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TWO-YEAR CLINICAL TESTS WITH DIFFERENT METHODS OF LOCAL CARIES-PREVENTIVE FLUORINE APPLICATION IN SWEDISH SCHOOL-CHILDREN

by

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In all countries with high caries rates the utilization of the remarkable caries-preventive effect of fluorine has appeared urgent. The Swedish National Board of Health, realizing the impossibility at present to provide for complete dental care to the whole population without efficient caries-preventive methods, in 1952 and 1957 appointed committees to survey the use of fluorides in the prevention of dental caries. These committees recommended that the drinking water should be fluoridated under certain restrictions (*Abramson & al.* 1954, *Sellman, Ericsson & Strålfors* 1958). They also recommended investigations into other ways for the caries-preventive utilization of fluorides.

It was soon found that the psychological prerequisites for the fluoridation of communal water supplies in Sweden were so baffled that its large-scale realisation would be delayed for an unpredictable number of years. Consequently the National Board of Health, advised by one of the present authors (Y.E.), found it urgent to test other methods of applying fluorides to the teeth.

ARRANGEMENTS MADE BY THE NATIONAL BOARD OF HEALTH

The tests were to be carried out on school-children and were calculated to require such a number of children that only a fairly

large city could provide a homogeneous material. Among suitable Swedish cities the Board of Health selected Göteborg, an industrial and commercial city with about 400,000 inhabitants. The following facts contributed to the selection. The administrative and dental authorities of the city showed a keen interest in the planned investigations. The caries rate had long been very high. The drinking water, derived from lakes and rivers, contained less than 0.3 p.p.m. of fluorine.

When the preliminary plans for the Göteborg study had been settled, the dental officers of the Stockholm County Organization for Dental Care expressed their willingness to study the effect of a fluorine dentifrice. This offered an opportunity to test a toothpaste of new formulation. This trial was undertaken in Södertälje, an industrial town in Stockholm County, and was co-ordinated with the Göteborg study. The present paper is a joint report of the two studies.

When designing the investigations a selection had to be made among the plethora of methods for fluorine application which had been tested *in vivo* or *in vitro* during the last 25 years. The methods chosen for the studies and the reasons for their selection are summarized below.

Topical application of sodium fluoride solution

— because in almost all previous investigations with this method a substantial caries inhibition had been registered (review: *Sellman, Ericsson & Strålfors* 1958). This method would thus form an appropriate yard-stick for the other methods to be tested.

Topical application of stannous fluoride solution

— because *in vitro* the ability of stannous fluoride to decrease the solubility of enamel surfaces was reported to exceed that of sodium fluoride (*Ericsson* 1950, *Muhler* 1957) and because favourable results had been reported from clinical tests (*Muhler* 1960).

Mouthrinses with sodium fluoride solution

— because a prophylactic effect appeared probable in view of studies showing that in salivary environment fluorine is taken up by dental enamel (*Ericsson* 1958), and because it was envisaged

that mouthrinses would facilitate a mass application with very little demand on manpower for supervision.

Dentifrice containing stannous fluoride with calcium pyrophosphate as abrasive

— because a dentifrice of this type had been extensively tested in U.S.A. and had been reported to give a positive effect (review: Muhler 1961).

Dentifrice containing sodium fluoride with sodium bicarbonate as abrasive

— because this dentifrice contained one of the few compatible combinations of sodium fluoride and abrasive which, at the planning of the experiments, appeared to be of practical value (Ericsson 1961).

Dentifrice containing sodium monofluorophosphate with calcium carbonate as abrasive (tested in Södertälje)

— because this fluorine compound was found to provide a fluorine uptake by calcium phosphate and dental enamel while being completely inert to calcium carbonate, a widely used abrasive in dentifrices (Ericsson 1961).

Control groups

For each group given a fluorine-containing dentifrice a control group was given a dentifrice of the same formulation without fluorine. In the Göteborg study a main control group was given no caries-preventive treatment at all.

PART I. THE GÖTEBORG STUDY

Material and methods

The children

10-year-old children in Göteborg elementary schools were selected for the investigations because, (1) their number of erupted and erupting teeth was considered sufficient for the tests, (2) they were to be kept together in classes for the planned experimental period before being split up in different secondary schools, (3) the collaboration at this age is generally good and the ability to understand given instructions satisfactory. Owing to the last reason the selection was limited to children in normal

classes, excluding mentally less developed children. Children who had received any kind of fluorine treatment prior to the study were also excluded and so were children who had lived in areas with more than 0.5 p.p.m. of fluorine in the drinking water.

In a previous Göteborg study (*Henrikson, Oldén & Torell 1958*) a group of 58 children had acquired a mean of 4.2 ± 0.42 new DMF-surfaces from their fourth to their fifth school year. Another group of 113 children had acquired 4.0 ± 0.34 new DMF-surfaces from their fifth to their sixth school-year. As the children had been chosen at random and as the caries frequency in the elementary schools had been nearly the same since 1947 (City of Göteborg: Sjukvårdsstyrelsens handlingar 1961, Dnr 1238/60) the figures mentioned above were assumed to indicate the caries situation in the age groups of the present study. These figures were used for an approximate calculation of the suitable number of participants in the groups of the planned study. It was estimated that with 150 children left in each group after an experimental period of two years, the mean number of new DMF-surfaces ought to be 20 per cent lower in a test group than in a control group if a caries-reducing effect of the fluorine treatment was to be probable at the 95 % level. According to previous experience a loss of 5–10 % of the participants every year seemed probable. With this in view it was decided that the number of children in each of the study groups should be 175–200 at the outset.

9 groups, each comprising 175–210 children, with an even distribution of girls and boys, were picked from elementary schools where no extreme social or economic conditions prevailed among the parents. The groups were randomly constituted and randomly assigned to the different test methods, according to a system worked out with the assistance of statisticians from the Bureau of Statistics and the Medical Administration of Göteborg City. Since the study was to be performed as a blind test, the nine groups were given code numbers.

The participation in the study was voluntary. A letter was sent to the parents of the presumptive participants informing them of previous experience from local fluorine treatment and inviting them to let their children join the study. The response was very positive since practically all the parents gave their permission.

The letter to the parents may be given the following English translation:

To parents of children attending the fourth school year,

The prevalence of dental caries is low in areas where the drinking water contains certain amounts of fluorine whether this content is naturally occurring or purposely added at the water works (so-called fluoridation). It is evident that this caries-preventive effect is brought about chiefly by the incorporation of fluorine in the enamel, which makes the teeth more resistant. Attempts have therefore been made to prevent caries by treating the enamel with solutions of fluorine salts. Many carefully performed studies have been reported. They have convincingly shown that it is possible to obtain a notable decrease in dental caries through such local treatment of the teeth.

Several methods for this local application of fluorine salts to the enamel surface have been practiced,

- 1) Painting the enamel surface with solutions of fluorides;
- 2) Tooth-brushing or mouth-rinsing with solutions of fluorides;
- 3) Tooth-brushing with fluorine-containing toothpastes.

These three methods have all been found to be caries-reducing and completely harmless. At present, however, it is impossible to decide which of them gives the greatest reduction of tooth decay. In order to throw light on this question a study is to be performed in Göteborg. The study will be financially supported by the State Medical Research Council and the City of Göteborg. It connects to the trials with local fluorine treatment which for some years have been in progress at the school dental clinics of Göteborg and which have given promising results.

From the facts mentioned above it is clear that the purpose of the planned study is to compare several caries-reducing methods, the effectiveness and harmlessness of which are well established in investigations performed in Sweden and abroad. It is not intended to test new methods the workings of which are unknown.

The study is to be performed in cooperation with its originator Professor Yngve Ericsson, adviser to the National Board of Health in the field of caries prevention. It will be conducted by Docent Per Torell, University of Göteborg. It has been found expedient to start the study with children in their fourth school year, among them the class to which your child belongs.

If you should object to your child's participation in the study, please inform the class teacher within a week. Any requests for further information are to be addressed to

- 1) The Chief Dental Officer of the Schools, Mr. Siberg;
- 2) Mrs. Florath, School Dental Surgeon;
- 3) Docent Torell.

(telephone numbers given)

The fluorine application

The solutions used for topical applications were obtained by dissolving 2 % sodium fluoride or 10 % stannous fluoride in distilled water. The sodium fluoride was analytically pure and the pH-value 6.74 in a 2 % solution. The stannous fluoride was manufactured by Riedl & Co. A freshly prepared 10 % solution had the pH-value 2.80 and showed no opalescence. The stannous fluoride was kept as a dry powder in capsules of 1 g and was dissolved in water immediately before each application.

The sodium fluoride solution was applied four times, strictly according to *Knutson* (1948). The stannous fluoride solution was applied once, strictly according to *Muhler* (1958).

