PERIODONTAL CHANGES IN FLUOROSED AND NONFLUOROSED TEETH BY SCANNING ELECTRON MICROSCOPY

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SUMMARY: To date, studies on the effect of fluoridated water on gingival and periodontal status have shown inconsistent results. Here a first attempt has been made to compare cemental and periodontal ligament changes in two groups of fluorosed and nonfluorosed noncarious healthy teeth (16 teeth in each group) by scanning electron microscopy (SEM). Two important observations were made from the SEM impressions: (1) Globular mineralized debris was 37.5% in the fluorosed group compared to 6.25% in the nonfluorosed group. (2) Partial/initial mineralization of connective tissue fibres (periodontal ligament area) was 43.75% in the fluorosed group but only 18.75% in the nonfluorosed group.

Keywords: Dental fluorosis; Fiber mineralization; Fluorosed and nonfluorosed teeth; Periodontal changes; Scanning electron microscopy (SEM).

INTRODUCTION

Microbial plaque is considered to be a major etiologic factor in periodontal disease. Among various environmental etiologic factors, the influence of fluoride on periodontal health is still controversial. Although studies have been conducted on the effects of elevated fluoride in drinking water on gingivitis and periodontitis, the results have been inconsistent.

The present study arose firstly from routine clinical observations of moderate to advanced periodontitis in subjects residing from high fluoride belts of Davangere District, Karnataka State, India.[1] In that work we found a strong association of periodontal disease with high fluoride water using a community periodontal index of treatment needs (CPITN) in a population aged 15-74 years. Possible reasons for this association are discussed in that report.

Secondly, no effort appears to have reported in the literature to account for increased periodontal disease in high fluoride areas apart from blaming oral poor hygiene and plaque levels. In addition to inflammatory process that are common to high and normal fluoride levels of water, changes in fluorosed hard and soft tissues of periodontium suggest that fluoride should be suspected as an etiological (environmental) agent for periodontal disease. However, as far as we are aware, no direct experimental data are available comparing periodontal changes in human fluorosed and nonfluorosed otherwise healthy teeth. For these reasons, an initial attempt has been made here to use scanning electron microscopy (SEM) to study periodontal differences in fluorosed and nonfluorosed teeth.

MATERIALS AND METHODS

Study teeth consisted of 32 periodontally healthy noncarious fluorotic and nonfluorotic teeth (16 in each group) that were atraumatically extracted due to

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orthodontic reasons from subjects aged 18 to 25 years residing in the Davangere District of Karnataka State, India. All patients from whom teeth were obtained gave written informed consent, and the study was conducted in accordance with the guidelines of the World Medical Association Declaration of Helsinki. Fluorotic teeth were confirmed by the presence of enamel fluorosis and a patient history of having been born and raised in geographic areas in and around Davangere, India, that have naturally occurring high water fluoride concentrations (>1.5 ppm). Teeth with intrinsic stains caused by other reasons such as porphyria, erythroblastosis fetalis, tetracycline therapy, etc., or those with enamel or root caries were excluded from the study. The diets of subjects with and without dental fluorosis were quite similar. The fluorosed teeth had type C, D, or E according to Jackson's criteria for dental fluorosis assessment.[2]

Preparation of tooth specimens included removal of crowns of teeth by sectioning at cemento enamel junction using carborundum discs. The root surface was selected for examination by SEM analysis. For SEM analysis, the teeth were dehydrated and a conductive layer of carbon was applied, and the mounted specimens were then sputter coated with gold for examination with a JEOL-JSM-S10-A scanning electron microscope, operated at 20KV. The specimens were examined at magnification ×20, ×600, ×1200. Polaroid photomicrographs were taken for these magnifications. All SEM evaluations were done by a single experienced investigator who was blinded regarding the type of teeth examined.

RESULTS

SEM results between the two groups of teeth are summarized the Table and illustrated by examples in Figures 1–6. As observed by the SEM impressions, the periodontally fluorosed group had higher percentages of hypermineralized surface, resorption bays/cavitations, partial/initial mineralization of connective tissue fibers, insertion area for fibers, globular mineralized debris, and calculus/ calculus-related debris than the nonfluorosed group.

