

Disfiguring Dental Fluorosis in Auckland, New Zealand

John Colquhoun

216 Atkinson Rd, Titirangi, Auckland, New Zealand

INTRODUCTION

Early in 1983 two dental operators, each in charge of a primary school dental clinic in the Auckland Health District of New Zealand, reported to the author, who was then the Principal Dental Officer of the Department of Health in that district, that a disturbing number of their patients exhibited a type of enamel mottling which they thought might be dental fluorosis. The district's water supply had been fluoridated since 1966 to a level of 1 part per million. Some of the cases were very disfiguring. The parents of some of these latter cases had reported that the children, when very young, used and swallowed large quantities of fluoride toothpaste. This study describes the author's subsequent investigation.

He first examined the cases of such mottled enamel, reported from these two clinics, which occurred among their 458 patients, aged from 7 to 12 years. He found that over 25% of these patients had variable degrees of diffuse white opacities (mottling), following the surface growth lines (perikymata), with a high degree of bilateral correspondence in severity between homologous teeth, and sometimes with discoloration or pitting of the enamel surface. This is the condition, described in extensive literature on the subject, as dental fluorosis(1,2). Typical cases were photographed.

He then examined all of the 390 patients of the same age attending the two primary school dental clinics drawing their patients from the small unfluoridated part of urban Auckland, with a natural fluoride content of its water supply of 0.2 parts per million(3). He found that only 5% of these children had the very mild form of the same condition.

The suggestion was made to the Head Office of the New Zealand Department of Health that a fuller, more systematic scientific survey of the incidence of dental fluorosis in Auckland was indicated. Head Office discouraged this proposal, pointing out that surveys had already been carried out in Hastings (fluoridated in 1954) and other places. The results of these other surveys had not been released, or published, but public statements from Head Office were made that "there is no evidence of an increase in enamel opacities in New Zealand." The author therefore proceeded to carry out this fuller survey, with the help of some Auckland school dental clinic staff. Because of the conditions under which the author had to carry out this survey, which included his retirement from his Health Department position at the end of 1983, it falls short of what he would have wished. For example, there was insufficient time to complete many case studies, or to ascertain the extent of fluoride tablet and fluoride toothpaste use.

MATERIAL AND METHODS

Because the two clinics initially investigated — one in a low income suburb, comparable in average income to the unfluoridated part of the district, and the other in a higher income suburb(4) — might not be typical of the whole fluoridated Auckland area, the author chose at random 8 more clinics in suburbs with various income levels, from the remaining 46 clinics in the fluoridated area with patients of the same primary school age range (7 to 11 or 12 years old). Time permitted examination and classification of all patients at 6 of these which, along with the original 2 investigated, provided 1955 patients for inclusion in this study. For this enlarged sample of patients from the fluoridated area, the initial screenings were made mostly by the clinic operators, and all cases of symmetrical diffuse mottling which they found were examined and classified by the author.

In addition to examining all the 390 patients over 7 years old at the 2 clinics in the unfluoridated part (Onehunga) of urban Auckland, the author was able to examine the majority of the

342 patients of the same age in the remaining part of the district's unfluoridated area: an off-shore island, where the residents drink collected rainwater.

The resulting patient groups were representative of the three areas (fluoridated, unfluoridated groundwater and unfluoridated rainwater) in socio-economic status, based on information on incomes and occupations of the areas where the children lived(4). Age and sex distributions of the children were the same in each area. Ethnic composition of the areas was similar except that, as is usual in New Zealand, the percentage of Maori and Pacific Island Polynesian residents was higher in the lower socio-economic areas.

Because the small unfluoridated areas in the Auckland Health District are of low socio-economic level(4), the patients in the larger fluoridated area were divided into three socio-economic groups, from census information on the suburbs where they lived(4), thus enabling comparisons both between patients from socio-economic areas within the fluoridated area, and between patients from the fluoridated and unfluoridated areas of similar socio-economic level.

The examinations were made in the dental clinics, with a combination of natural and artificial light. Only cases in which the opacities were clearly visible with the teeth undried, were recorded. Children with such mottling, who were known to have grown up in areas different in fluoridation status from those where they were examined, were excluded from the results. On the other hand, the proportion of children at each clinic who were not life-long residents of the suburb was not ascertained, though there is no reason to suppose the proportions differed between areas.

The names, ages, dental clinics attended, teeth affected, and stage of mottling of each pair of affected teeth, for all cases of bilaterally symmetrical diffuse mottling, were listed. As with most systems, the stage assigned to each case was the one which corresponded to the two most severely affected teeth in the mouth. As none of these lists revealed any sex, race or ethnic relationship, these categories were not separated in the results.

