A comparison of the plaque-inhibiting effect of stannous fluoride and chlorhexidine

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A double blind clinical trial was undertaken in order to compare the plaque inhibiting effect of SnF_2 (0.2 % and 0.3 %) with chlorhexidine (0.1 %) applied as mouthrinses in a test panel of 12 dental hygienist students. The experimental series were performed in periods of four days. The mean Plaque Index values were 0.35 and 0.2 when employing SnF_2 and 0.1 when chlorhexidine was used, whereas distilled water resulted in a mean value close to 1.0. The long-term effect of a 0.3 % SnF_2 solution was tested in another group of five students for a period of three weeks. The two trials confirmed previous reports claiming that SnF_2 is effective as a plaque inhibitor and, furthermore, that this effect could be maintained for a period of at least three weeks. The staining problem was less than in similar studies using chlorhexidine.

Key-words: Preventive dentistry; human

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INTRODUCTION

Since efficient mechanical tooth cleaning seems to require more engagement and skill than most individuals are able to perform, the dental profession have been looking for chemicals to replace or support the cleaning procedure (*Gjermo*, 1972). The most interesting agent in recent years seems to be chlorhexidine which can cause an almost complete inhibition of plaque formation when applied in the mouth at 12 hours intervals (*Löe & Schiött*, 1970). However, due to certain side effects caused by bisbiguanides, like the strong and bitter taste, interference with the taste sensation, discoloration of the tongue, teeth and fillings (*Gjermo & Rölla*, 1971; *Flötra et al.* 1971), it would be desirable to find other agents without these side effects.

Stannous fluoride has been reported to inhibit plaque formation in rats (*König*, 1959) and to reduce the weight of dental plaque capable of adhering to enamel (*Glantz*, 1967). In a study of the antibacterial properties of fluoride (*Anders et al.*, 1974) significant bacterial reduction in whole saliva was evident following use of SnF_2 (1.200 ppm F–). A recent study (*Tinanoff et al.*, 1976) indicated that a stannous fluoride solution was effective as a mouthrinse in man. The effect was

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evaluated by electron microscopy of pieces of enamel which had been carried in a device in the oral cavity by a test person.

The effectiveness of stannous fluoride as a caries preventive agent is well established. The data presented by the authors above certainly seem to warrant further investigations concerning its inhibitory effect on plaque formation. The aim of the present study was to compare the plaque inhibiting effect of stannous fluoride with that of chlorhexidine in a group of students for a period of three weeks. A further intention was to observe discoloration and other possible untoward side effects caused by stannous fluoride.

MATERIAL AND METHODS

The test panel was 12 female dental hygienist students who volunteered for the experiment. All the students had a thorough prophylaxis before the experiment started. Ten ml of freshly made SnF_2, 0.2 % or 0.3 % or a similar volume of 0.1 % chlorhexidine gluconate or distilled water was applied by the group as a mouthrinse for one minute twice a day. No other hygiene was allowed during the test period. The students rinsed with 10 ml 15 % (w/v) sucrose for one minute every second hour between 8 a.m. and 10 p.m. to enhance plaque formation. The test periods were four days and the students were permitted three days of habitual oral hygiene between each period. The Plaque Index (Pl.I.) (*Löe*, 1967) was brought to 0 at the beginning of each experimental period. The experiment was performed according to a double blind design and the different mouthrinses were randomly distributed among the test panel in each of four experimental series. The experiments were concluded with the recording of Pl.I.

The long term effect of a 0.3 % SnF_2 solution was tested in another group of five students for a period of three weeks. The first week of the period the students rinsed with 10 ml 15 % sucrose 8 times daily to provoke plaque formation. This was suspended for the last two weeks but no other oral hygiene than two daily mouthrinses with SnF_2 solution was performed. Also this experiment was concluded with recording of the Pl.I. Student's *t*-test was used to evaluate statistical significance. Discoloration was evaluated from color photographs and from a black and white negative film of the lower front teeth according to a photometric technique (*Eriksen & Gjermo*, 1973).

RESULTS

Plaque inhibition

Table I shows the distribution of the individual Pl.I. scores of the dental hygienist students and their variation within the test groups. The control group which rinsed with distilled water had a mean Pl.I. of about 1.0. The two stannous fluoride mouthrinses yielded Pl.I. values of 0.20 and 0.35 respectively, whereas chlorhexidine gave 0.12. The range of the individual Pl.I. scores was widest when the test persons rinsed with 0.2 % SnF_2. The difference in Plaque Index values between the placebo group and the other groups was statistically significant ($P<0.001$).

Table II gives the individual Pl.I. scores of the students who rinsed twice a day for three weeks with 0.3 % SnF_2 solution. The mean Pl.I. score was almost equal to that of the dental hygienist students after the four days experiment with the same mouthrinse.