Applications as mouthrinses were performed either daily with a 0.05 % sodium fluoride solution or fortnightly with a 0.2 % sodium fluoride solution. The compositions of the solutions were as follows:

0.05 % sodium fluoride solution for mouthwash

Sodium fluoride	0.50 g
Saccharine	0.02 g
Peppermint oil	0.20 g
Anise oil	0.15 g
Tween 20	0.40 g
Metagin	0.50 g
Alcohol	5.00 g
Distilled water ad	1000 ml

0.2 % sodium fluoride solution for mouthwash

Sodium fluoride	2 g
Tap water ad	1000 ml

The mouthwashing solutions for unsupervised use were distributed in plastic bottles containing one litre of solution. In the neck of every bottle a plastic beaker was inserted, from the 10 ml level of which a plastic tube went down to the bottom of the bottle. Through this tube a 10 ml volume could be pumped up in the beaker by gently pressing the bottle. The text on the label of the bottle instructed the child to rinse its mouth carefully with one 10 ml volume every evening following the toothbrushing.

The fortnightly mouthrinses were performed at school and

were supervised by specially trained dental nurses, who strictly followed the method previously used in Göteborg (*Fjæstad-Seger, Norstedt-Larsson & Torell 1961, Torell & Siberg 1962*).

The daily mouthwashes as well as the use of dentifrices were not supervised. This was thought to facilitate a realistic estimation of the prophylactic effect, since the variable inherent in individual orderliness was included.

The different toothpastes had the following compositions.

Stannous fluoride/calcium pyrophosphate toothpaste

Stannous fluoride	0.40 g
Calcium pyrophosphate (ignited to 1000°C)	40.00 g
Aerosil (finely powdered silica)	3.00 g
Flavours	3.22 g
Hydrochloric acid (0.526-N)	3.89 g
Carboxy methyl cellulose	3.00 g
Glycerol	10.00 g
Distilled water ad	100.00 g

The corresponding control dentifrice had the same composition with the exclusion of stannous fluoride and the addition of slightly more hydrochloric acid to compensate the acidity of the excluded stannous fluoride. The pH values of both dentifrices were 4.8—5.0.

Sodium fluoride/sodium bicarbonate toothpaste

Sodium fluoride	0.24 g
Sodium bicarbonate	56.00 g
Sodium lauryl sulphate	2.00 g
Carboxy methyl cellulose	1.50 g
Glycerol	10.00 g
Flavours	0.25 g
Water ad	100.00 g

The control dentifrice had the same composition with the exception of the sodium fluoride.

Certain laboratory tests carried out before the start of the study had added supplementary data to previous literature on the fluorine retention from mouthwashes and toothpastes, on the

fluorine uptake from different fluorides and fluorine-containing toothpastes and on the compatibility of different fluorides and various toothpaste ingredients. Some of these studies have been reported elsewhere (Ericsson 1961, Hellström 1960).

The test dentifrices were distributed in internally lacquered aluminium tubes until it was found that these tubes did not resist the acid stannous fluoride toothpaste. This paste and its control paste were then distributed in plastic tubes.

The tubes were labelled with the code numbers and the text "Dentifrice for fluoride treatment. Take 1—2 cm on the toothbrush every morning and evening. Screw on cap immediately after use."

The children in the dentifrice groups were instructed not to swallow the dentifrice. Such swallowing was characterized as unsuitable although not hazardous. They were also instructed to rinse their mouths with water immediately after the brushing.

The caries evaluation

The development of caries in the nine groups was evaluated in three separate ways,

- 1) from the carious surfaces clinically recorded by two specially trained dentists;
- 2) from the proximal carious lesions recognized on bite-wing radiographs;
- 3) from the fillings inserted at the end of the experimental period by the dentists of the various school dental clinics.

The clinical examination

The clinical examination was carried out by two skilled school dentists, Svea Florath L.D.S. and Margit Henrikson L.D.S., who had earlier experience from caries recording in the clinical studies reported by *Osvald, Quensel & Gustafsson* (1955) and *Henrikson, Oldén & Torell* (1958). The great number of participants necessitated two recording dentists. During the whole study both of them examined their half of the children in each of the nine groups. On the registration charts the different groups were referred to by their code numbers. The two examiners did not have access to the code during the course of the investigation.

The clinical examinations were performed in the morning under highly standardized conditions as to light, mirrors, explorers, airdrying, separation of the teeth etc. In principle, every recorded cavity should have been recognized objectively beyond any possibility of doubt. The detailed criteria were,

Fissure caries. If softness is palpable with the explorer point or if the explorer point resists withdrawal *and* the margins of the fissure appear chalky when the tooth is dried.

Smooth surface caries. If the explorer point detects a loss of surface continuity in a chalky or brown stained area of diminished translucency.

It is well known that the number of cavities recorded in clinical studies is subject to considerable error. In order to increase the reliability and consistency of their diagnoses of caries the

Table 1

Duplicate recording of caries in 30 children 11 years old performed by the examiner M. H.

Number of cavities detected at both examinations	144
Number of cavities detected only at examination I	4
Number of cavities detected only at examination II.....	7
Total number of cavities detected at examination I	148
Total number of cavities detected at examination II	151

Table 2

Duplicate recording of caries in 35 children 11 years old performed by the examiner S. F.

Number of cavities detected at both examinations	201
Number of cavities detected only at examination I	3
Number of cavities detected only at examination II.....	3
Total number of cavities detected at examination I	204
Total number of cavities detected at examination II	204

Table 3

Calibration recording of caries in 62 children 11 years old performed by the two examiners M. H. and S. F.

Number of cavities detected by both examiners	333
Number of cavities detected only by examiner M. H.	47
Number of cavities detected only by examiner S. F.	43
Total number of cavities detected by examiner M. H.	380
Total number of cavities detected by examiner S. F.	376

examiners of the present study and their chairside-assistants underwent a one-year pre-experimental training with repeated duplicate examinations and calibrations. Tests at the end of the training period showed that the assessments of the two examiners met high demands as to reliability and reproducibility (Tables 1—3). The necessity of such pre-experimental training has been recently ascertained by *Davies & Cadell* (1963).

All caries registrations including those of the training period were made on charts which had been specially devised for this study in order to facilitate the future machine computation of the experimental data. The eruption data were also registered on these charts. A tooth was denoted as "erupted" if it reached the occlusal plane, if not as "under eruption" as soon as any part of the tooth was visible.

Registrations were made on three occasions,

- 1) A base registration at the beginning of the study;
- 2) An intermediate registration after the study had been in progress for one year;
- 3) A final registration after the study had been in progress for two years.

The examinations were performed as blind tests. During the whole study the examiners had no knowledge of the code of the treatment given to the children. Participants from different groups were always examined in mixed order. Reexaminations were made without access to the charts from previous examinations.

The x-ray examination

The x-ray bite-wing examination was performed with the apparatus devised by Backer Dirks & co-workers (*Backer Dirks, van Amerongen & Winkler* 1951, *Backer Dirks & Kwant* 1954). It was carried out by Knut Ehrby L.D.S., who is in charge of the x-ray department at the Göteborg Central School Dental Clinic.

As in the clinical study it was decided that a carious defect should be diagnosed beyond any possibility of doubt. The following detailed criteria were used. All radiolucent areas involving the dentin were regarded as carious. Radiolucent areas only involving the enamel were regarded as carious if the areas were distinctly U- or V-shaped. In order to bring about a high degree

of reproducibility the following scheme was employed. The examining dentist (Ehrby) scrutinized all radiographs successively and registered the findings on special charts. Without access to these charts he examined all radiographs once more in the same way. The discrepancies between these two examinations were then discussed by the examiner and one of the authors (Torell) whereby a definite assessment was made. The study was a blind test as the examination charts did not refer to the treatment or to the code numbers of the groups.

Three series of bite-wing radiographs were taken, the first at the beginning of the study, the second after a year and the third at the end of the study.

The number of surfaces filled at the end of the study

During an experimental time as long as two years a certain amount of restorations have to be made in the carious teeth of the participants. The following precautions were taken to avoid that the fillings inserted at the dental clinics should bias the observations of the two examiners. A complete dental treatment was made immediately before the base registration. After the one-year examination had been made, the participating children again received a complete dental treatment. The treating dentists had access to the caries data of the one-year registration. As a rule they were not allowed to fill other surfaces than those registered as carious on the charts. They were, however, free not to fill a registered cavity if they did not consider it necessary.

After the two examiners had made the two-year registration, the children once more received a complete dental treatment. This time the treating dentists had no access to the data of the two-year registration. With certain limitations, therefore, the number of surfaces filled at the end of the study can be regarded as a measure of the caries development during the second experimental year.

Calculations

The data were programmed for and processed by an IBM 1401 electronic computing machine.