Classification

All permanent teeth of all the children were examined. Only bilaterally symmetrical diffuse opacities were recorded. Each pair of homologous teeth was classified as follows:

Stage 1: Any of the following, without discoloration or pitting:

- small patches, up to 2 mm in diameter, mostly on cusp tips or incisal edges
- larger patches, in the same position, or extending along marginal ridges and crown surfaces.
- continuous or broken horizontal lines on crown surfaces (these usually occur with some discoloration or pitting)

Stage 2: Any of the above, with some yellow or brown discolored patches also present.

Stage 3: Any of the above, with some pitting.

The results are set out in Tables 1 and 2. Chi square test was applied.

Fluoride toothpaste use

Information on sales of fluoride toothpaste in New Zealand were obtained from the Department of Health Head Office and is set out in Table 3.

Disfigurement

Various subjective methods of assessing disfigurement were considered. Although operator, parent and child assessments frequently concurred, it was decided to use wholly objective criteria: the presence of discoloration or pitting (stages 2 or 3) and the involvement of incisor teeth.

RESULTS

There is a highly significant difference ($P < 0.001$) between the incidence of dental fluorosis in the fluoridated and unfluoridated areas: fluoridated 24.9%, unfluoridated groundwater 4.9%, unfluoridated rainwater 2.9% (Tables 1,2).

The most commonly affected teeth, in all areas, were the first permanent molars (90% of all cases in the fluoridated area and 83% in the unfluoridated), followed by incisors (39% and 24%), premolars (26% and 7%), canines (16% and 3%) and second permanent molars (10% and 17%). In the younger age groups, of course, only the first permanent molars and incisors were erupted.

In the fluoridated area 50% of all cases involved only 2 or 4 teeth, and 15% involved more than 10 teeth. In the unfluoridated area 83% of the cases involved only 2 or 4 teeth, and 7% (two fluoride tablet takers) involved more than 10 teeth.

There were no significant differences between incidences of dental fluorosis in the various age groups.

Within the fluoridated area, the incidence of dental fluorosis was not significantly correlated with socio-economic level, though it was somewhat higher ($0.10 > P > 0.05$) in the low socio-economic area. However, the incidence of advanced (stages 2 and 3) dental fluorosis was inversely correlated with socio-economic level, and the differences are significant ($P < 0.05$).

Fluoride toothpaste use

In New Zealand use of fluoride toothpaste has increased recently (Table 3). However, these results show no trend toward increased severity of dental fluorosis among younger children. This suggests that water fluoride is the controlling factor.

Disfigurement

Two objective measures of this are: numbers and percentages with advanced (stage 2 or 3) dental fluorosis (discoloration or pitting — few would dispute that this condition disfigures the teeth involved); and numbers and percentages with dental fluorosis involving the front (incisor) teeth (the labial surfaces or incisal edges display the opacities,

and only clearly visible opacities were recorded — most parents considered this to be disfiguring). The significant socio-economic relationship of advanced dental fluorosis is reported above. However, using either criterion there is a very significant difference in the incidence of disfigurements between the high and low income suburbs of the fluoridated area ($P < 0.01$) and between the fluoridated and unfluoridated areas ($P < 0.001$).

Individual observations

The two cases of advanced dental fluorosis in the unfluoridated area, and the only ones in that area with more than 10 teeth involved, had been given fluoride tablets, at the recommended dose regimen, since birth (one intermittently and the other regularly).

In the unfluoridated 0.2 ppm natural fluoride area, the most advanced case, a 10 year old Maori boy, displayed faint horizontal white lines on his upper central incisors. He asserted that he was very fond of tea, which he had drunk regularly from a very early age, and that his family was fond of fishing, and seafoods.

In the high income fluoridated area, at least two of the advanced cases had taken fluoride tablets, on the recommendation of the family dentist, though living in a fluoridated area. Some but not all of the children with fluorosis, or their parents, reported the use and swallowing of fluoride toothpaste since an early age.

REFERENCES

- (1) Jenkins, G.N.: The physiology and biochemistry of the mouth. Blackwell, Oxford, (2nd edition) 1978. pp. 466-471.
- (2) Moller, I.J.: Fluorides and dental fluorosis. *Int.Dent.J.*, 32: 135-147, 1982.
- (3) Water analysis reports. Auckland District Health Office files.
- (4) New Zealand census of populations and dwellings 1981. Department of Statistics, Wellington, 1982.

