Noriaki Ikeda,[1] M.D.; Goutaro Watanabe,[1] M.Sc.; Akira Harada,[1] B.Sc.; and Tsuneo Suzuki,[1] M.D.

A Scanning Electron Microscopy and Electron Probe X-Ray Microanalysis (SEM-EPMA) of Pink Teeth

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ABSTRACT: Samples of postmortem pink teeth were investigated by scanning electron microscopy and electron probe X-ray microanalysis. Fracture surfaces of the dentin in pink teeth were noticeably rough and revealed many more smaller dentinal tubules than those of the control white teeth. Electron probe X-ray microanalysis showed that the pink teeth contained iron which seemed to be derived from blood hemoglobin. The present study confirms that under the same circumstance red coloration of teeth may occur more easily in the teeth in which the dentin is less compact and contains more dentinal tubules.

KEYWORDS: odontology, dentition, microscopy, X-ray analysis, postmortem pink teeth, dentin

Postmortem red coloration of teeth (pink teeth) has often been found in autopsy cases, and some workers have carried out biochemical investigations into the nature of the postmortem occurrence of pink teeth [*1-3*]. However, we have found no reference in the literature to the morphological investigation of pink teeth. The present study was aimed at using scanning electron microscopy (SEM) and electron probe X-ray microanalysis (EPMA) for investigating the morphology and analyzing the chemical composition of pink teeth.

Materials and Methods

Dead dogs were left for seven to ten days in a forest where pink teeth had been found earlier in two human decomposed bodies [*4*]. Some teeth of the dogs turned pink, but others remained white. The white teeth were used as controls. The pink and the white control teeth were fractured in a brass cylinder by a blow from a close fitting pestle. The fractured dentinal surfaces of the teeth were used as samples for investigations.

SEM and EPMA were performed on a Elionix EXM-3500 electron probe X-ray microanalyzer. The morphological studies were carried out on gold coated samples in a SEM system operated between 10 and 15 kV, and the X-ray analyses were performed on carbon coated samples at 15 kV and 2.5×10^{-10} A beam current. X-ray analysis was done at least three times after the specimen was displaced by random motion.

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[1]Forensic scientist, forensic scientist, forensic scientist, and professor, respectively, Department of Forensic Medicine, Yamagata University School of Medicine, Yamagata, Japan.

Results

The crowns of the pink teeth had a pale pink appearance, while the roots had a deep pink color. The fractured dentinal surfaces of the pink teeth had a large zone of red color.

At low SEM magnification ($\times$1400), the texture of the dentinal surfaces of the pink teeth was rough while that of the control teeth was smooth. The dentinal surfaces of the pink teeth had many more smaller holes than those of the control white teeth (Fig. 1). At higher magnification ($\times$10 000), it was obvious that the multicratered appearance of the dentinal surfaces of both pink and white control teeth was produced by the dentinal tubules. In the pink teeth, the intertubular areas were noticeably rough, and the pattern suggested that the dentin was less compact. In the control white teeth, however, the intertubular areas were smooth and the dentin seemed to be well compacted (Fig. 2).

EPMA of the samples of the pink and the control white teeth revealed that the dentinal surfaces of both generated energy spectra indicating that these regions were composed mainly of phosphorus and calcium. The energy spectrum obtained from the pink teeth contained trace amounts of iron, while that from the control white teeth did not (Fig. 3).

Discussion

Several authors have stated that red coloration of teeth is increased by blood congestion in the head [3,5]. The high percentage of pink teeth in corpses recovered from water might thus be attributed to the natural head down repositioning of bodies in water after death [5]. All corpses recovered from water, however, have not always had pink teeth. Some authors have

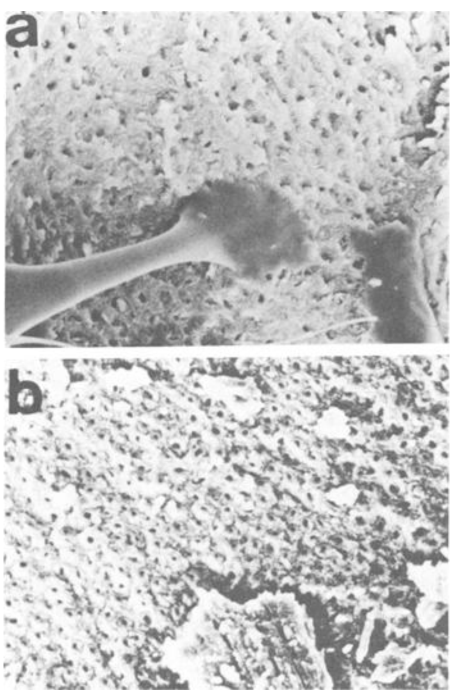

FIG. 1—*Scanning electron micrographs of dentinal surfaces:* (a) *control white tooth and* (b) *pink tooth. The pink teeth have rougher surfaces with many more smaller holes ($\times$1400).*

