Dental Fluorosis in the Deciduous Dentition of Ethiopian Children

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SUMMARY: While the problem of dental fluorosis in the permanent dentition has been extensively studied, fluorosis in the deciduous teeth is less well known.
The purpose of the present study was to assess the prevalence and severity in newly shed teeth, collected from school children in two areas with different fluoride contents in drinking water; Addis Ababa, with 0.2 - 0.7 mgF/L, and Wonji-Shoa, with 1.7 -17.7 mgF/L. A total of 405 teeth were collected and screened according to tooth-type.
The teeth were examined for dental fluorosis, as well as caries, calculus and attrition. Among the fluorotic teeth, 18 were selected for further inspection: the teeth were sectioned, and thin specimens were studied by the use of micro-radiography and microscopy. According to western standards, relatively little caries was found in the examined teeth. However, 10%, respectively 25% of deciduous molars in Wonji-Shoa and Addis Ababa had caries, mostly in the fissures. Attrition was found in practically all teeth. Dental fluorosis was diagnosed in 49 teeth, while 26 teeth were characterised as "possibly fluorotic".
Most of the fluorotic teeth showed low-grade fluorosis. Only a few cases were severe, i.e. with pitting of the enamel. No fluorosis was found in anterior teeth, a few cases were diagnosed in the canines, while the highest prevalence and degree of fluorosis was seen in deciduous molars. Thus, there is a clear relationship between the enamel damage and the onset and duration of mineralisation of the teeth. Similarly, a strong relation was found between the fluoride contents of the drinking water and the prevalence and severity of dental fluorosis.

Key Words: Dental fluorosis, drinking water, deciduous dentition, Ethiopia.

INTRODUCTION

Fluoride is classified as a trace element, but is, in fact ubiquitous, and may rank among the more common elements in the biosphere1. As far as oral health is concerned, it is also one of the most interesting. Fluoride may enter the human body through solid food, through various beverages, and even through the air. The predominant fluoride source is, however, drinking water. Most surface waters contain less than 0.1 mg F/L, while ground waters may, depending upon the local base rock, contain rather high concentrations of fluoride.

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Igneous rock, which has an average fluoride content of 715 mg/kg, often contains high-fluoride water 2. Bårdsen et al. (1999) 3 found fluoride concentrations as high as 9.5 mg/L in ground water in very old granite and gneisses in Western Norway. Extremely high fluoride concentrations may be found in lakes and wells in areas with volcanic bedrock of relatively recent origin, e.g. in the African Rift Valley. Fluoride contents of 5000-6000 mg/L have been reported in acid spring waters located close to volcanic activity 1.

Potable water: According to WHO, the recommended upper limit for fluoride in drinking water should be 1.5 mg/L 3. In hot climates, where water intake is higher, the fluoride concentration should be even lower. Adequate drinking water is, however, scarce in many hot regions, and health authorities have had to accept water with higher fluoride concentrations. This is the case in certain areas of the African Rift Valley.

Rift Valley is known for endemic fluorosis. Dental fluorosis is caused by long-term, high intake of fluoride during childhood, especially during the first 6-7 years of life. The ameloblasts, which are highly specialised cells responsible for the production of enamel, are particularly susceptible to fluoride. Therefore, the most obvious harmful effect of prolonged excessive fluoride intake, is a faulty mineralisation of, and morphological changes in hard tissues such as enamel.

The degree of enamel damage depends on the amount of fluoride being ingested 4. Mild dental fluorosis is seen as thin white lines in the enamel, while, in serious cases, the whole tooth appears chalky white or, after a while, brownish, with brittle enamel that may break apart during mastication. Contra-lateral teeth are equally affected; i.e. the enamel changes are symmetric, which makes diagnosis easier. Dental fluorosis is used as a biomarker for excessive intake of fluoride during the period of enamel formation; roughly the first 7-8 years of life.

While fluoride is the cause of fluorosis, factors such as the quality of food may influence the degree of enamel changes. In most cases the severity of fluorosis is closely correlated with fluoride concentration in the drinking water.

Dental fluorosis may affect both dentition, but, as pointed out e.g. by Fejerskov et al. 5, primary teeth exhibit less dental fluorosis than their permanent successors. Most studies, consequently, have concentrated on fluorosis in the permanent dentition. The objective of the present study was to assess, macroscopically and microscopically, dental fluorosis, dental caries and dental abrasion in newly shed deciduous teeth.

MATERIAL AND METHOD

The deciduous teeth donors were primary school children, aged 5-14 years, living in two different areas in Ethiopia:

Addis Ababa, a big, highly polluted city, served with low-fluoride drinking water, 0.2 –0.7 mg/L; mostly from surface water reservoirs in the mountains.

Wonji-Shoa, a sugar estate in rural Rift Valley, with various villages, approximately 100 km south of the capital. The villages depend on sub-surface water sources, the fluoride concentrations of which vary from approximately 2 to 15 mg/L.

After the approval of the proper authorities, an Ethiopian research assistant approached the children, offering pencils and notebooks in exchange for newly shed deciduous teeth. The offer was well received, and a total of more than a thousand teeth were collected. The present material consists of 405 teeth.