TABLE 1

LEVELS OF DENTAL FLUOROSIS IN AUCKLAND SCHOOLCHILDREN

Examined October-November 1983

Area fluoridation. Suburbs socio-econ. levels: Incomes (high status occup'ns %)	Age group (yrs)	No. of child- ren	No. with dental fluorosis stage:				No. cases involving types of teeth:					No. cases involving nos. of teeth:						
			1	2	3	total	inc- isor	can- ine	pre- molar	1st molar	2nd molar	2	4	6	8	10	12+	
Fluoridated (1ppm) High: \$7798 -\$9974 (20%-47%)	7	152	26	1	2	29	16	-	-	28	-	4	10	8	4	3	-	
	8	121	22	5	5	32	17	1	-	30	-	3	13	6	4	2	4	
	9	155	35	9	4	48	31	9	10	44	-	6	12	9	10	5	6	
	10	149	28	2	2	32	14	10	18	27	5	3	9	8	2	1	9	
	11+	82	17	3	-	20	6	9	14	16	7	-	5	3	3	4	5	
Totals		659	128	20	13	161	84	29	42	145	12	16	49	34	23	15	24	
Percentages																		
	7	148	28	1	2	31	12	-	-	31	-	7	15	4	5	-	-	
Fluoridated (1ppm) Middle: \$7067 -\$7255 (27%-33%)	8	140	27	1	3	31	11	-	-	30	-	6	15	3	6	-	1	
	9	151	28	2	5	35	12	7	7	35	1	2	17	5	3	2	6	
	10	157	33	3	3	39	12	10	13	36	4	2	17	4	5	2	9	
	11+	80	11	4	2	17	8	7	9	16	4	-	6	2	2	-	7	
	Totals		676	127	11	15	153	55	24	29	148	9	17	70	18	21	4	23
Percentages																		
	7	108	32	-	-	32	4	-	1	30	-	2	27	1	1	1	-	
Fluoridated (1ppm) Low: \$5279 -\$7003 (7%-15%)	8	121	31	1	2	34	8	2	1	33	-	5	19	5	2	1	2	
	9	140	31	1	1	33	11	5	4	32	-	4	15	7	2	1	4	
	10	111	26	2	1	29	14	8	16	24	7	2	5	2	8	6	6	
	11+	140	41	2	1	44	12	9	32	27	20	2	10	9	6	4	13	
	Totals		620	161	6	5	172	49	24	54	146	27	15	76	24	19	13	25
Percentages																		
	7	108	32	-	-	32	4	-	1	30	-	2	27	1	1	1	-	
Fluoridated area:	Totals	1955	416	37	33	486	188	77	125	439	48	48	195	76	63	32	72	
	Percentages																	
		7	100	4	-	-	4	1	-	-	4	-	3	1	-	-	-	-
	Unfluoridated (groundwater 0.2ppm) Low: \$5105 -\$6131 (9%-16%)	8	78	7	-	-	7	-	-	-	7	-	4	3	-	-	-	-
		9	71	3	-	-	3	1	-	-	3	-	2	-	-	1	-	-
10		89	2	-	-	2	-	-	-	3	-	2	1	-	-	-	-	
11+		52	3	-	-	3	-	-	-	-	2	1	1	-	-	-	-	
Totals			390	19	-	-	19	2	-	-	17	2	12	6	-	1	-	-
Percentages																		
	7	61	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Unfluoridated (rainwater) Low: \$3291 (16%)	8	69	4	-	-	4	2	-	-	4	-	1	1	-	-	2	-	
	9	58	2	-	-	2	1	-	-	2	-	-	2	-	-	-	-	
	10	49	-	1	-	1	1	1	1	-	1	-	-	-	-	-	1	
	11+	105	2	-	1	3	1	-	1	1	2	1	1	-	-	-	1	
	Totals		342	8	1	1	10	5	1	2	7	3	2	4	-	-	2	2
Percentages																		
	7	61	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Unfluoridated area:	Totals	732	27	1	1	29	7	1	2	24	5	14	10	-	1	2	2	
	Percentages																	
		7	100	4	-	-	4	1	-	-	4	-	3	1	-	-	-	-
		8	78	7	-	-	7	-	-	-	7	-	4	3	-	-	-	-
		9	71	3	-	-	3	1	-	-	3	-	2	-	-	1	-	-

Table 2 DENTAL FLUOROSIS LEVELS IN AUCKLAND SCHOOLCHILDREN 1983 Summary

Area: fluoridation status and socio-economic level	No. of children	Percentages of children with dental fluorosis:			Percentages of fluorosis cases involving:		
		All stages	Advanced stages	Incisal teeth	2 or 4 teeth	6 - 10 teeth	Over 10 teeth
Fluoridated (1ppm)							
High	659	24.4	5.0	12.7	40.4	44.7	14.9
Middle	676	22.6	3.8	8.1	56.9	28.1	15.0
Low	620	27.7	1.8	7.9	52.9	32.6	14.5
Total	1955	24.9	3.6	9.6	50.0	35.2	14.8
Unfluoridated (ground)							
Low	390	4.9	0.0	0.5	94.7	5.3	0.0
(rain)	342	2.9	0.6	1.5	60.0	20.0	20.0
Total	732	4.0	0.3	1.0	82.8	10.3	6.9

Table 3: Fluoride toothpaste consumption in New Zealand

Year	Fluoride toothpaste as proportion of total toothpaste sales (%)
1970-71	6
1972-73	15-17
1974-75	37-43
1976-77	51-56
1978-79	69-73
1980	76