The statistical calculations, beyond those effected by the data machine, were performed in collaboration with the Göteborg City Bureau of Statistics.

Results

The number of participants

The number of participants was reduced during the experiment (Table 4). In most cases the quittings were of an acci-

Table 4
Loss of participants during the study.

Group	Participants at the start	Participants at the end	Loss of participants	
			Number	Percentage
NaF-paint.	192	159	33	17.2 %
SnF ₂ -paint.	171	141	30	17.5 %
NaF-wash. 1/1	190	160	30	15.8 %
NaF-wash. 1/14	211	172	39	18.5 %
SnF ₂ -Ca ₂ P ₂ O ₇ -dfr.	196	169	27	13.8 %
Ca ₂ P ₂ O ₇ -dfr.	198	179	29	14.6 %
NaF-NaHCO ₃ -dfr.	196	166	30	15.3 %
NaHCO ₃ -dfr.	176	154	22	12.5 %
Main control	196	162	34	17.3 %

dental nature as moving to other places or other schools, illness etc. In all groups some children left after the first year disappointed at the appearance of new carious lesions in spite of the prophylactic treatment. In a few cases the reason given for quitting was more specific, as for instance "unpleasant taste" of dentifrices and mouthwash solutions or objectionable pigmentation of the teeth thought to be caused by the treatment. In none of the groups, however, the number of quittings appeared to be particularly great. This concept was corroborated by a statistical treatment of the figures of Table 4, which confirmed that the differences between the groups regarding loss of participants could be ascribed to chance.

The pre-experimental caries experience of the groups

Tables 5, 6, 13, 14, and Figures 4 and 5 demonstrate that the nine groups were well balanced as to pre-experimental caries experience. When the data obtained during the experimental years were treated statistically no corrections were therefore needed to compensate for any differences in the initial caries picture of the groups. It also seemed justified to associate any

Table 5.

Number of pre-experimental DMF-surfaces recorded clinically in the nine groups at the start of the study.

	Mean number of DMF-surfaces	Standard error of the mean	Significant difference in comparison with the control group
NaF-paint.	13.9	0.51	none
SnF ₂ -paint.	14.4	0.53	none
NaF-wash. 1/1	14.4	0.53	none
NaF-wash. 1/14	15.2	0.59	none
SnF ₂ -Ca ₂ P ₂ O ₇ -dfr.	14.2	0.53	none
Ca ₂ P ₂ O ₇ -dfr.	14.5	0.54	none
NaF-NaHCO ₃ -dfr.	14.7	0.58	none
NaHCO ₃ -dfr.	14.6	0.56	none
Main control	14.5	0.53	—

Table 6.

Number of pre-experimental DMF-surfaces recorded roentgenographically in the nine groups at the start of the study.

	Mean number of DMF-surfaces	Comparisons between the control group and the other groups χ^2 -value (f = 7)	Significance
NaF-paint.	3.57	13.56	none
SnF ₂ -paint.	3.81	4.60	none
NaF-wash. 1/1	3.54	1.32	none
NaF-wash. 1/14	3.97	3.44	none
SnF ₂ -Ca ₂ P ₂ O ₇ -dfr.	3.77	4.28	none
Ca ₂ P ₂ O ₇ -dfr.	3.85	9.12	none
NaF-NaHCO ₃ -dfr.	3.94	4.60	none
NaHCO ₃ -dfr.	4.17	8.48	none
Main control	3.59	—	—

changes in caries activity observed during the experiment with the different types of treatment given to the groups.

Evaluations based on the distribution of the participants as to new DMF-surfaces

Table 7 gives the mean number of new DMF-surfaces recorded clinically in the different groups. The statistical relations between these means are given in Table 8. Fig. 1 condenses Tables 7 and 8.

Table 7.

Numbers of new DMF-surfaces recorded clinically in the different groups at the end of the study.

	Mean $\pm$ standard error
NaF-paint.	8.04 ± 0.46
SnF ₂ -paint.	9.67 ± 0.55
NaF-wash. 1/1	5.10 ± 0.39
NaF-wash. 1/14	7.87 ± 0.41
SnF ₂ -Ca ₂ P ₂ O ₇ -dfr.	7.87 ± 0.54
Ca ₂ P ₂ O ₇ -dfr.	10.19 ± 0.53
NaF-NaHCO ₃ -dfr.	8.32 ± 0.52
NaHCO ₃ -dfr.	10.12 ± 0.48
Main control	10.02 ± 0.53

Table 8.

Clinical examination. Comparisons between the groups as to mean numbers of new DMF-surfaces. The table gives the "t"-values of the differences.

	NaF-paint.	SnF ₂ -paint.	NaF-wash. 1/1	NaF-wash. 1/14	SnF ₂ -Ca ₂ P ₂ O ₇ -dfr.	Ca ₂ P ₂ O ₇ -dfr.	NaF-NaHCO ₃ -dfr.	NaHCO ₃ -dfr.	Main control
NaF-paint.	---	3.17 **	4.88 ***	0.28 o	0.24 o	3.06 **	0.40 o	3.13 **	2.82 **
SnF ₂ -paint.	---	---	6.78 ***	2.62 **	2.33 *	0.68 o	1.78 o	0.62 o	0.46 o
NaF-wash. 1/1	---	---	---	4.89 ***	4.16 ***	7.74 ***	4.95 ***	8.12 ***	7.48 ***
NaF-wash. 1/14	---	---	---	---	0.00 o	3.46 ***	0.68 o	3.57 ***	3.21 **
SnF ₂ -Ca ₂ P ₂ O ₇ -dfr.	---	---	---	---	---	3.06 **	0.60 o	3.11 **	2.84 **
Ca ₂ P ₂ O ₇ -dfr.	---	---	---	---	---	---	2.52 *	0.10 o	0.23 o
NaF-NaHCO ₃ -dfr.	---	---	---	---	---	---	---	2.54 *	2.29 *
NaHCO ₃ -dfr.	---	---	---	---	---	---	---	---	0.17 o
Main control	---	---	---	---	---	---	---	---	---

Probability: *** > 99.9 % ** > 99 % * > 95 % o < 95 %

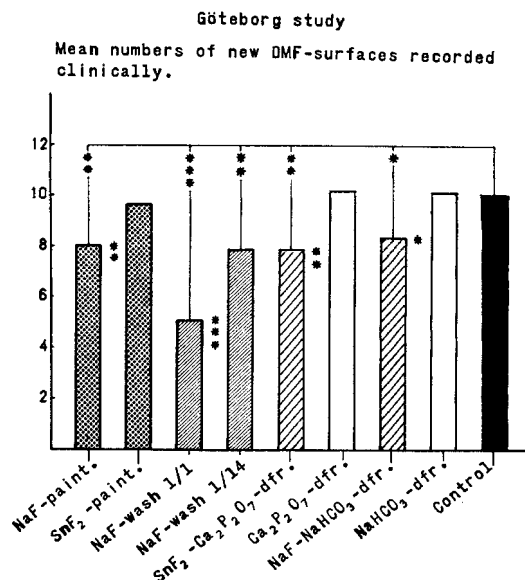


Fig. 1. Group denotions:

NaF-paint = topical application of 2 % NaF solution according to Knutson.

SnF₂-paint = single topical application of 10 % SnF₂ solution.

NaF-wash 1/1 = daily mouthwash with 0.05 % NaF solution.

NaF-wash 1/14 = mouthwash with 0.2 % NaF solution every fortnight.

SnF₂-Ca₂P₂O₇-dfr. = dentifrice containing stannous fluoride and calcium pyrophosphate.

Ca₂P₂O₇-dfr. = control for SnF₂-Ca₂P₂O₇-dfr.

NaF-NaHCO₃-dfr. = dentifrice containing sodium fluoride and sodium bicarbonate.

NaHCO₃-dfr. = control for NaF-NaHCO₃-dfr.

Control = main control group.

Asterisks denote significance of difference between compared groups (cf. Table 8).

The DMF-surfaces recognized roentgenographically are similarly presented in Tables 9 and 10 and in Fig. 2.

Table 9.

Mean numbers of new DMF-surfaces recorded roentgenographically in the different groups at the end of the study.

NaF-paint.	2.55
SnF ₂ -paint.	4.13
NaF-wash. 1/1	1.88
NaF-wash. 1/14	2.62
SnF ₂ -Ca ₂ P ₂ O ₇ -dfr.	3.62
Ca ₂ P ₂ O ₇ -dfr.	4.09
NaF-NaHCO ₃ -dfr.	2.72
NaHCO ₃ -dfr.	4.01
Main control	3.94

Table 10.