Table. Comparison of SEM impressions of periodontal ligament areas of 16 fluorosed and 16 nonfluorosed healthy human teeth from the Davangere District, Karnataka State, India

SEM Impressions	Fluorosed healthy teeth		Nonfluorosed healthy teeth	
	Number	Percent	Number	Percent
Hypermineralized surface	8	50	3	18.75
Resorption bays/ cavitations	4	25	2	12.25
Absence of connective tissue fibers	1	6.25	0	0
Presence of connective tissue fibers	12	75	12	75
Partial/initial mineralization of connective tissue fibers	7	43.75	3	18.75
No evidence of mineralization of connective tissue fibers	3	18.75	3	18.75
Insertion area for fibers	4	25	0	0
Globular mineralized debris	6	37.5	1	6.25
Calculus/calculus-related debris	5	31.25	2	12.25

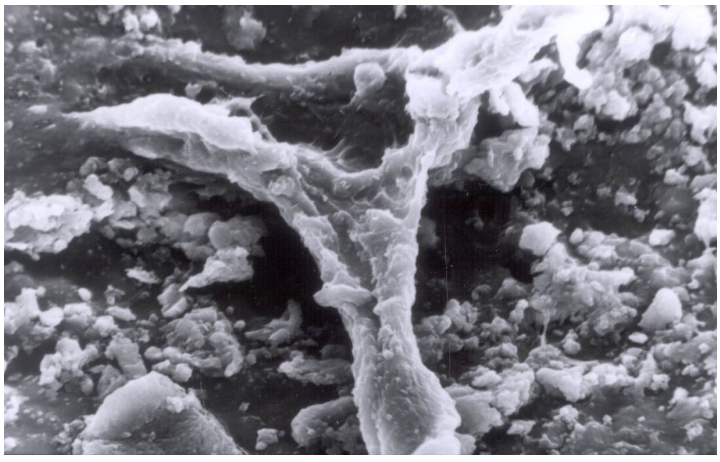

Figure 1. Partially mineralized connective tissue bundles in fluorosed healthy group (x1200).

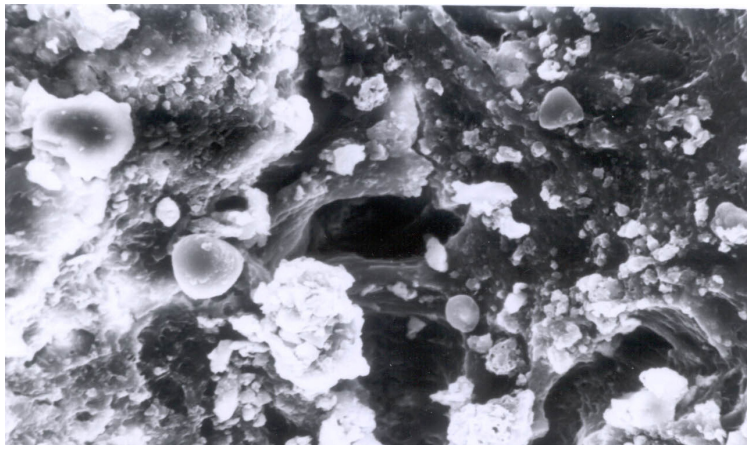

Figure 2. Aggregation of mineralized globular debris in a resorption cavitation in nonfluorosed healthy group (x1200).

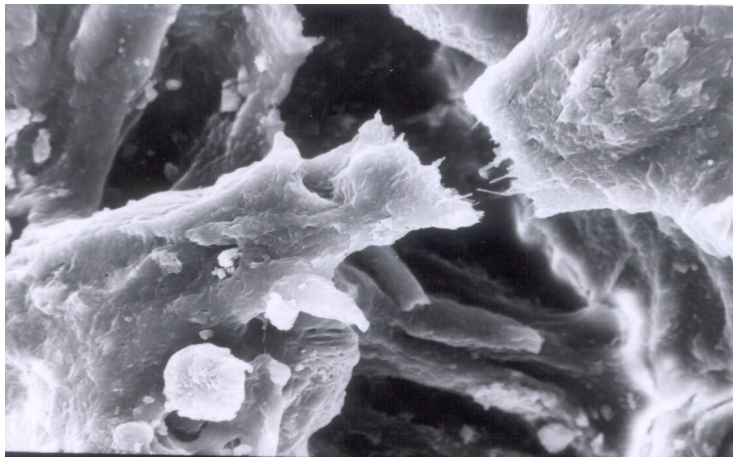

Figure 3. Normal looking connective tissue fiber in nonfluorosed healthy group with no evidence of mineralization (x1200).

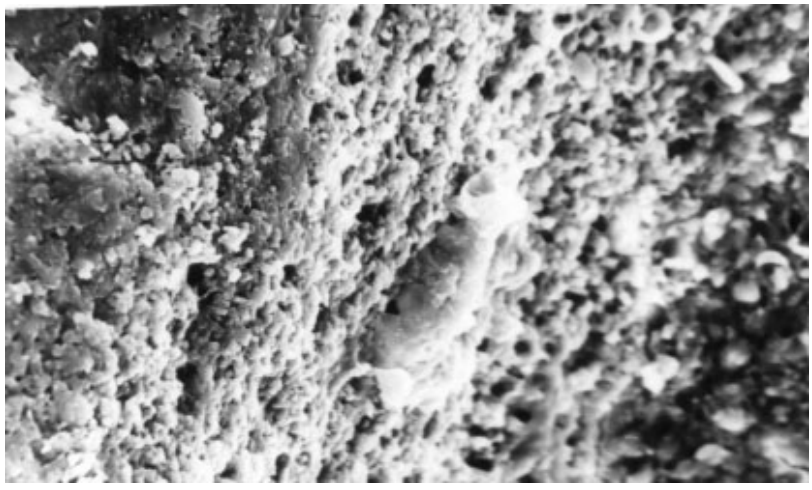

Figure 4. Globular mineralized debris in fluorosed health group with porosities that may be insertion areas for connective tissue fibers (x1200).

