

# Effect of Stannous Fluoride and Iodine on Root Caries and Bone Loss in Rats<sup>1</sup>

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**ABSTRACT.** Rice rats were distributed by littermate into four experimental groups as follows: stannous fluoride (0.4%), iodine-sodium iodide (1.0%), a combination of iodine-sodium iodide and stannous fluoride, and a distilled water control. Each rat was treated by swabbing the molar teeth daily. All rats were fed diet 2000 and double-distilled water *ad libitum*, and were sacrificed after 9 weeks. Root surface caries and bone loss were determined. Root surface caries was significantly ( $P < 0.05$ ) inhibited by stannous fluoride and the combination of iodine-sodium iodide and stannous fluoride, but was not affected significantly by iodine-sodium iodide alone. On the other hand, bone loss scores were significantly lower in all groups compared to the demineralized water control.

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## INTRODUCTION

Although root surface caries is apparently a major problem in industrialized countries, surprisingly little is known about the condition, particularly in relation to its etiology and prevention (Newbrun 1984). However, available literature suggests that topical and systemic fluoride is beneficial in prevention or arrest of root caries in humans and rodents (Jordan and Sumney 1973, Shannon and Wightman 1970, Koch et al. 1982, Wescott et al. 1975, Rorilie et al. 1977).

Anticariogenic (coronal caries) and antiplaque properties of stannous fluoride (SnF<sub>2</sub>) solutions are well documented (Konig 1959; Tinanoff et al. 1982; Leverett et al. 1981; Muhler and Day 1951; Tinanoff and Camosci 1980; Tinanoff and Weeks 1979). *In vitro* and *in vivo* antimicrobial effects of iodine (I<sub>2</sub>) have been reported by several investigators (Caufield and Gibbons 1979; Al-Joburi et al. 1982). Our search of the literature did not reveal any documented animal study to investigate the effect of I<sub>2</sub> and SnF<sub>2</sub> on root caries. Therefore, the purpose of this investigation was to evaluate the effectiveness of topically applied I<sub>2</sub>-sodium iodide (I<sub>2</sub>-NaI) and SnF<sub>2</sub> alone and in combination, on root caries and alveolar bone loss in rice rats.

## MATERIAL AND METHODS

Rice rats (*Oryzomys palustris*) were bred and maintained in The Ohio State University College of Dentistry Animal Facility. They were routinely fed Purina Lab Chow. A 2.5-cm cube of alfalfa was placed into each cage when bedding was being changed. The alfalfa served as additional nutrient and extra bedding material. Eighty rice rats (sex random) ranging in age from 25-35 d were divided by littermates into four groups of 20 each. Rats 25-35 d of age were kept in individual cages with wire mesh bottoms. In order to protect the rats from deleterious effects of the wire mesh, an unused empty paint can (11.5 cm deep × 8.8 cm diam.) was placed in each cage.

The animals were not inoculated with any microorganism. Previous studies have shown that these rats apparently harbor a microflora capable of causing root surface caries (Doff et al. 1977 a and b). The four experimental groups were as follows: Group I was SnF<sub>2</sub> (0.4%); Group II was a combination of SnF<sub>2</sub> and I<sub>2</sub>-NaI (SnF<sub>2</sub> was applied in the morning and I<sub>2</sub>-NaI in the evening); Group III was I<sub>2</sub>-NaI (1%); and Group IV, the control group, was demineralized water. All solutions contained 50% glycerine in deionized water to facilitate their application and adherence to the tooth surface. Test solutions were applied topically (15 sec/quadrant or 60 sec/animal; duration of experiment = 9 wk) twice daily to molar teeth using a saturated

cotton-tipped applicator. All rats were provided double-distilled, deionized water and diet 2000 *ad libitum*. Animals were weighed weekly. After 9 weeks, the rats were killed by carbon dioxide inhalation and scored for alveolar bone loss and root surface caries (Doff et al. 1977). Animal weight gain, bone loss, and root caries data were analyzed by analysis of variance and the Newman-Keuls test (Winer 1971).