After listing name, age and hometown as well as identifying the tooth according to the WHO system, the exfoliated teeth were placed in small plastic envelopes that were labelled, and closed. The teeth were brought to Norway, sterilised by heating, and examined for abrasion, caries and dental fluorosis by a team of dental students and experienced dentists.

RESULTS

According to western standards, relatively little caries was found in the examined teeth. However, 10 %, respectively 25 % of deciduous molars in Wonji-Shoa and Addis Ababa had caries, mostly in the fissures. Attrition was found in practically all teeth.

As compared to standards in Northern Europe, the exfoliation of deciduous teeth (tooth shedding), and thereby tooth eruption, took place earlier in the Ethiopian material, and children in rural Wonji-Shoa seemed to shed their teeth at a slightly lower age than their counterparts in Addis Ababa.

In the whole material, dental fluorosis was diagnosed in 49 teeth; 44 in Wonji-Shoa, and 5 in Addis, while 37 teeth were characterised as “possibly fluorotic”; 28 and 9 in WS and AA, respectively (Table 2). Deciduous incisors showed no signs of fluorosis, neither in Addis Ababa nor in Wonji-Shoa. With the exception of two doubtful findings, also canines in Addis Ababa were without dental fluorosis. Deciduous molars seemed to be most susceptible to fluorotic damage. Most of the fluorotic teeth showed low-grade fluorosis. Only a few cases were *severe*, i.e. with pitting of the enamel.

Among the fluorotic teeth, 18 were selected for further inspection: These teeth were sectioned, and thin specimens were studied by the use of microradiography and microscopy. The microradiographs showed light degrees of dental fluorosis manifested by hypo-mineralised sub-surface areas in the enamel. The microradiographic picture of mild degree of fluorosis is similar to what is seen in early stages of dental caries, but the differential diagnosis can normally be made based on the localisation of the lesion; intra-orally also by the symmetrical appearance of dental fluorosis.

TABLE 1. Number of deciduous teeth with fluorosis.

Type	Wonji-Shoa 1.7 –17.7 mgF/L					Addis Ababa 0.2-0.7 mg/L				
	Total	Positive		Doubtful		Total	Positive		Doubtful	
Incisors	39	0		0		85	0		0	
Canines	39	9	23 %	7	18 %	47	0	0 %	2	4 %
Molars	72	35	49 %	11	23 %	123	5	4 %	7	6 %
All	150	44	40 %	18	16 %	255	5	3 %	9	5 %

DISCUSSION

The present study shows that the deciduous dentition is susceptible to excessive intake of fluoride. As compared to the permanent dentition, however, the prevalence is lower, and the severity of fluorosis in temporary teeth is less, even in areas with high fluoride in drinking water. This is in agreement with previous findings [7].

For the permanent dentition, the severity of dental fluorosis seems to increase going distally in the dental arch. There is also a relationship between the onset and duration of the enamel formation – and the degree of fluorosis in the individual teeth. The same relationship could, with one notable exception, be observed in the deciduous teeth collected in the high-fluoride area of Wonji-Shoa.

As shown in Table 1, no fluorosis was found in the incisors (n=39), 9 out of 39 (23 %) of the canines were found to have dental fluorosis, while 35 of 72 (49 %) of the molars were found to be fluorotic.

As the second deciduous molar starts and especially finishes mineralisation of the crown later than the first deciduous molar, one would have expected a difference in the prevalence and severity of fluorosis in the two teeth. According to the limited material analysed till now, this is not the case. It may be of interest to note that in the permanent dentition, the premolars, which erupt to replace the deciduous molars, are affected by dental fluorosis as badly as are the permanent molars.

In all deciduous teeth the mineralisation of the tooth-crowns start in utero. In central incisors, (both jaws) the enamel mineralisation is more or less finished at birth while lateral incisors and the first temporary molars have fully formed crowns during the first 6 months of life. The enamel tissue of canines and the second deciduous molars will be mineralised during the first year.

Dental fluorosis is caused by an excessive intake of fluoride. There is no reason to believe that enamel in the deciduous dentition is more resistant to fluorotic changes than is enamel in permanent teeth. However, during pregnancy the placental barrier seems to protect the foetus against excessive fluoride intake, even where the mother's intake is high. Only minor differences are seen in the fluoride level in blood of prenatal babies in high and low-fluoride areas. Also mother-milk is low in fluoride, with only moderate differences between high- and low-fluoride areas. Consequently, in children who are being breast-fed, the daily fluoride intake is low. During weaning,

however, a child may be exposed to special weaning food that may be prepared mixed with local, high fluoride drinking water. Alternatively, children may be fed "adult food" which may also be high in fluoride; especially if high-fluoride salts or tenderisers (trona) have been added to the food.

A previous examination in Wonji-Shoa[8] found that practically all maxillary permanent incisors in children born and bred in these high-fluoride villages, were fluorotic. This is in stark contrast to the 0 % found in the deciduous front teeth.

CONCLUSION

The deciduous dentition may develop dental fluorosis, though the prevalence and severity of the fluorotic damage is less than what is seen in the permanent dentition in the same area/same persons. A strong relation has been found between the fluoride contents of the drinking water and the prevalence and severity of the fluorosis. In the present material no fluorosis was found in the deciduous incisors. On the average, more severe fluorosis was observed in the "distal" than in the "anterior" teeth. This is probably related to an increasing intake of fluoride in a child that is being weaned.

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