In both experiments the macroscopical appearance of the plaque seemed to be altered when SnF_2 was used; its adherence to the enamel also seemed to be markedly weakened.

Side effects

Some of the participants in both groups complained of a rather strong metallic taste of the stannous fluoride solution and of a dryness in the mouth after the rinsing. None of them had noticed any interference with the taste sensation. One of the students in the long term experiment developed a sublingual desquamative lesion of the oral mucosa after

Table I. *Mean plaque index after rinsing with stannous fluoride solutions, chlorhexidine gluconate and placebo.*

Test persons	SnF_2 0.2%	SnF_2 0.3%	Chlorhexidine gluconate 0.1%	Placebo
A.B.H.	0.39	0.51	0.35	0.63
E.H.	0.31	0.14	0.07	0.79
G.B.	0.36	0.13	0.06	0.76
J.B.	0.12	0.11	0.06	0.96
T.S.	0.53	0.16	0.04	1.24
B.J.	0.11	–	0.20	0.83
M.K.	0.05	0.00	0.05	0.88
R.B.	0.12	0.30	0.10	0.84
T.R.	0.20	0.19	0.17	0.94
E.G.	0.23	0.10	0.14	1.80
A.E.A.	0.73	0.21	0.02	1.27
A.H.	1.10	0.22	0.13	1.27
Mean	0.35	0.20	0.12	1.02
S.D.	0.31	0.13	0.09	0.32

Table II. *Plaque indices after 3 weeks of rinsing with 0.3% SnF_2 solution and no other oral hygiene.*

Test persons	$\bar{X}$
O.P.K.	0.13
B.O.	0.17
J.J.N.	0.43
G.W.	0.29
A.G.V.	0.17
Mean	0.24
S.D.	0.12

two weeks. This lesion disappeared the last week when the SnF_2 concentration was decreased from 0.3% to 0.2%.

Varying amounts of a yellowish-brownish discoloration of the tongue and the teeth were observed when rinsing with the SnF_2 solutions. An intraindividual photometric evaluation of polished versus unpolished lower incisors demonstrated a marked difference in translucency. The discoloration was more marked in long-term group, and could not be totally removed by ordinary toothbrushing. It was not difficult, however, to remove the stain by pumicing. The stain appeared thus to be different from that produced by chlorhexidine which is very tenacious.

Some of the students in both groups showed a rapid formation of calculus. In the four days experiments this calculus was rather soft and it was sometimes difficult to distinguish the calculus formation from the plaque formation. This phenomenon was more evident in the long-term group.

DISCUSSION

The present study confirms previous reports claiming that stannous fluoride is effective as a plaque inhibitor (*König*, 1959; *Tinanoff et al.*, 1976) and furthermore that this effect could be maintained over a period of 3 weeks.

The small amounts of plaque present in the groups rinsing with stannous fluoride seemed to be different from ordinary, sucrose induced plaque. It was much looser and could easily be removed from the enamel surface in most cases. It seems possible that this «plaque» may consist of epithelial cells and proteins (*Tinanoff et al.*, 1976) and that the plaque-inhibiting effect of the mouthrinses may be even more favorable than the plaque indices indicate. It is well known that tin ions adsorb to the surface of microorganisms and influence the metabolism of bacterial cells. *Lilienthal* (1956) showed that tin fluoride reduced the pH drop in bacterial cultures significantly more than did sodium fluoride. Stannous fluoride may thus influence the pathogenicity of bacteria on tooth surfaces.

The mechanism of the plaque inhibiting effect is unknown. However, it is known that tin ions are retained in the mouth for many hours after a mouthrinse (*Bonesvoll*, 1977) and it is possible that these ions interfere with the adsorption mechanism by being bound to the lipoteichoic acid present on the surface of gram positive bacteria and thus changing their net charge. Recent data indicate that the charge may be one important factor in the bacterial adsorption to teeth (*Rölla*, 1976 and 1977).

The staining problem was less than in similar studies using chlorhexidine. The mechanism of the increased and rapid formation of calculus is unknown. Other side effects were negligible.

A possible clinical use of stannous fluoride mouthrinses would depend on toxicological consideration concerning the frequent oral application of the rather high amounts of tin. However, tin has been regarded as relatively non-toxic, and appreciable amounts are accepted in food (*Nekervis & MacIntosh*, 1955).

Whether or not the commercially available stannous fluoride containing toothpastes exert plaque inhibiting activity and whether the tin ions are of any significance for the beneficial clinical effect exhibited by these products is at present unknown. Therefore, a study is now in progress to elucidate this problem. Further investigations concerning the ultra structure of plaque exposed to stannous fluoride are also being initiated.

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