

Post-War Implications of Fluorine and Dental Health*

The Use of Topically Applied Fluorine

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PRESENT knowledge and trends of evidence on the relationship of fluorine and dental health indicate that the incidence of dental caries can be reduced by either of two methods of fluorine therapy. These methods are: (1) the addition of 1 part per million of fluorine to municipal water supplies; and (2) the topical application of fluoride solution to the teeth. It is the purpose of this paper to present experience with and to discuss the relative usefulness of the second method of fluorine therapy.

The first published reports on the use of topical application of fluoride solution to the teeth of humans were made in 1942 by two independent investigators. Bibby¹ reported on the application of 0.1 per cent sodium fluoride solution to the permanent teeth of 89 children aged 10 to 13 years, and Cheyne² reported on the application of 0.05 per cent potassium fluoride solution to the deciduous teeth of 27 children aged 4.5 to 6 years. Both of these investigators concluded that the treatment effected a 50 per cent reduction

in the incidence of dental caries. In a subsequent report on the second year of observations on the caries experience in his study group, Bibby³ concluded that the effectiveness of the treatment had decreased slightly.

The most recent report on experience with topically applied fluoride was made by Knutson and Armstrong,⁴ who obtained a 40 per cent reduction in the yearly incidence of dental caries by using a 2 per cent solution of sodium fluoride. A condensed analysis of the major findings of this study of 289 treated children and 326 negative control children, aged 7 to 15 years, will be given below.

During an 8 week treatment period the 289 children in the treated group received from 7 to 15 applications of the fluoride solution to the teeth in the upper left and the lower left quadrants of the mouth. The teeth in the right quadrants were not treated and were utilized as direct controls. The incidence of new caries in the treated and in the untreated permanent teeth during the first year after treatment are compared by mouth quadrants in Table 1. Because of the bilaterally equal occurrence of dental caries in population groups, it is expected that the

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TABLE 1

The Incidence of Caries in Permanent Teeth Previously Free of Caries; Comparison of Fluoride-treated and Untreated Quadrants in Each Jaw of 289 Treated Children

Item	Upper Jaw Persons	Lower Jaw Persons
Lower incidence in treated quadrant	63	48
Higher incidence in treated quadrant	26	30
Incidence equal (one or more) in treated and untreated quadrants	15	12
No new carious teeth in either treated or untreated quadrants	185	199
Total number of children	289	289

number of instances in which individuals have more caries in the left than in the right quadrants of the jaw will equal the number of instances in which the opposite result is obtained. It will be noted from the data in Table 1 that for the upper quadrants, 26 children had more, whereas 63, or 2.4 times as many children, had fewer new carious teeth in the treated than in the untreated quadrants. For the lower jaw, 30 children had more, and 48, or 1.6 times as many children, had fewer new carious teeth in the treated than in the untreated quadrants.

The number of permanent teeth that were non-carious at the time of treatment and the number of these that became carious during the following year are presented for the treated group of children in Table 2. In addition, the numbers of new carious tooth surfaces which occurred in the non-carious and in the previously carious teeth are also given. According to the data in this table, 54 non-carious teeth in the upper

left and 100 in the upper right quadrant were attacked by caries; a difference of 46.0 per cent less new caries in the treated than in the untreated upper teeth. In the lower jaw, 46 new carious teeth occurred in the left and 66 in the right quadrants; a difference of 30.3 per cent less caries in the treated than in the untreated lower teeth. These findings, together with those presented in Table 1, indicate that the treatment was more effective for the upper than for the lower teeth.

As would be expected, the number of tooth surfaces attacked by caries is highly correlated with the number of teeth attacked. However, it is important to note (Table 2) that, although the numbers of tooth surfaces which became carious in previously carious teeth are lower in the treated than in the untreated teeth—49 in the treated and 57 in the untreated upper teeth, and 64 in the treated and 72 in the untreated lower teeth—the differences are relatively insignificant. Ap-

TABLE 2

Dental Caries Experience during the Year Ending in May, 1943, for the Permanent Teeth in the Fluoride-treated and Untreated Quadrants of the Jaws of 289 Minnesota Children

Quadrant	Number of Non-carious Teeth, April, 1942	New DF * Teeth, May, 1943	DF Surfaces in New DF Teeth	New DF Surfaces in Previously Carious Teeth	Total New DF Surfaces
<i>Upper</i>					
Treated (left)	1,010	54	63	49	112
Untreated (right)	1,026	100	109	57	166
<i>Lower</i>					
Treated (left)	1,236	46	56	64	120
Untreated (right)	1,246	66	75	72	147

DF = Carious (decayed or filled)

parently the treatment is of questionable value in preventing caries attack on the non-carious surfaces of teeth previously attacked.

The particular study under discussion was not designed to determine the minimum number of effective treatments. However, no marked difference in the amount of caries reduction was observed when the findings for the children who received 7 to 8 treatments were compared with those for the children who received 12 to 15 treatments.

Do fluoride treatments of half the teeth in the mouth affect the environment and caries experience of the untreated teeth in the other half of the mouth? In order to answer this question the caries experience of the teeth in a negative control group consisting of 326 children was studied concurrently with that in the treated group. Since the past caries experiences of the treated and of the control groups of children were quite similar, it seemed reasonable to expect that the incidence of dental caries during the study year would normally be approximately the same for both groups. Comparison of the caries experience in these two groups of children on the basis of number and percentage of teeth attacked by caries is presented in Table 3. The percentage caries attack rate (standardized for age) is 6.8 for the teeth in the untreated or right quadrants of the

mouths of the treated group and 7.0 for the teeth in either the right or the left quadrants of the mouths of the control group of children. Because of the similarity in these rates it was concluded that the effect of the fluoride treatment is exclusively local during the first year following treatment.