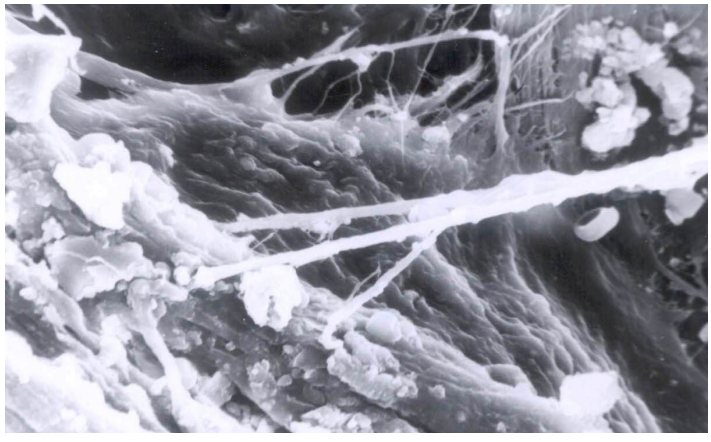

Figure 5. Normal and partially mineralized connective tissue in fluorosed healthy group (x1200).

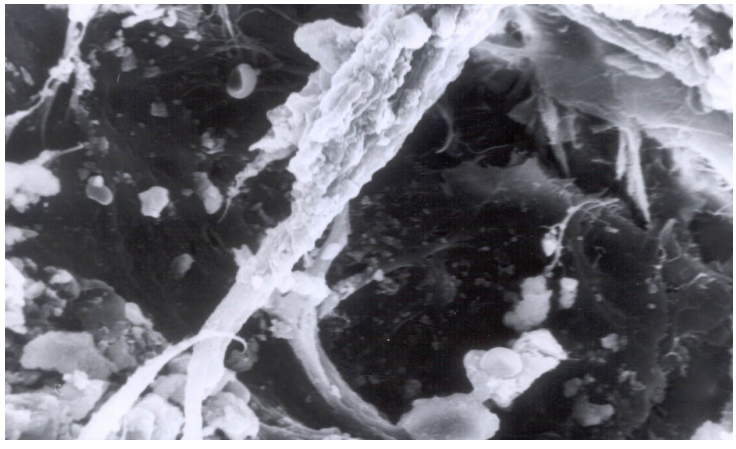

Figure 6. Early stage of mineralization in fluorosed healthy group (x1200).

DISCUSSION

Fluoride has long been known to have a significant effect on dental enamel. Human studies conducted to analyze the effect of fluoride on periodontal status have yielded varying results suggestive of no relation between periodontal health and consumption of fluoride,[3] a decrease in periodontal index score,[4] attachment loss among adults living in a natural fluoride area,[5] increase in gingival bleeding index score,[6] or gingivitis and gingival recession among individuals from high fluoride areas.[7] Vazirani[8] reported that on gross examination of teeth with mottled enamel, the most striking feature observed was higher incidence of root resorption of every tooth.

The higher percentage of resorption bay/cavitations observed in the present study is consistent with the findings of Bimstein et al.,[9] who suggested that occurrence of resorption lacunae is a common finding when extensive alveolar bone loss takes place and also where cementum repair is unable to compensate for resorption.

Amongst the several SEM impressions interpreted and compared in this study, the higher percentage of partial/initial mineralization of connective tissue fibers and the even higher percentage of globular mineralized debris exclusively in the fluorosed teeth are worth mentioning. Further comparative study of these differences and how they affect periodontal ligaments is clearly desirable. A cattle study by Krook et al.[10] showed that fluoride has a toxic effect on the resorbing cementocytes, thereby leading to hypercementosis, osteonecrosis, and recession of the gingiva, alveolar crest, and alveolar bone. The medical literature also records that radiography of patients with skeletal fluorosis shows the bones of extremities to have periosteal thickening and calcification of ligaments and muscular attachments.[11]

Within the limits of this study, healthy fluorosed teeth were found to exhibit a higher percentage of periodontal mineralization of connective tissue fibers and globular mineralized deposits than nonfluorotic healthy teeth. Further histologic evaluation and a larger sample size would be beneficial from a research point of view.

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