION

The reduction procedure of the mesio-distal width of tooth by stripping of proximal

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enamel is practiced by some orthodontists to obtain space needed for teeth alignment, especially when the arch-length deficiency does not necessitate the tooth sacrifice.

This procedure has been suggested by several authors either as a possible treatment for tooth size discrepancies or as a mean of gaining the arch-length. Begg[1] has stated that the reduction of the widths of all the upper and lower incisors and canines for orthodontic purpose conforms more closely to basic biologic requirements than does orthodontic tooth extraction, regardless of whether posterior or anterior teeth are extracted.

This stripping process must be carried out with care because of the danger of penetrating the proximal enamel. Kapur, Fisher and Manly[2] investigated the influence of mechanical alteration of the surface of enamel sections through scratching, polishing, and grinding on the rate of subsurface penetration by a lactate buffer. They reported that roughening of the enamel surface increased the rate of penetration of the buffer by up to 27%, while polishing of the roughened surface with sand paper reduced the penetration rate to within 10% of the original.

Manly, Emerson and Kapur[3] suggested the penetration of enamel surface by acid buffer solution. Rogers and Wagner[4] reported that the enamel treated with single application of fluoride has significantly lower the rate of decalcifiation for the first 96 hours of exposure to lactate buffer.

The limited depth of the protection of fluoride suggested that continued protection of stripped enamel surface should be sought by regularly scheduled treatment of the enamel with fluoride derived from concentrated topical solution and regular use of a fluoride-containing dentifrice.

Using the technique developed by Manly et al. which permits a histological comparison of penetration rate and microscopic examination of demineralization, the present study was to examine the effect on enamel solubility of a low pH stannous fluoride solution applied topically and periodically to the stripped enamel surfaces of the teeth. The application of topical fluoride to stripped surfaces has been suggested by Rogers and Wagner because of recognized capacity to reduce the incidence of dental caries.

METHOD AND MATERIAL

Anterior teeth without decay and premolar teeth extracted for orthodontic purposes were obtained from Department of Oral Surgery, Infirmary of Dental College, S. N. U., and stored until use in 10% formalin.

After light pumicing to remove debris, the teeth were reduced in mesio-distal diameter by means of abrasive strips and later fine linen strips until the stripped enamel surface appeared smooth and 0.5 mm. of enamel was removed from the mesial surface, followed by similar treatment of the distal surface. After stripping and polishing, the teeth were mounted in blocks of cold-cure acrylic resin. Cross-sections of the crowns of the teeth were cut at a thickness of approximately 250 microns by means of a sectioning

machine. A section representing the middle third of the crown of the teeth was selected for the study and were fractured bucco-lingually so that both proximal surface of the teeth could be mounted side by side. The sections were mounted in the manner suggested by Manly, Emerson and Kapur[3]. The stripped enamel surfaces were mounted 3.0 mm. from the edge of a 1 by 3 inches microscopic slide with epoxy resin. A second glass slide was clamped on top of the sections, and then small amount of wax was placed against the proximal surface of the enamel to protect the surfaces to be tested.

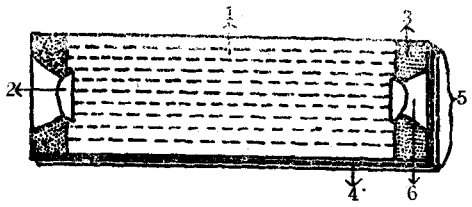

Fig. 1 1;Cold-cure acrylic resin
2; Tooth
3; Paraffin wax
4; Wax sealing
5; Microscopic slide
6; Slot

Epoxy resin was then injected between the two slides until the section were completely enclosed. After the resin had hardened for 24 hours, the wax was removed with dental explorer, exposing the enamel surface to be tested and creating a slot for the buffer solution to enter.

A paraffin wax seal was made around the edge of the slide in order to protect the epoxy resin from any possible reaction with the acidic buffer solution. A commercially available 8% stannous fluoride was injected into one of the slots available for study from each section (one mesial and one distal surface), this solution was left in contact with the enamel for 4 minutes and removed by blotting. The slides were placed in histologic staining dishes containing 1 molar lactate buffer solution of pH 5.0.

Care was taken to make sure that the lactate buffer filled completely the slot during an incubation at 37 degree centigrade. After 96 hours, stannous fluoride was reinjected into the above fluoridated preparates. After 4 minutes the slides were placed in histologic staining dishes containing 1 molar lactate buffer solution of pH 5.0. A grid was prepared so that the rate of travel of the decalcification wave would be measured. The starting point for the grid was the original margin forming the apex of the slot. Later measurement was made to the deepest point of apparent interaction with buffer solution.

RESULTS

Results obtained from the previously described procedure is given in Table 1. The number of sections tested is tabulated together with the mean cumulative depth of decalcification and the difference observed between the control group and fluoride treated group was due to chance. The difference among the means was highly significant during each exposure period.

