

Topical Applications of Fluoride Solutions in Dental Caries Control

FRANK E. LAW, D.D.S., M.P.H., MARGARET H. JEFFREYS, M.P.H., and HELEN C. SHEARY, B.S.

BOTH sodium fluoride and stannous fluoride in solutions of various concentrations have been used as topical agents, and their effectiveness as dental caries preventives among school children has been reported. A series of four applications of 2 percent solution of sodium fluoride to the teeth of children has been shown to reduce the incidence of dental caries by approximately 40 percent (1, 2). Reports on the effectiveness of 2 and 8 percent concentrations of stannous fluoride solution, topically applied, have varied widely among different workers (3-7).

This study was designed to explore the relative caries-inhibiting effectiveness of sodium fluoride and stannous fluoride solutions under like controlled conditions. To establish comparability between this investigation and those conducted earlier, corresponding concentrations and procedures were chosen. The three study groups compared results observed after four applications of 2 percent sodium fluoride solution, four applications of 2 percent stannous fluoride solution, and one application of 8 percent stannous fluoride solution.

Participants were elementary school children residing in five Delaware communities. The water supplies in these areas were essentially fluoride free. A residence history was obtained for each individual, and children with more than 2 years' absence from the community at any time were omitted from the final evalua-

tion. The residence requirements were established to insure that participants had not received the benefits of fluoride-bearing water.

Materials and Methods

There were 884 children 7 to 13 years of age in Sussex and Kent Counties, Del., who met the residence requirements for participation in the study. Of this number, 823 children received the prescribed treatments and were present for the final 12-month reexamination. Study groups were set up by school so as to produce approximately equal numbers of children for participation in the evaluation of each of the three fluoride application procedures to be used (table 1). The three study groups showed similar rates of prevalence of dental caries at the beginning of the study.

A dental prophylaxis preceded the initial examination. All examinations were made by the same examiner using a No. 4 plane mouth mirror, double-end No. 5 explorer, artificial light, and portable dental chair, with compressed air available as required. Dental prophylaxis was not given prior to the second examination.

The 2 percent sodium fluoride solution was prepared daily. The stannous fluoride solutions (2 and 8 percent) were prepared four times daily because this compound is unstable in aqueous solution and susceptible to chemical change. Distilled water was used in the preparation of all solutions.

The first group of children received four applications of 2 percent sodium fluoride solution. The second group received four applications of 2 percent stannous fluoride solution. Applications were made at 2- to 7-day intervals. The

Dr. Law is chief and Miss Sheary is dental hygienist in the Disease Control Branch, Division of Dental Public Health and Resources, Public Health Service. Miss Jeffreys is director, division of oral hygiene, Delaware State Board of Health.

Table 1. Age distribution of 823 children available for reexamination at the end of 12-month period, by procedure

Study procedure	All ages	Age, in years, at time of treatment						
		7	8	9	10	11	12	13
4 applications 2 percent sodium fluoride.....	269	31	50	61	52	38	22	15
4 applications 2 percent stannous fluoride.....	273	28	43	65	50	45	30	12
1 application 8 percent stannous fluoride.....	281	42	54	52	37	41	32	23

Table 2. Dental caries experience of 823 children during a 12-month period in permanent teeth of fluoride-treated and untreated mouth quadrants

