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EFFECT OF TOPICALLY APPLIED AGENTS ON ENAMEL

VII. EXPERIMENTS IN VITRO WITH UNBUFFERED SODIUM FLUORIDE SOLUTIONS

by

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In a previous paper[1] the writers reported preliminary experiments performed in order to study the change in acid resistance of dental enamel after treatment with sodium fluoride solutions. The increase in resistance was less than might have been expected when considering earlier laboratory tests[2, 3, 4, 5]. As the material was too small for an elucidation of this discrepancy an extended study was undertaken.

EXPERIMENTAL SERIES I

Material and method

Newly erupted premolars from Gothenburg and Oslo were used in the experiments, which were performed according to the modified method of *Mörch, Torell & Hals*[1]. The experimental area of the teeth was, thus, divided into halves, one of which was treated with the fluoride solution, while the other half served as control. The fluoride solution was allowed to dry on the enamel for 10 minutes. The tooth was then placed in neutral saliva for one hour, and incubated with sugar-saliva mixture for 18—48 hours. The decalcifying effect of the sugar-saliva mixture was

studied in polarized light on ground sections imbibed in water, and evaluated according to a scheme described previously[1].

The results of the recordings are given in Table I.

Table I.

0.5 M NaF, pH 6.63

Number of experiments	Positive difference		No difference	Negative difference
	Slight	Very Slight		
110	7	5	96	2

Percentage positive cases 11 ± 3
Percentage negative cases 2 ± 1.8
Difference 9 ± 3.3

The recordings give no reliable indications of an increase in resistance to sugar-saliva mixtures after treatment of dental enamel with unbuffered sodium fluoride solutions.

Discussion

There is an apparent discrepancy between the results of this study and those of the laboratory tests cited above. If possible this should be explained. In the present experiments the teeth were placed in neutral saliva immediately after the application of the fluoride solution. This means a possible transfer of fluoride ions from the treated to the untreated halves of the experimental areas. The reports by *Sundvall-Hagland*[6] and by *Ericsson*[7] indicate that such a transfer must be regarded as highly probable. The difference in acid resistance between treated and untreated halves may be assumed to be more or less inversely proportional to the amount of fluoride ions transferred. With this in mind the writers decided to vary the experimental conditions in a way diminishing the influence of the diffusion of fluoride ions.

EXPERIMENTAL SERIES II

Material and method

were the same as in series I with the exception that the control half was moistened with neutral saliva and kept isolated during the time of the application as well as during the first incubation of an hour's duration in neutral saliva.

The results of the recordings are given in Table II.

Table II.
0.5 M NaF, pH 6.63

Number of experiments	Positive difference		No difference	Negative difference
	Slight	Very slight		
57	1	16	36	4
Percentage positive cases 30 ± 6				
Percentage negative cases 7 ± 3.3				
Difference 23 ± 7				

The sodium fluoride treatment has established a statistically significant increase in the resistance of the dental enamel to sugar-saliva mixtures.

Discussion

The experience made in series I and II indicates that a single application of sodium fluoride only brings about a very slight increase in the resistance of dental enamel to sugar-saliva mixtures. This is in accordance with the fact that practically no caries inhibiting effect has been recorded clinically as the result of a single application[8, 9].

The figures of series II are in closer accordance with previous laboratory reports[2, 3, 4, 5] than are the figures of series I. It may be argued, however, that the number of cases with no differences in series I is too great for a perfect agreement. The following review of data may clarify this seeming discrepancy. It has been shown in several investigations that an application of a neutral sodium fluoride solution may lead to the formation of calcium fluoride in the surface layer of the enamel, this calcium fluoride being more insoluble than hydroxyapatite[10, 11, 12]. It has also been shown that the precipitated calcium fluoride crystals only have a very weak adherence to the enamel surface[10, 12]. In a special study on the effect of sugar-saliva mixtures on dental enamel[13] the writers found that the outermost part of the hypermineralized surface layer of the enamel had to be destroyed before the hydrogen ions could penetrate into the enamel deep enough to establish an "inner spot". As mentioned above, a sodium fluoride solution deranges and loosens the substance

of a part of this hypermineralized layer. Therefore, the intact enamel layer which has to be dissolved before an inner spot can be established must be thinner on the fluoride treated half than on the untreated half of the same experimental area. The dissolution of this intact hypermineralized thinner layer must, however, be retarded by the calcium fluoride crystals precipitated during the application. Hence, it seems probable that after a certain period of exposure to sugar-saliva, treated and untreated halves can present identical histologic pictures, although a determination of the calcium and phosphate ions dissolved from the two halves during the same time would have given higher values for the untreated half than for the treated half.

The present study adds evidence to previous findings[6, 7] that the diffusion of fluoride ions in the saliva is of great significance in topical application of fluoride. This diffusion mechanism will give too low values for the caries reduction when fluoride treated quadrants of the jaws are compared with untreated "control" quadrants from the same individual. It must, therefore, be emphasized that such studies always must comprise an extra control group of individuals who have not received any fluoride treatment at all.

SUMMARY

The effect of 0.5 M sodium fluoride solutions when applied topically *in vitro* on dental enamel was studied according to a method described previously. It was found that the application established a statistically significant increase in the enamel resistance to sugar-saliva mixtures. The present study supports earlier suppositions that fluoride ions can be transferred in the saliva from fluoride treated areas to untreated control areas.

RÉSUMÉ

EFFET SUR L'ÉMAIL D'AGENTS APPLIQUÉS LOCALEMENT

VII. EXPÉRIENCES IN VITRO AVEC DES SOLUTIONS NON TAMPONS DE FLUORURE DE SODIUM

L'effet de 0,5 M de solutions de fluorure de sodium appliquées localement *in vitro* sur l'émail dentaire a été étudié suivant une méthode décrite précédemment. On a trouvé que l'application

provoquait une augmentation significative du point de vue statistique de la résistance de l'émail aux mélanges sucre-salive. La présente étude a confirmé les suppositions faites antérieurement sur la possibilité que les ions fluorure soient transportés dans la salive des surfaces traitées au fluorure aux surfaces de contrôle non traitées.

ZUSAMMENFASSUNG

DIE WIRKUNG LOKAL VERABREICHTER LÖSUNGEN AUF DEN ZAHNSCHMELZ

VII. UNTERSUCHUNGEN IN VITRO MIT NICHT-GEPUFFERTEN NATRIUMFLUORIDLÖSUNGEN

Die Wirkung von 0,5 M Natriumfluoridlösungen, lokal appliziert *in vitro* auf den Zahnschmelz, wurde mittels einer früher beschriebenen Methode studiert. Dabei wurde festgestellt, dass die Applikation eine statistisch signifikante Erhöhung der Resistenz des Zahnschmelzes gegen die Zucker-Speichellösung bewirkt. Die vorliegende Arbeit unterstützt frühere Annahmen, dass Fluoridionen im Speichelfluss von fluoridbehandelten Flächen zu unbehandelten Kontrollflächen transportiert werden können.

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