Table 1. Cumulative decalcification of stripped enamel sections after variousexpos ures, to pH 5 lactate buffer (fluoride sections treated with stannous fluoride prior to exposure)

Exposure (hours)	Group	Number	Mean depth of decalcification and S.D. (mm)	Difference (P-value)
48	C	28	0.24±0.02	<0.001
	F	28	0.18±0.03	
96	C	28	0.32±0.02	<0.001
	F	28	0.21±0.02	
144	C	27	0.42±0.04	<0.001
	2 F	27	0.23±0.03	
192	C	27	0.53±0.05	<0.001
	2 F	27	0.23±0.03	
240	C	21	0.60±0.04	<0.001
	2 F	21	0.24±0.03	
288	C	19	0.66±0.03	<0.001
	2 F	19	0.24±0.03	

C=Control F=Fluoride. S.D. =Standard deviation

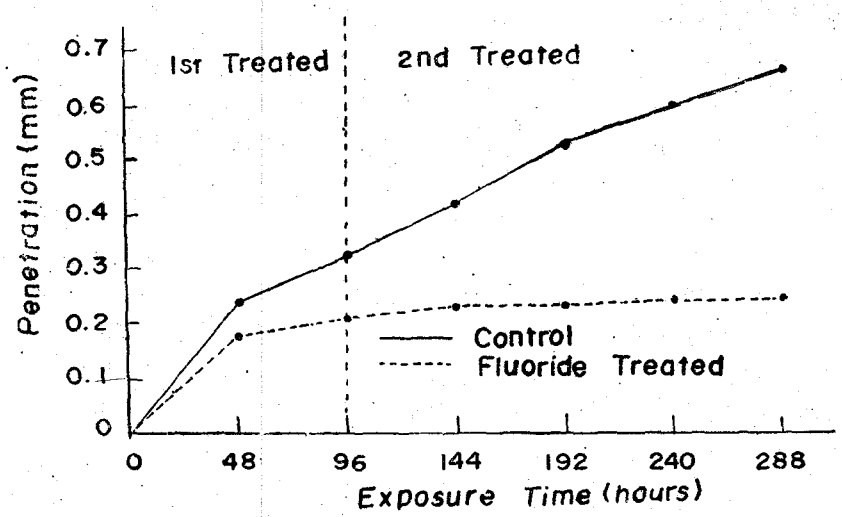

Fig. Ⅱ Cumulative decalcifcation depth versus hours of exposure to lactate buffer solution, pH 5. Point represent mean values from twenty eight teeth.

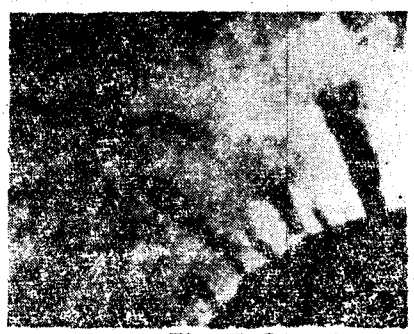

Fig. Ⅲ. Control

Fig. Ⅲ. Fluoride

Fig. Ⅱ shows the mean cumulative decalcification depth measurements from the onset of the experiment through each of the time period. The rate of decalcification appeared to decrease by a nearly constant factor during all the experimental period(Fig. Ⅱ).

Fig. Ⅲ shows a photomicrograph of the fluoridated slides and control slides prepared by the slot technique before submergence in the lactate buffer solution. (Fig. Ⅲ)

Fig. Ⅳ shows the amount of decalcification after 144 hours of incubation (second topical application of fluoride). The zone of decalification has not neared the enamel tufts in the fluoridated specimen.

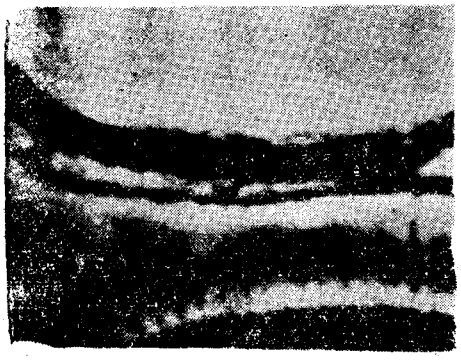

Fig. Ⅵ. Control

Fig. Ⅶ. Fluoride

DISCUSSION

This study was designed to investigate the effect of double topical application of fluoride on decalcification of enamel which had been altered by an orthodontic technique. The results of this investigation showed that the fluoride treated enamel had a significantly more reduced decalcification rate than control enamel during all the experimental periods. After 144 hours the difference in cumulative penetration rate appeared significant.

The fluoride treated enamel showed nearly constant rate. The control enamel showed increased rate. These results correspond to those reports by Kapur et. al[2], Rogers and Wagner[4]. Kapur and co-workers found that the topical application of sodium fluoride produced an initial reduction of demineralization in outer layer, but once in subsurface the demineralization occured rapidly. Rogers and Wagner reported that the beneficial effect of the fluoride application in reducing the rate of decalcification decreased significantly as the exposure to lactate buffer progressed.

The decalcification rates of both fluoridated and non-fluoridated sections were greatest in the initial 48 hours interval and decreased thereafter. This might be explained by an increase in slot depth as cavity formation progressed and partial neutralization of the lactate buffer in the depth of the slot. The effect of the double application of fluoride in reducing the rate of decalcificatition increased significantly as the exposure to lactate buffer progressed. This study suggests that regularly scheduled topical applications of fluoride are really of clinical value in protecting enamel surfaces reduced in mesio-distal width for orthodontic purposes.

SUMMARY

In this study, sections of twenty eight teeth were used to investigate the effect of topical application of 8% stannous fluoride on the decalcification rate of enamel surfaces stripped in a manner suggested for orthodontic purposes. The enamel treated with a single application of a fluoride had a significantly lower the rate of decalcification for the first 96 hours to lactate buffer solution. After double application of fluoride, decalcification rate decreased signicantly. This study suggested that the continuing protection of stripped surfaces should be sought by regularly scheduled treatment of the enamel with the topical application of fluoride and regular use of a fluoride containing dentifrice.

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