Study procedure	Number sound teeth May 1957	New DF ¹ teeth May 1958		New DF ¹ surfaces May 1958	
		Number	Percent	Number	Percent
Both jaws					
4 applications 2 percent sodium fluoride:					
Treated quadrants.....	1, 526	103	6. 7	118	7. 7
Untreated quadrants.....	1, 540	159	10. 3	184	11. 9
4 applications 2 percent stannous fluoride:					
Treated quadrants.....	1, 542	100	6. 5	117	7. 6
Untreated quadrants.....	1, 562	151	9. 7	171	10. 9
1 application 8 percent stannous fluoride:					
Treated quadrants.....	1, 601	134	8. 4	148	9. 2
Untreated quadrants.....	1, 630	165	10. 1	197	12. 1
Upper jaw					
4 applications 2 percent sodium fluoride:					
Treated quadrants.....	672	62	9. 2	70	10. 4
Untreated quadrants.....	669	85	12. 7	100	14. 9
4 applications 2 percent stannous fluoride:					
Treated quadrants.....	688	64	9. 3	73	10. 6
Untreated quadrants.....	686	95	13. 8	104	15. 2
1 application 8 percent stannous fluoride:					
Treated quadrants.....	716	80	11. 2	85	11. 9
Untreated quadrants.....	738	92	12. 5	109	14. 8
Lower jaw					
4 applications 2 percent sodium fluoride:					
Treated quadrants.....	854	41	4. 8	48	5. 6
Untreated quadrants.....	871	74	8. 5	84	9. 6
4 applications 2 percent stannous fluoride:					
Treated quadrants.....	854	36	4. 2	44	5. 2
Untreated quadrants.....	876	56	6. 4	67	7. 6
1 application 8 percent stannous fluoride:					
Treated quadrants.....	885	54	6. 1	63	7. 1
Untreated quadrants.....	892	73	8. 2	88	9. 9

¹ Decayed or filled.

third group received one application of 8 percent stannous fluoride solution. In each group one side of the mouth was treated and the other half provided the control. Approximately one-half of the children in each group were treated in right mouth quadrants and the remainder in left mouth quadrants. The application technique followed the method described by Knutson (8).

Results

The dental caries experience of the 823 children during a 12-month period is shown in table 2.

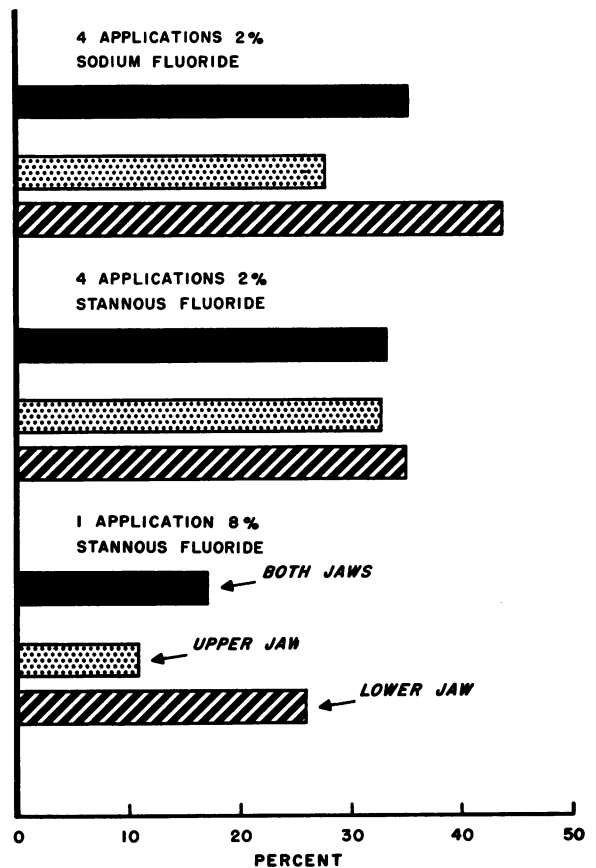
In untreated mouth halves the incidence of new dental caries was remarkably similar in the three study groups during the 1-year study period. The percentage of untreated sound permanent teeth becoming carious ranged, by group, from a low of 9.7 percent to a high of 10.3 percent.

In treated mouth halves the percentage of new dental decay in the course of the study year was approximately equal in two of the study groups: for children treated with 2 percent solution of sodium fluoride, 6.7 percent;

Table 3. Percent less new caries in fluoride-treated than in untreated previously sound permanent teeth of 823 children during a 12-month period

Study procedure	Upper jaw	Lower jaw	Both jaws
	Percent less newly carious teeth		
4 applications 2 percent sodium fluoride.....	27.6	43.5	35.0
4 applications 2 percent stannous fluoride.....	32.6	34.4	33.0
1 application 8 percent stannous fluoride.....	10.4	25.6	16.8
Percent less newly carious surfaces			
4 applications 2 percent sodium fluoride.....	30.2	41.7	35.3
4 applications 2 percent stannous fluoride.....	30.3	31.6	30.3
1 application 8 percent stannous fluoride.....	19.6	28.3	24.0

Percent less newly carious teeth in fluoride-treated than in untreated permanent teeth, by procedure



and for those with 2 percent solution of stannous fluoride, 6.5 percent. The incidence of new caries was 8.4 percent for the group treated with 8 percent stannous fluoride solution.