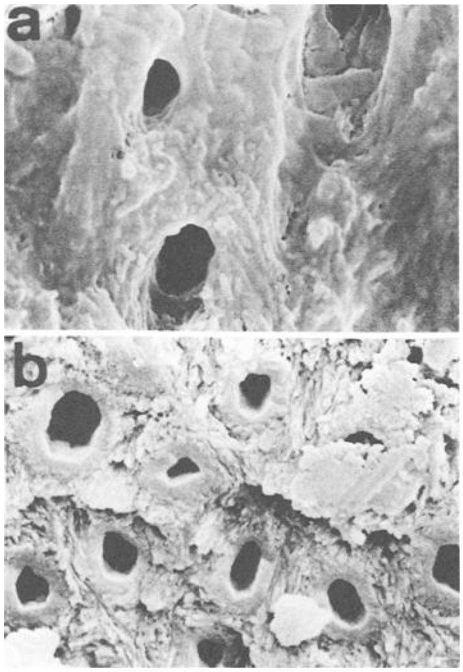

FIG. 2—*High-magnification scanning electron micrographs of dentinal surfaces:* (a) *control white tooth and* (b) *pink tooth. Both teeth have a multicratered appearance. The intertubular surfaces of the control white tooth are smooth, while those of the pink tooth are rough (×10 000).*

carried out biochemical investigations of pink teeth [*1-3*]. It seems plausible that seeping of hemoglobin or its degradation products into the dentinal tubules induces this phenomenon [*6*]. The pink teeth, however, have not been investigated in relation to the dentinal micromorphology and chemical composition.

In the present study, we observed that there were many more smaller dentinal tubules in the dentin of the pink teeth than in the control white teeth, and the pattern of the intertubular surfaces suggested that the intertubular dentin of the pink teeth was less compact. EPMA revealed that the dentin of the pink teeth contained iron and it seemed to be derived from blood hemoglobin. From these observations, it was conceivable that the blood might be able to seep into the dentin more easily in the teeth which have more dentinal tubules and less compact intertubular dentin. The present study, therefore, confirms that under the same circumstance, the pink teeth may occur more often in the teeth of which dentin is less compact and has more dentinal tubules.

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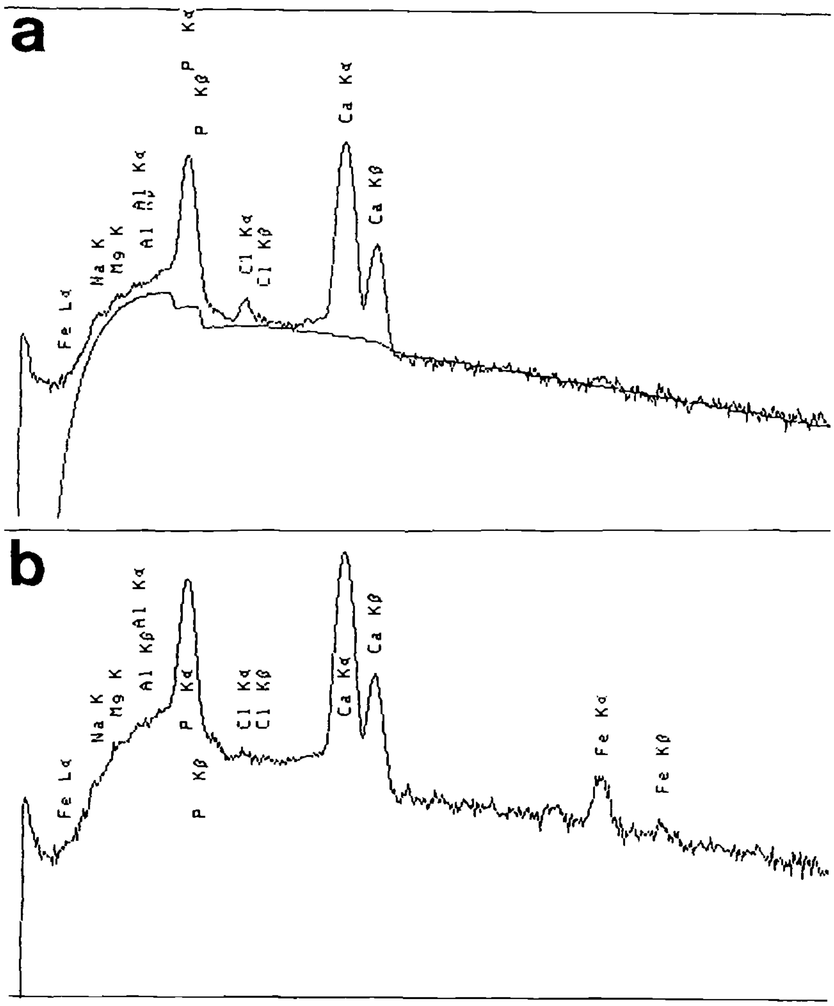

FIG. 3—*EPMA of dentinal surfaces:* (a) *control white tooth and* (b) *pink tooth. The prominent peaks are phosphorus (P) and calcium (Ca). An iron peak (Fe) is detected in the spectrum of the pink tooth.*

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Address requests for reprints or additional information to
Tsuneo Suzuki, M.D.
Department of Forensic Medicine
Yamagata University School of Medicine
Yamagata 990-23, Japan