A summary of the major findings of this most recently reported study on the topical application of fluoride to the teeth is as follows:

1. The treatment described effected a 40 per cent reduction in the incidence of dental caries during the first year following treatment. The treatment was appreciably more effective in preventing caries in the upper than in the lower teeth.
2. The treatment was of questionable value in inhibiting caries extension on the non-carious surfaces of previously attacked teeth. There was no evidence that the treatment effected an arrest of active caries.
3. During the first year after treatment, the caries inhibiting effect was confined to those teeth to which the fluoride solution was topically applied.

Before proceeding to a discussion of the usefulness of the topical application of fluoride to the teeth, it must be admitted that at present the total experience with this method for obtaining reduction in the incidence of dental caries is very meager and merely sufficient to encourage further study. However, the results of these preliminary tests have given rise to the conviction that the effectiveness of this

TABLE 3

The Number and Percentage of Non-carious Permanent Teeth Attacked by Caries during the Year Ending May, 1943, by Left and Right Mouth Quadrants; 289 Fluoride-treated and 326 Control Children, Aged 7 to 15 Years

Mouth Quadrants	Number of Non-carious Teeth, April, 1942	Number of Carious Teeth, May, 1943	Per cent Carious (Crude Rate)	Per cent Carious (Standardized Rate *)
				<i>Treated Group</i>
Left (treated)	2,245	100	4.4	4.5
Right (untreated)	2,272	166	7.3	6.8
			<i>Control Group</i>	
Left	2,828	201	7.1	7.0
Right	2,829	220	7.8	7.0

* Numerical average of the age-specific rates

type of therapy can be improved markedly. Therefore, in order to limit the present consideration of the relative usefulness of topically applied fluorides in post-war dental health programs, this discussion will be based on the pessimistic assumption that the current indications of the prophylactic effect of the two methods of fluoride therapy will be established at the current level of apparent effectiveness and that other more efficient methods will not soon be available for use.

It has been demonstrated by Dean and his coworkers⁵ that approximately 1 p.p.m. of fluoride in communal water supplies is associated with a 50 to 65 per cent reduction in the prevalence of dental caries. For the purposes of this discussion, this level of prophylactic effectiveness is accepted as the expected result of the purposeful adjustment of municipal water supplies to a fluoride concentration of 1 p.p.m. Under the foregoing assumptions it is obvious that fluoride added to water supplies is more effective in preventing dental caries than fluoride applied topically to the teeth. Furthermore, a program based on the addition of fluoride to municipal water supplies is far less costly and far less difficult to administer than one based on individual therapy. Nevertheless in considering a program for an over-all reduction of dental caries in this country, the topical application of fluoride to the teeth cannot, for several major reasons, be dismissed as only of academic interest.

First, in order to obtain the full caries-inhibiting effect of fluoride bearing waters, it is necessary that the individual depend on such supplies for his ordinary purposes of water consumption during the first 8 years of life, or during the period when the teeth (excepting third molars) are being calcified. Thus this method is of direct value to future populations only. On the other hand, the topical applica-

tion of fluoride affords a preventive measure for use on the teeth of present populations.

Second, if all municipal water supplies in this country were adjusted to contain 1 p.p.m. of fluoride, approximately one-third of the population would not be covered by this form of fluoride therapy. Among that third of the population dependent on private wells or other supplies for their source of water,⁶ the topical application of fluoride is a useful substitute method.

Third, since neither method of fluoride therapy is a complete dental caries prophylaxis, a periodic dental examination for the early detection and treatment of those teeth which become carious will continue to be an important health service. The topical application of fluoride to the teeth could be routinely administered with each periodic dental examination. This possibility, together with the desirability of treating teeth with fluoride soon after eruption, reduces the importance of the problem of multiple treatments. Since, for example, the eruption of the permanent teeth occurs largely during the age span 6 to 13 years, the treatment of each annual crop of newly erupted teeth would afford an opportunity to submit previously erupted teeth to renewed treatment. Furthermore, the ability to secure a concrete preventive service may constitute an important incentive for obtaining periodic dental examination and the early correction of carious and other dental defects.

There is at least a theoretical possibility that a few individuals will develop mottled enamel from fluorine-treated waters, whereas this result is not possible through the use of topically applied fluorine. However, this comparison will not be used here to discredit the former method of therapy and favor the latter. There is no evidence that 1 p.p.m. of fluoride in the

communal water supplies produces dental fluorosis of esthetic importance to the individual or that it produces deleterious effects of any health significance; it is known that higher concentrations produce both. However, the danger of overdosage is common to many of the forms of therapy in extensive use today. Therefore, an indictment of the fluorine treatment of waters on the basis of our present knowledge of the dangers of overdosage does not seem reasonable.

From the foregoing considerations, the general conclusion is that the topical application of fluoride to the teeth is very likely to afford a method of practical usefulness for reducing the incidence of dental caries in the populations of the post-war period.

SUMMARY

A review of the reported experience on the dental caries-inhibiting effect of topical applications of fluoride solution to the teeth has been presented. Present indications are that the incidence of dental caries can be reduced approximately 40 per cent by this method of fluoride therapy.

Although it is highly probable that a 50 to 65 per cent reduction in dental caries can be accomplished by the simple addition of 1 p.p.m. of fluoride to domestic water supplies, the topical application of fluoride to the teeth affords a useful adjunct or substitute method for obtaining a somewhat smaller reduction in the incidence of dental caries. There is a particular usefulness of the topical method of therapy to present populations and to that third of the population dependent on private wells for their water supplies.

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