The experience in the three study groups was similar for upper and lower teeth separately, although the rate of new dental caries incidence was somewhat higher in upper than in lower teeth in both treated and untreated mouth quadrants. In each treatment group the number of newly decayed tooth surfaces in previously sound permanent teeth followed a pattern similar to that of the newly carious teeth (table 2).

Percentage reductions in the incidence of newly carious teeth and of newly carious surfaces in previously sound teeth are shown in table 3 and the chart.

There were 35 percent fewer new carious teeth in treated as compared with untreated

mouth quadrants following four applications of 2 percent sodium fluoride solution and 33 percent fewer after four applications of 2 percent stannous fluoride solution. The reduction was substantially less, 16.8 percent, for teeth treated with a single application of 8 percent stannous fluoride solution.

The topical fluoride study in Delaware shows that all fluoride-treated mouth quadrants incurred a lower incidence of new caries than untreated quadrants. The most favorable results were obtained from the two procedures using four applications of either 2 percent sodium fluoride or 2 percent stannous fluoride, as demonstrated by the greater relative reductions in new dental caries in treated teeth. At the 5 percent level of significance the reductions observed are greater than would be considered likely to have arisen by chance. Although permanent teeth treated with a single application of 8 percent stannous fluoride showed a lower caries rate than untreated teeth, the reduction was substantially smaller than in the other treatment groups, and it could not be concluded that the observed reduction was not due to chance.

Summary

The effectiveness of sodium fluoride and stannous fluoride as dental caries preventives was tested in three groups of school children 7-13 years of age. One group received four applications of 2 percent sodium fluoride solution, another group was treated with four applications of 2 percent stannous fluoride solution, and a third group received one application of 8 percent stannous fluoride solution. In each group one side of the mouth was treated and the other served as control.

Results of this study, 12 months after the initial examination, indicate that the incidence of dental caries was significantly lower in non-

carious permanent teeth treated with four applications of 2 percent sodium fluoride solution or 2 percent stannous fluoride solution than in untreated teeth. Their effectiveness was essentially the same.

One application of 8 percent stannous fluoride solution was considerably less effective in preventing dental caries than either of the other two procedures. The reduction in the incidence of dental caries obtained by this procedure was not statistically significant.

REFERENCES

- (1) Knutson, J. W., and Armstrong, W. D.: The effect of topically applied sodium fluoride on dental caries experience. I. Report of findings for the first study year. *Pub. Health Rep.* 58: 1701-1715, Nov. 19, 1943.
- (2) Galagan, D. J., and Knutson, J. W.: The effect of topically applied fluorides on dental caries experience. V. Report of findings with two, four and six applications of sodium fluoride and of lead fluoride. *Pub. Health Rep.* 62: 1477-1483, Oct. 10, 1947.
- (3) Howell, C. L., Gish, C. W., Smiley, R. D., and Muhler, J. C.: Effect of topically applied stannous fluoride on dental caries experience in children. *J. Am. Dent. A.* 50: 14-17, January 1955.
- (4) Gish, C. W., Howell, C. L., and Muhler, J. C.: Effect of a single topical application of stannous fluoride on caries experience. *International Association of Dental Research, 34th Meeting, March 1956.* (Abstract.)
- (5) Gish, C. W., Howell, C. L., and Muhler, J. C.: A new approach to the topical application of fluorides for the reduction of dental caries in children. *J. Dent Res.* 36: 784-786, October 1957.
- (6) Nevitt, G. A., Witter, D. H., and Bowman, W. D.: Topical applications of sodium fluoride and stannous fluoride. *Pub. Health Rep.* 73: 847-850, September 1958.
- (7) Jordan, W. A., Snyder, J. R., and Wilson, V.: Stannous fluoride clinical study in Olmstead County, Minnesota. *Pub. Health Rep.* 73: 1010-1014, November 1958.
- (8) Knutson, J. W.: Sodium fluoride solution: Technic for applications to the teeth. *J. Am. Dent. A.* 36: 37-39, January 1948.