The roentgen study. Comparisons between the groups as to the mean numbers of new DMF-surfaces. The table gives the χ^2 -values calculated ($f = 7$)

	NaF-paint.	SnF ₂ -paint.	NaF-wash. 1/1	NaF-wash. 1/14	SnF ₂ -Ca ₂ P ₂ O ₇ -dfr.	Ca ₂ P ₂ O ₇ -dfr.	NaF-NaHCO ₃ -dfr.	NaHCO ₃ -dfr.	Main control
NaF-paint.	--	16.3 *	20.6 **	5.2 o	7.8 o	22.3 **	5.0 o	27.3 ***	16.8 *
SnF ₂ -paint.	--	--	44.8 ***	18.5 **	7.8 o	3.5 o	26.9 ***	4.6 o	4.1 o
NaF-wash. 1/1	--	--	--	17.99 *	23.1 **	52.1 ***	22.8 **	50.4 ***	41.8 ***
NaF-wash. 1/14	--	--	--	--	9.0 o	40.3 ***	6.0 o	20.3 **	15.7 *
SnF ₂ -Ca ₂ P ₂ O ₇ -dfr.	--	--	--	--	--	9.1 o	7.5 o	11.1 o	7.0 o
Ca ₂ P ₂ O ₇ -dfr.	--	--	--	--	--	--	38.6 ***	11.8 o	4.1 o
NaF-NaHCO ₃ -dfr.	--	--	--	--	--	--	--	43.4 ***	10.6 o
NaHCO ₃ -dfr.	--	--	--	--	--	--	--	--	7.6 o
Main control	--	--	--	--	--	--	--	--	--

Probability: *** > 99.9 % ** > 99 % * > 95 % o < 95 %

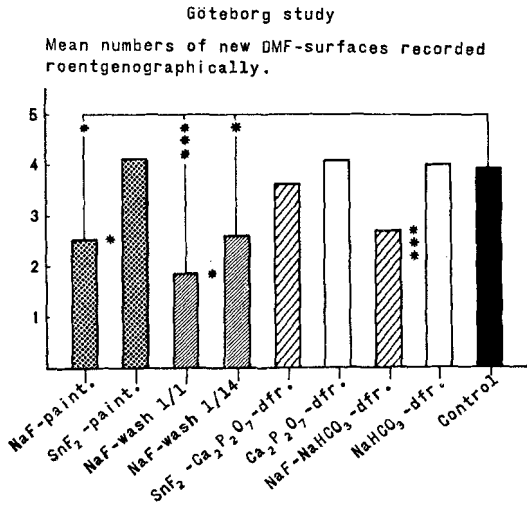


Fig. 2. Group denotations as in Fig. 1.

Tables 11 and 12 and Fig. 3 present roentgenographic data for teeth which were not fully erupted when the study started. The

Table 11.

Percentage of children in each group with carious lesions recognized roentgenographically at the end of the study in teeth which were not fully erupted at the start.

NaF-paint.	15.2 %
SnF ₂ -paint.	25.6 %
NaF-wash. 1/1	13.8 %
NaF-wash. 1/14	16.9 %
SnF ₂ -Ca ₂ P ₂ O ₇ -dfr.	18.4 %
Ca ₂ P ₂ O ₇ -dfr.	24.1 %
NaF-NaHCO ₃ -dfr.	15.2 %
NaHCO ₃ -dfr.	26.6 %
Main control	28.4 %

Table 12.

Comparison between the groups as to the percentage of children with caries lesions detected roentgenographically in teeth which were not fully erupted at the start of the study. The table gives the "P"-values of the differences.

	NaF-paint.	SnF ₂ -paint.	NaF-wash. 1/1	NaF-wash. 1/14	SnF ₂ -Ca ₂ P ₂ O ₇ -dfr.	Ca ₂ P ₂ O ₇ -dfr.	NaF-NaHCO ₃ -dfr.	NaHCO ₃ -dfr.	Main control
NaF-paint.	—	2.24 *	0.36 o	0.42 o	0.78 o	2.08 *	0.00 o	2.50 *	2.91 **
SnF ₂ -paint.	—	—	2.58 **	1.87 o	1.52 o	0.31 o	2.26 *	0.20 o	0.55 o
NaF-wash. 1/1	—	—	—	0.78 o	1.14 o	2.46 *	0.36 o	2.86 **	3.29 ***
NaF-wash. 1/14	—	—	—	—	0.36 o	1.68 o	0.43 o	2.12 *	2.53 *
SnF ₂ -Ca ₂ P ₂ O ₇ -dfr.	—	—	—	—	—	1.30 o	0.78 o	1.77 o	2.16 *
Ca ₂ P ₂ O ₇ -dfr.	—	—	—	—	—	—	2.10 *	0.52 o	0.90 o
NaF-NaHCO ₃ -dfr.	—	—	—	—	—	—	—	2.52 *	2.93 **
NaHCO ₃ -dfr.	—	—	—	—	—	—	—	—	0.36 o
Main control	—	—	—	—	—	—	—	—	—

Probability: *** > 99.9 % ** > 99 % * > 95 % o < 95 %

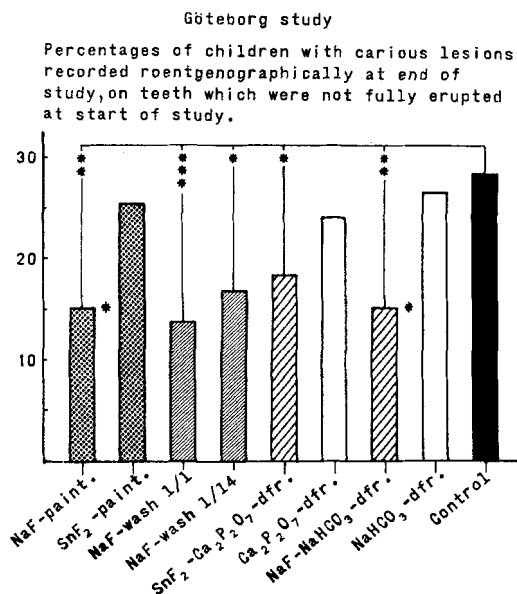


Fig. 3. Group denotations as in Fig. 1.

object was to study the effect of reactions between fluoride ions and dental enamel with a minimum of pre-experimental changes in the composition of the surface layers.

Calculations based on the caries prevalences of the different tooth surfaces

In each group the caries prevalences of all different tooth surfaces were determined at each of the three examinations. The caries prevalence was expressed as the number of DMF-surfaces in proportion to the number of erupted surfaces. The ratios thus calculated in the main control group were compared with the corresponding ratios of the other eight groups. The differences were statistically evaluated.

Table 13 and Fig. 4 comprise data from the clinical examinations and include all surfaces of the incisors, canines, premolars, first and second molars. Of the 128 surfaces involved, data from the corresponding surfaces of the left and right sides were grouped together. The comparisons of clinically registered caries prevalences were thus based on 64 pairs of tooth surfaces. Due regard was taken to this pairing at the statistical treatment.

Table 13.

Differences between the main control group and the other groups as to the clinically registered caries prevalences of the 64 pairs of tooth surfaces.

	Duration of experiment	Number of surfaces with lower prevalences in the main control group				Number without difference	Number of surfaces with higher prevalences in the main control group			
		***	**	*	o		o	*	**	***
NaF-paint.	base year				20	15	29			
	one year				20	8	35	1		
	two years				13	7	44			
SnF ₂ -paint.	base year		1		17	18	28			
	one year		2	1	24	5	32			
	two years		2		21	3	37	1		
NaF-wash. 1/1	base year				34	8	21	1		
	one year				13	8	38	1	2	1
	two years				6	4	41	7	5	1
NaF-wash. 1/14	base year				37	12	15			
	one year				34	5	24	1		
	two years				23	3	30	6	1	1
SnF ₂ -Ca ₂ P ₂ O ₇ -dfr.	base year				22	17	24		1	
	one year				19	8	36	1		
	two years				19	4	38	3		
Ca ₂ P ₂ O ₇ -dfr.	base year				30	13	21			
	one year				38	4	22			
	two years				38	1	25			
NaF-NaHCO ₃ -dfr.	base year				16	14	34			
	one year				26	7	30	1		
	two years				24	4	33	3		
NaHCO ₃ -dfr.	base year		1		27	13	23			
	one year				28	7	29			
	two years				28	4	30	2		

Probability: *** > 99.9 % ** > 99 % * > 95 % o < 95 %

Table 14 and Fig. 5 comprise comparisons based on the roentgenographically registered caries prevalences of 42 unpaired proximal surfaces.