## RESULTS

Mean bone loss, root caries, and weight gain data are given in Table 1. Mean bone loss scores ranged from 23.1 to 33.8 (areas affected). Values between experimental groups were not significantly ( $P > 0.05$ ) different from each other, but were significantly ( $P < 0.05$ ) different from the distilled water control. Mean root surface caries scores ranged from 6.31 to 21.1. The SnF<sub>2</sub> alone and in combination with iodine significantly ( $P < 0.05$ ) reduced root surface caries. The reduction with SnF<sub>2</sub> alone was significantly ( $P < 0.05$ ) greater than the combination. By itself, I<sub>2</sub>-NaI did not inhibit root surface caries significantly. Weight gain data showed that there was no significant ( $P > 0.05$ ) difference among the experimental groups.

## DISCUSSION

The analysis of data clearly indicated that the SnF<sub>2</sub> application given twice daily for root caries is better than once daily. This is in agreement with Tinanoff et al. (1980) who demonstrated that twice daily rinsing with 0.04% SnF<sub>2</sub> or 0.1% SnF<sub>2</sub> significantly ( $P < 0.05$ ) reduced plaque scores in short-term studies.

In previous experiments (Rosen et al. 1985), the use of sodium fluoride (NaF) had no effect on bone loss. In the present study, SnF<sub>2</sub> resulted in a significant reduction in bone loss. This reduction could be due to the greater antimicrobial activity of SnF<sub>2</sub> over NaF.

Previous experiments (Toth et al. 1986) have also indicated that the ratio of root surface caries to bone loss is less than was observed in this experiment. In this study, 65% of the exposed roots developed root surface caries in the control group. In a previous study (Rosen et al. 1985), only 27% of the exposed roots developed root surface caries. It is suggested that a change in microflora may have occurred in our colony of rice rats, resulting in accelerated root caries development.

This study does not provide data or explanation as to why I<sub>2</sub>-NaI alone did not have a significant effect on root

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TABLE 1

Mean bone loss and root caries scores and weight gain  $\pm$  SE in rats receiving topical fluoride (as SnF<sub>2</sub>) and iodine (as I<sub>2</sub>-NaI) for 9 weeks. Values in brackets are not significantly different (P > 0.05).

Group no.	No. of rats surviving experiment	Treatment	Bone loss scores (areas affected)	Root caries scores (areas affected)	Mean wt. gain (g)
I	17	SnF <sub>2</sub> (0.4%)	23.1 $\pm$ 1.23	6.31 $\pm$ 1.12	22.5 $\pm$ 3.69
II	17	SnF <sub>2</sub> $\pm$ I <sub>2</sub> -NaI* water	27.1 $\pm$ 1.24	11.8 $\pm$ 1.26	35.5 $\pm$ 4.04
III	17	I <sub>2</sub> -NaI (1%)	28.1 $\pm$ 1.85	16.1 $\pm$ 2.63	25.0 $\pm$ 2.66
IV	17	Demineralized water	33.8 $\pm$ 1.92	21.1 $\pm$ 2.09	35.6 $\pm$ 3.32

\*SnF<sub>2</sub> applied in a.m.; I<sub>2</sub>-NaI applied in p.m.

caries. A possible explanation may be that the micro-organism involved in the etiology of root caries may be resistant to iodine. Increasing the concentration to 2% may exert a positive effect (Caulfield 1981). Another explanation may be the inability of iodine to be retained on root surface for longer periods of time and to subsequently penetrate the plaque (Caulfield and Gibbons 1979). The potential difference between I<sub>2</sub> and SnF<sub>2</sub> in regard to root surface caries may be due to different mechanisms involved in caries inhibition between two agents. Stannous fluoride has anticariogenic action by physicochemical interaction with enamel or cementum, as well as a strong antiplaque property, whereas iodine is an antimicrobial agent.

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