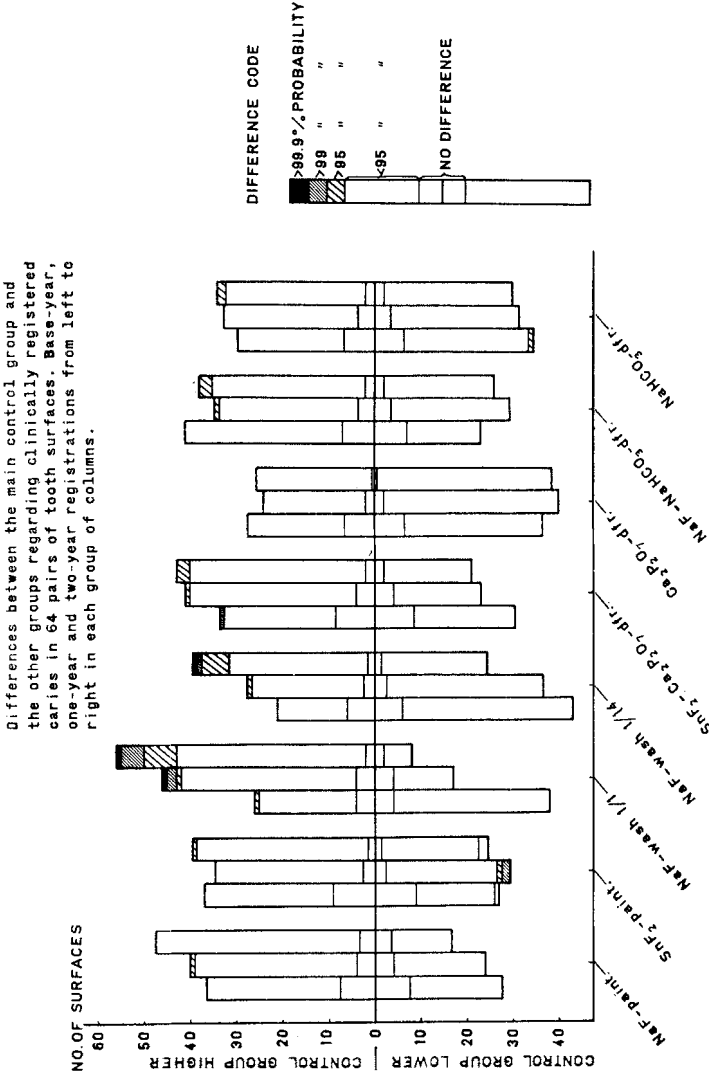


Fig. 4. Göteborg study. Group denotations as in Fig. 1.

Table 14.

Differences between the main control group and the other groups as to the roentgenographically determined caries prevalences of the 42 proximal surfaces studied.

		Number of surfaces with lower prevalences in the main control group				Number without difference		Number of surfaces with higher prevalences in the main control group			
Duration of experiment		***	**	*	o			o	*	**	***
NaF-paint.	base year				15	10		17			
	one year				7	5		28	1	1	
	two years				7	3		31	1		
SnF ₂ -paint.	base year				15	10		17			
	one year				15	5		22			
	two years		2		14	3		23			
NaF-wash. 1/1	base year				14	10		18			
	one year				10	6		21	5		
	two years				4	3		19	13	3	
NaF-wash. 1/14	base year				23	7		12			
	one year				18	6		16	1	1	
	two years				10	3		23	2	3	1
SnF ₂ -Ca ₂ P ₂ O ₇ -dfr.	base year				12	10		20			
	one year				15	5		21	1		
	two years		1		13	3		24	1		
Ca ₂ P ₂ O ₇ -dfr.	base year				22	8		12			
	one year				17	5		20			
	two years				22	5		14	1		
NaF-NaHCO ₃ -dfr.	base year		1		19	8		14			
	one year				13	5		23		1	
	two years				8	5		29			
NaHCO ₃ -dfr.	base year				17	9		16			
	one year				20	5		17			
	two years				22	2		18			

Probability: *** > 99.9 % ** > 99 % * > 95 % o < 95 %

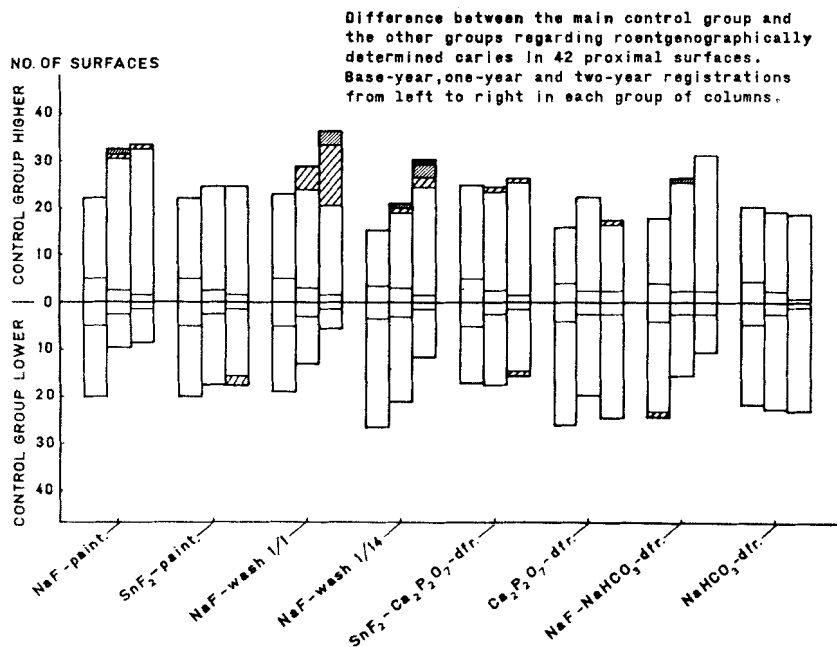


Fig. 5. Göteborg study. Group denotations as in Fig. 1.

Evaluations based on the numbers of fillings inserted at the end of the study

Table 15 presents the mean numbers of surfaces filled in the nine groups at the end of the study. Table 16 gives the statistical relations between these means. The two Tables 15 and 16 are condensed in Fig. 6.

Table 15.

Numbers of surfaces filled after the experiment. Data from the regular school dental care.

	Mean $\pm$ standard error
NaF-paint.	3.17 ± 0.26
SnF ₂ -paint.	3.98 ± 0.27
NaF-wash. 1/1	2.01 ± 0.17
NaF-wash. 1/14	2.20 ± 0.17
SnF ₂ -Ca ₂ P ₂ O ₇ -dfr.	3.29 ± 0.27
Ca ₂ P ₂ O ₇ -dfr.	4.16 ± 0.31
NaF-NaHCO ₃ -dfr.	3.62 ± 0.27
NaHCO ₃ -dfr.	3.64 ± 0.26
Main control	3.90 ± 0.32

Table 16.

Comparison between the groups as to mean numbers of fillings performed in the regular dental care at the end of the study. The table gives the "t"-values of the differences.

	NaF-paint.	SnF ₂ -paint.	NaF-wash. 1/1	NaF-wash. 1/14	SnF ₂ -Ca ₂ P ₂ O ₇ -dfr.	Ca ₂ P ₂ O ₇ -dfr.	NaF-NaHCO ₃ -dfr.	NaHCO ₃ -dfr.	Main control
NaF-paint.	—	2.16 *	3.74 ***	3.13 **	0.32 o	2.48 *	1.18 o	1.31 o	1.74 o
SnF ₂ -paint.	—	—	6.16 ***	5.56 ***	1.60 o	0.44 o	0.74 o	0.92 o	0.19 o
NaF-wash. 1/1	—	—	—	0.78 o	4.00 ***	6.06 ***	5.03 ***	5.26 ***	5.11 ***
NaF-wash. 1/14	—	—	—	—	3.41 ***	5.52 ***	4.44 ***	4.65 ***	4.59 ***
SnF ₂ -Ca ₂ P ₂ O ₇ -dfr.	—	—	—	—	—	2.07 *	0.85 o	0.93 o	1.44 o
Ca ₂ P ₂ O ₇ -dfr.	—	—	—	—	—	—	1.30 o	1.29 o	0.58 o
NaF-NaHCO ₃ -dfr.	—	—	—	—	—	—	—	0.05 o	0.65 o
NaHCO ₃ -dfr.	—	—	—	—	—	—	—	—	0.63 o
Main control	—	—	—	—	—	—	—	—	—

Probability: *** > 99.9 % ** > 99 % * > 95 % o < 95 %

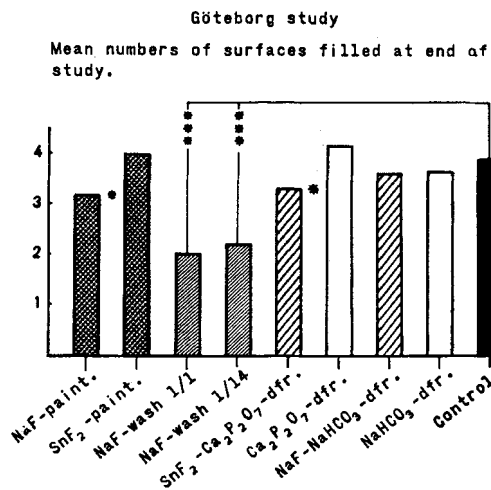


Fig. 6. Group denotions as in Fig. 1.

Conclusions

The daily mouthwashing group had acquired significantly fewer new DMF-surfaces than any of the other groups.

Significant caries reduction was also obtained in the groups given mouthwashes with 0.2 % sodium fluoride solution fortnightly, four topical applications at the start of the study with a 2 % sodium fluoride solution or fluorine-containing dentifrices. The differences between these groups were insignificant.

The control dentifrice groups showed the same development of caries as the main control group. Hence the caries reducing effect of the fluorine dentifrices must be ascribed to their fluorine compounds.

No caries inhibition was observed in the group given a single topical application with stannous fluoride at the start of the study.

Discussion

In accordance with the results of a large number of previous studies the topical application of sodium fluoride *ad modum* Knutson caused a significant caries reduction.

The results obtained with the mouthwashing solutions are in keeping with data on reactions in salivary environment between fluoride ions and dental enamel (*Sundvall-Hagland 1955, Ericsson 1958, Mörch, Hals & Torell 1961*) and with preliminary clinical results (*Fjæstad-Seger, Norstedt-Larsson & Torell 1961, Torell & Siberg 1962, Torell 1963, Ollinen 1963*).

The 0.05 % sodium fluoride solution used every day was found to be significantly more effective than the 0.2 % sodium fluoride solution used every fortnight. This result probably depends on the difference in application frequency. It agrees with clinical observations that fluoride mouthwashings twice a month give greater caries reduction than do fluoride mouthwashings once a month (*Torell 1963*).

The caries-inhibiting effect brought about by mouthrinses every fortnight with a sodium fluoride solution points to a method suitable for mass application in places where water fluoridation is impossible for technical, legal or psychological reasons. In fact, such clinical application has already caused a considerable re-

duction in the number of fillings inserted in the school dental service (*Torell* 1965).

Correspondingly, the still greater protective effect obtained with daily mouthrinses indicates that this method should be recommended in cases of rampant caries or cases at risk of such caries development, e.g. with pathologically or pharmacologically reduced salivation, enforced high frequency of carbohydrate ingestion, wiring of teeth or jaws etc.

The caries reduction observed in the two fluorine dentifrice groups is of almost the same magnitude as reported by *Jordan & Peterson* (1959) and *Muhler* (1962) from two-year studies with a stannous fluoride/calcium pyrophosphate dentifrice. The superiority of daily rinses with sodium fluoride solutions to daily use of fluorine toothpastes may depend on a better reactive contact between fluoride ions and enamel surface obtained by mouth-rinsing, on the different pH values, on some negative influence of the abrasives, or on other factors.

The present study shows that fewer DMF-surfaces appeared after daily use of a fluoride mouthwash than after a series of four topical applications with a 2 % sodium fluoride solution. To a certain degree this result may be ascribed to the greater application frequency of the first-mentioned method. However, the comparison made does not seem to do full justice to the caries-preventive capacity of the topical application method since a number of teeth recorded as carious at the final examination had not erupted when the study started. With this in view a special table is presented containing data registered at the one-year examination and pertaining exclusively to teeth, which were fully erupted at the beginning of the study (Table 17). Table 17 shows the mean number of new DMF-surfaces to be lower in the daily mouthwashing group than in the group given four topical applications. The difference was statistically insignificant, which is in contrast to the significant differences of the two-year results. The findings indicate that in age-groups with erupting teeth topical application series with a 2 % sodium fluoride solution probably have to be carried out at least once every year to give a caries reduction comparable to that of unsupervised daily use of mouthwashes with a 0.05 % sodium fluoride solution.

Table 17.

Mean numbers of new DMF-surfaces recorded clinically after one year in teeth which were fully erupted at the start of the study.

NaF-paint.	2.26
SnF ₂ -paint.	3.38
NaF-wash. 1/1	1.89
NaF-wash. 1/14	2.66
SnF ₂ -Ca ₂ P ₂ O ₇ -dfr.	2.83
Ca ₂ P ₂ O ₇ -dfr.	2.85
NaF-NaHCO ₃ -dfr.	2.30
NaHCO ₃ -dfr.	2.84
Main control	2.88

Comparisons:

	χ^2 -value (f = 5)	Significance
NaF-wash. 1/1 vs NaF-paint.	10.02	None
NaF-wash. 1/1 vs SnF ₂ -paint.	39.04	***
NaF-paint. vs SnF ₂ -paint.	16.16	**
SnF ₂ -paint. vs Main control	3.84	None

Neither the table last mentioned nor the two-year tables show any caries reduction in the group given the single topical application of a 10 % stannous fluoride solution. This finding is not in accordance with data presented in several papers (*Howell, Gish, Smiley & Muhler 1955, McLaren & Brown 1955, McDonald & Muhler 1957, Nevitt, Witter & Bowman 1958, Law, Jeffreys & Sheary 1961, Mercer & Muhler 1961, Gish, Muhler & Howell 1962, Peterson & Williamson 1962, Salter, McCombie & Hole 1962*). In some of these studies applications of stannous fluoride solutions were reported to be more caries-reducing than applications of sodium fluoride solutions, in others no difference was found between the effects of stannous fluoride and sodium fluoride. It is well known that there are also inconsistencies in the reported results of topical sodium fluoride application.

The varying and seemingly controversial results achieved with stannous fluoride may depend on geographically determined factors as for instance variations in the fluorine content of the drinking water. The chemical characteristics of tin fluorides (*Torell, Mörch & Hals 1958*) indicate that hydrolyzed tin compounds can function as collectors of fluoride ions in areas where the concentration of fluorine in the drinking water is optimal or suboptimal.

PART II. THE SÖDERTÄLJE STUDY

The trial was undertaken to test a sodium monofluorophosphate/calcium carbonate dentifrice. In general design and in all details it conformed to the Göteborg study. The registrations and local particulars of the Södertälje study were managed by Olov Idesjö L.D.S., senior dental officer of the Stockholm County Organization for Dental Care.

Material and methods*The children*

About 750 children participated in the study. They belonged to two age-groups, the mean starting ages of which were 10 and 11 years, respectively. Each of the age-groups was randomly divided into two groups including an equal number of girls and boys. Two of the four groups thus obtained (one younger and one older) were given the fluorine dentifrice and the other two the control dentifrice.

The composition and distribution of the dentifrices

The sodium monofluorophosphate/calcium carbonate dentifrice had the following composition:

Sodium monofluorophosphate	0.8 g
Calcium carbonate	33.0 g
Aerosil	2.0 g
Sodium lauryl sulphate	2.0 g
Carboxy methyl cellulose	3.0 g
Glycerol	8.5 g
Flavours	1.2 g
Water	ad 100.0 g

The corresponding control dentifrice had the same composition with the exclusion of the sodium monofluorophosphate and the same reaction, slightly above neutrality. The two kinds of dentifrices were marked similarly as in the Göteborg study. The clinical examiner had no access to the marking code during the study. The use of the toothpastes was unsupervised.

The caries evaluation

The development of caries was evaluated in two separate ways,

1) from the number of DMF-surfaces clinically recorded by Dr. Idesjö, whose duplicate recording is given in Table 18;

Table 18.

Södertälje study. Duplicate recording of caries for 59 children 11 years old performed by examiner O. I.

Number of cavities detected at both examinations	306
Number of cavities detected only at examination I	89
Number of cavities detected only at examination II	55
Total number of cavities detected at examination I	395
Total number of cavities detected at examination II	361

2) from the number of DMF-surfaces recognized on x-ray records obtained *ad modum* Backer Dirks & al. (loc.cit.). The records were first examined by Dr. Idesjö. Without access to his findings they were reexamined by Dr. Ehrby in Göteborg. The discrepancies between these two examinations were discussed by Drs. Ehrby and Torell whereby the definite assessments were made.

Results

The number of participants

The numbers of participants are given in Table 19. The loss of participants during the study was significantly greater in the control groups.

Table 19.

Södertälje study. Number of participants during the study.

	Participants at the start	Participants at the end	Loss
<i>Younger groups</i>			
Na ₂ PO ₃ F-dfr.	177	148	16.4 %
Control-dfr.	180	137	23.9 %
<i>Older groups</i>			
Na ₂ PO ₃ F-dfr.	215	188	12.6 %
Control-dfr.	217	180	17.1 %
<i>Both groups</i>			
Na ₂ PO ₃ F-dfr.	392	336	14.3 %
Control-dfr.	397	317	20.2 %
		Difference	5.9 % $\pm$ 2.7
			"t"-value = 2.19*

The pre-experimental caries experience

Table 20 indicates that the groups were balanced as to pre-experimental caries experience.

Table 20.

Södertälje study. Pre-experimental caries experience.

	Younger children		Older children	
	Na ₂ PO ₃ F-dfr.	Control-dfr.	Na ₂ PO ₃ F-dfr.	Control-dfr.
<i>Roentgen study:</i>				
Mean numbers of DMF-surfaces	2.29	2.46	3.76	4.13
Comparisons between the groups.				
X ² -value (f = 6)		8.89		7.43
<i>Clinical study:</i>				
Mean numbers of DMF-surfaces	11.30 ± 0.55	12.02 ± 0.44	14.52 ± 0.63	15.41 ± 0.72
Difference		0.72 ± 0.70		0.89 ± 0.96

Evaluations based on the distribution of the participants as to new DMF-surfaces

Table 21 and Figs. 7 and 8 give the numbers of new DMF-surfaces recorded clinically and roentgenographically. The caries

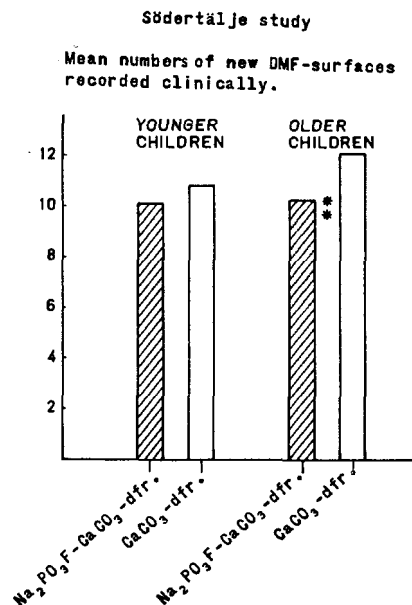


Fig. 7. Group denotations:

Na₂PO₃F-CaCO₃-dfr. = dentifrice containing sodium monofluorophosphate and calcium carbonate.

CaCO₃-dfr. = control for Na₂PO₃F-CaCO₃-dfr.

Table 21.

Södertälje study. Numbers of new DMF-surfaces recorded during the experiment.

	Younger children		Older children	
	Na ₂ PO ₃ F-dfr.	Control-dfr.	Na ₂ PO ₃ F-dfr.	Control-dfr.
<i>Roentgen study:</i>				
Mean numbers of DMF-surfaces	3.66	4.31	4.28	5.74
Comparisons between the groups.				
χ^2 -value ($f = 7$)		5.76		24.56*
<i>Clinical study:</i>				
Mean numbers of DMF-surfaces	10.11 $\pm$ 0.42	10.81 $\pm$ 0.53	10.25 $\pm$ 0.44	12.12 $\pm$ 0.54
Difference		0.70 $\pm$ 0.68		1.87 $\pm$ 0.70
"t"-value		1.03		2.67**

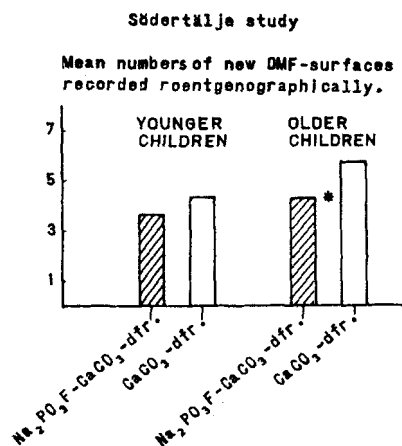


Fig. 8. Group denotations as in Fig. 7.

prevalences of the groups are notably high, especially the clinically recorded DMF-surfaces. A significant caries reduction was observed in the older test group and an insignificant reduction in the younger test group.

Discussion

The probability that the greater loss of participants in the control groups should depend on chance is less than five per cent. A real cause is therefore to be looked for. A few extremely caries-active children belonging to the control groups got up to 30 new cavities recorded at the one-year examination. This made them disappointed and caused them to stop using the dentifrice. This circumstance possibly also made other children in both groups rather cool to the study.

Most unfortunately a commercial sodium monofluorophosphate dentifrice was put on the market during the first experimental year, and soon afterwards several other dentifrices of this kind were marketed. This seems to have given some of the participating children and their parents the impression that the monofluorophosphate dentifrice already had been proved to be caries-reducing — an impression which may also have reduced interest in the proceeding study. The results of the Södertälje study should be judged with these disturbing factors in view.

The caries-preventive effect of the sodium monofluorophosphate/calcium carbonate dentifrice indicated by this study is in agreement with reports from basic research and from other clinical trials (*Hawes, Sannes & Brudevold 1954, Ericsson 1963 a and b, Finn & Jamison 1963, Goaz & al. 1963*).

Seemingly the fluorine dentifrice was more effective in the older group. This may be related to the fact that nearly 24 per cent of the children in the younger control group quitted the experiment.

SUMMARY

A two-year study was undertaken in Göteborg to evaluate the caries-reducing effects of various methods of local application of fluorides. The study included six experimental and three control groups. Each group contained about 200 randomly assigned

children. No significant differences in pre-experimental caries data were found between the groups.

In comparison with the control groups the following groups developed significantly less caries: a) a group with daily unsupervised mouthwashing with a 0.05 % sodium fluoride solution; b) a group with supervised mouthwashing once every fortnight with a 0.2 % sodium fluoride solution; c) a group given four topical applications with a 2 % sodium fluoride solution; d) an unsupervised group using a sodium fluoride/sodium bicarbonate dentifrice; e) an unsupervised group using a stannous fluoride/calcium pyrophosphate dentifrice.

The best results were obtained in the daily mouthwashing group.

No reduction was observed in a group given one topical application of a 10 % stannous fluoride solution.

In conformity with the Göteborg study a sodium monofluorophosphate/calcium carbonate dentifrice was tested in Södertälje. This trial comprised about 750 children, divided into two age-groups. No difference in pre-experimental caries experience was found between corresponding study groups. The use of the fluoride toothpaste was followed by a caries reduction, which was significant in the older group.

Acknowledgements

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Dr. *Otto Backer Dirks*, University of Utrecht, gave valuable advice for the provision and use of apparatus for standardized x-ray diagnosis of caries.

Financial support of the investigation was obtained from the Swedish Medical Research Council, the City of Göteborg, the County of Stockholm and the National Board of Health; in ad-

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RÉSUMÉ

EPREUVES CLINIQUES BIENNALES DE DIFFÉRENTES MÉTHODES D'APPLICATION LOCALE DE FLUOR SUR DES ÉCOLIERS SUÉDOIS

Une étude biennale a été faite à Göteborg afin de mettre à l'épreuve différentes méthodes d'application locale de fluorures. L'étude a compris six groupes expérimentaux et trois groupes de contrôle, chacun d'environ 200 enfants comparables. Aucune différence significative n'existait entre les groupes relativement à la prévalence de carie préexpérimentale.

En comparaison avec les groupes de contrôle les groupes suivants ont contracté significativement moins de carie: a) un groupe pratiquant, sans surveillance, des rinçages de bouche quotidiens avec une solution de fluorure de sodium 0,05 %; b) un groupe avec rinçage de bouche surveillé toutes les deux semaines avec une solution de fluorure de sodium 0,2 %; c) un groupe recevant quatre applications topiques d'une solution de fluorure de sodium 2 %; d) un groupe utilisant sans surveillance une pâte dentifrice contenant du fluorure de sodium et du bicarbonate de sodium; e) un groupe utilisant sans surveillance une pâte dentifrice contenant du fluorure d'étain et du pyrophosphate de calcium.

Les meilleurs résultats ont été gagnés avec le rinçage de bouche quotidien. Aucune réduction de la carie n'a été observée dans un groupe recevant une seule application topique d'une solution de fluorure d'étain (II) 10 %.

En conformité avec l'étude de Göteborg une pâte dentifrice contenant du monofluorophosphate de sodium et du carbonate de calcium a été mise à l'épreuve à Södertälje. Cette étude a compris 750 enfants environ, divisés en deux classes. Aucune différence ne fut trouvée entre les groupes quant à la prévalence de carie préexpérimentale. L'usage de la pâte dentifrice fluorée a été accompagné d'une réduction de carie, qui était significative dans le groupe d'enfants plus âgés.

ZUSAMMENFASSUNG

ZWEIJÄHRIGE KLINISCHE VERSÜCHE MIT VERSCHIEDENEN METHODEN
KARIESVERHÜTENDER ÖRTLICHER FLUORAPPLIKATION AN
SCHWEDISCHEN SCHULKINDERN

Eine zweijährige Studie wurde in Göteborg durchgeführt, um die kariesverhütenden Wirkungen einiger Methoden örtlicher Fluorapplikation zu bewerten. Die Studie umfasste sechs Experimentgruppen und drei Kontrollgruppen, jede Gruppe mit etwa 200 vergleichbaren Kindern, die auch keine gruppenweise signifikante präexperimentelle Kariesunterschiede aufwiesen.

Im Verhältnis zur Kontrollgruppe erhielten die folgenden Gruppen signifikant weniger Karies: a) eine Gruppe mit täglicher unüberwachter Mundspülung mit einer 0,05 % Natriumfluoridlösung; b) eine Gruppe mit überwachter Mundspülung jede zweite Woche mit einer 0,2 % Natriumfluoridlösung; c) eine Gruppe, die vier örtliche Bepinselungen mit einer 2 % Natriumfluoridlösung erhielt; d) eine Gruppe die eine Natriumfluorid-Natriumbikarbonatzahnpaste unüberwacht benutzte; e) eine Gruppe, die eine Zinnfluorid-Kalziumpyrophosphat-Zahnpaste unüberwacht benutzte.

Die besten Erfolge wurden in der täglich mundspülenden Gruppe erhalten.

Keine Kariesreduktion wurde in einer Gruppe gefunden, die eine örtliche Bepinselung mit 10 % Stannofluoridlösung erhielt.

In Übereinstimmung mit der Göteborg-Studie wurde eine Natriummonofluorophosphat-Kalziumkarbonat-Zahnpaste in Södertälje geprüft. Dieser Versuch umfasste anfänglich etwa 750 Kinder von zwei Jahresgruppen. Kein präexperimenteller Kariesunterschied wurde zwischen zusammengehörigen Gruppen gefunden. Die Benutzung der Fluor-Zahnpaste bewirkte eine Karieserniedrigung, die in der älteren Gruppe signifikant war.

REFERENCES

- Abramson, E. & al.*, 1954: Fluor som medel mot tandröta. Utredning verkställd av en expertkommitté genom Medicinalstyrelsens försorg. Sv. Tandläk.-T. 47: 1.
- Backer Dirks, O., J. van Amerongen & K. C. Winkler*, 1951: A reproducible method for caries evaluation. J. dent. Res. 30: 346.
- Backer Dirks, O. & G. W. Kwant*, 1954: A reproducible method for caries evaluation. IV Tandheelk. 61: 1.

- Davies, G. N. & P. B. Cadell*, 1963: Four investigations to determine the reliability of caries-recording methods. *Arch. oral Biol.* 8: 331.
- Ericsson, Y.*, 1950: Reduction of the solubility of enamel surfaces. *Acta odont. scand.* 9: 60.
- »— 1958: The distribution and reactions of fluoride ions in enamel-saliva environment, investigated with the radioactive fluorine isotope F^{18} . *Acta odont. scand.* 16: 127.
- »— 1961: Fluorides in dentifrices. Investigations using radioactive fluorine. *Acta odont. scand.* 19: 41.
- »— 1963 a: Löslighetsreduktion i tandytor genom fluorhaltiga slippastor och tandpastor. (English summary: Reduction of the solubility of dental surfaces by fluorine-containing polishing pastes and tooth-pastes.) *Sv. Tandläk.-T.* 56: 127.
- »— 1963 b: The mechanism of the monofluorophosphate action on hydroxyapatite and dental enamel. *Acta odont. scand.* 21: 341.
- Finn, S. B. & H. Jamison*, 1963: A comparative clinical study of three dentifrices. *J. Dent. Child.* 30: 17.
- Fjaestad-Seger, M., K. Norstedt-Larsson & P. Torell*, 1961: Försök med enkla metoder för klinisk fluorapplikation. *Sverig. Tandläk.-Förb. Tidn.* 53: 169.
- Gish, C. W., J. C. Muhler & C. L. Howell*, 1962: A new approach to the topical application of fluorides for reduction of dental caries in children: Results at the end of five years. *J. Dent. Child.* 29: 65.
- Goaz, P. W., L. P. McElwaine, H. A. Biswell & W. E. White*, 1963: Effect of daily applications of sodium monofluorophosphate solution on caries rate in children. *J. dent. Res.* 42: 965.
- Hawes, R. R., S. Sannes & F. Brudevold*, 1954: Pilot studies of three topical fluoride application procedures. *J. dent. Res.* 33: 661.
- Hellström, I.*, 1960: Fluorine retention following sodium fluoride mouth-washing. *Acta odont. scand.* 18: 263.
- Henrikson, M., I. Oldén & P. Torell*, 1958: Ett års erfarenhet av järnfluorid-pensling. *Göteborg. Tandl.-Sällsk. årsb.*
- Howell, C. L., C. W. Gish, R. D. Smiley & J. C. Muhler*, 1955: The effect of topically applied stannous fluoride on dental caries experience in children. *J. Amer. dent. Ass.* 50: 14.
- Jordan, W. A. & J. K. Peterson*, 1959: Caries inhibiting value of a dentifrice containing stannous fluoride: Final report of a two year study. *J. Amer. dent. Ass.* 58: 42.
- Knutson, J. W.*, 1948: Sodium fluoride solutions: Technic for application to the teeth. *J. Amer. dent. Ass.* 36: 37.
- Law, F. E., M. H. Jeffreys & H. C. Sheary*, 1961: Topical applications of fluoride solutions in dental caries control. *Publ. Hlth Rep. (Wash.)* 76: 287.
- McDonald, R. E. & J. C. Muhler*, 1957: The superiority of topical application of stannous fluoride on primary teeth. *J. Dent. Child.* 24: 84.

- McLaren, H. R. & H. K. Brown*, 1955: A study of a topically applied stannous fluoride solution in the prevention of dental caries. *Canad. J. publ. Hlth.* 46: 387.
- Mercer, V. H. & J. C. Muhler*, 1961: Comparison of a single application of stannous fluoride with a single application of sodium fluoride or two applications of stannous fluoride. *J. Dent. Child.* 28: 85.
- Muhler, J. C.*, 1957: The effect of different fluorides on the solubility of intact dental enamel surfaces. *J. dent. Res.* 36: 889.
- 1958: Topical treatment of the teeth with stannous fluoride. Single application technique. *J. Dent. Child.* 25: 306.
- 1960: The anticariogenic effectiveness of a single application of stannous fluoride in children residing in an optimal communal fluoride area. II. Results at the end of 30 months. *J. Amer. dent. Ass.* 61: 431.
- 1961: The effect of a stannous fluoride dentifrice on caries reduction in children during a three-year study period. *Caries Symposium*, p. 11, Bern.
- 1962: Effect of a stannous fluoride dentifrice on caries reduction in children during a three-year study period. *J. Amer. dent. Ass.* 64: 216.
- Mörch, T., E. Hals & P. Torell*, 1961: Effect of topically applied agents on enamel. VII. Experiments in vitro with unbuffered sodium fluoride solutions. *Acta odont. scand.* 19: 143.
- Nevitt, G. A., D. H. Witter & W. D. Bowman*, 1958: Topical application of sodium fluoride and stannous fluoride. *Publ. Hlth Rep. (Wash.)* 73: 847.
- Ollinen, P.*, 1963: Kariesprofylax genom applikation av fluorlösning med ferrosulfat. *Sverig. Tandläk.-Förb. Tidn.* 55: 743.
- Osvald, O., C.-E. Quensel & B. E. Gustafsson*, 1955: Metodfel vid klinisk kariesregistrering. (Abstract) *Odont. T.* 63: 451.
- Peterson, J. K. & L. Williamson*, 1962: Effectiveness of topical application of eight per cent stannous fluoride. *Publ. Hlth Rep. (Wash.)* 77: 39.
- Salter, W. A. T., F. McCombie & L. W. Hole*, 1962: The anticariogenic effects of stannous fluoride on the deciduous and permanent teeth of children aged 6 and 7. *Canad. dent. J.* 28: 363.
- Sellman, S., Y. Ericsson & A. Strålfors*, 1958: Kariesprofylax genom fluor. (English summary: Caries prevention through fluorine). *Svensk Tandläk.-T.* 51: 303.
- Sundvall-Hagland, I.*, 1955: Sodium fluoride application to the deciduous dentition. Stockholm 1955.
- Torell, P.*, 1963: Fluorsköljningen i Göteborg läsåren 1960—61 och 1961—62. *Sverig. Tandläk.-Förb. Tidn.* 55: 255.
- 1965: The Göteborg studies of methods for topical application of fluorides. *Advances in Fluorine Research and Dental Caries Prevention*. Vol. 3. Pergamon Press.
- Torell, P., E. Hals & T. Mörch*, 1958: Effect of topically applied agents on enamel. III. The chemical nature of tin fluorides. *Acta odont. scand.* 16: 329.
- Torell, P. & A. Siberg*, 1962: Mouthwash with sodium fluoride and potassium fluoride. *Odont. Revy* 13: 62.