FLUORESCENCE OF TETRACYCLINE ANTIBIOTICS IN DENTIN*

by

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Yellow-gold fluorescence under ultraviolet irradiation has been observed by *Milch, Rall & Tobie*[1], in bones of animals and humans, as well as in the continuous growing incisor of rodents following the administration of tetracycline antibiotics. *Bevelander & Rolle* report the retention of a fluorophor in the skeleton of chick embryos when tetracycline was fed to laying hens.[2] *Zipkin & Larson* found pronounced fluorescence of incisors and molars of rat pups at weaning, when the mothers had received tetracycline.[3]

This report deals with fluorescent lines found in the molars of young white rats which received oxytetracycline by intraperitoneal injections. In addition, fluorescent lines are described in 4 deciduous teeth and one supernumerary tooth from a girl who had been given chlortetracycline at the age of 8 months and repeatedly thereafter.

The fluorescence under ultraviolet irradiation discussed in this paper is yellowish and different from the natural blue autofluorescence of teeth described by *Hartles & Leaver*.[4]

The number of rats employed in the study, together with the age of the animals at the time of intraperitoneal injection of oxytetracycline** and the dosages given are recorded in Table 1. Each

* This work was carried out at the Forsyth Dental Infirmary, Boston, Massachusetts, U.S.A.

** Terramycin ® was obtained through the courtesy of Chas. Pfizer & Co.

Table I.

Dosage and time for intraperitoneal oxytetracycline injections.

Number of rats	Dose	Age in days	
		At Injection	At Sacrifice
6	10 mg/kg	25, 27, 35, 37	4 at 41 2 at 71
6	100 mg/kg	25, 27, 35, 37	4 at 41 2 at 71

animal received 4 injections. Ground sections of the mandibular first molar teeth were prepared according to the procedure of *Johannessen*[5] and were studied in a microscope under ultraviolet illumination. Tooth sections from the animals which received the low dosage of oxytetracycline exhibited fluorescent lines which were difficult to discern. Tooth sections from the high dosage animals showed 2 distinct sets of 2 lines in the dentin at locations

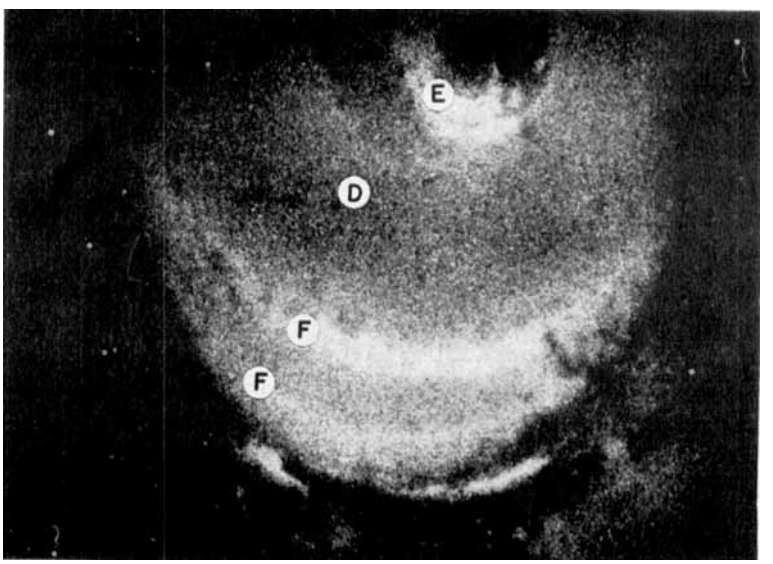

Fig. 1. Photomicrograph obtained with ultraviolet illumination of ground section of rat molar. E is the enamel. F denotes fluorescent lines in the dentin. (Original magnification × 60).

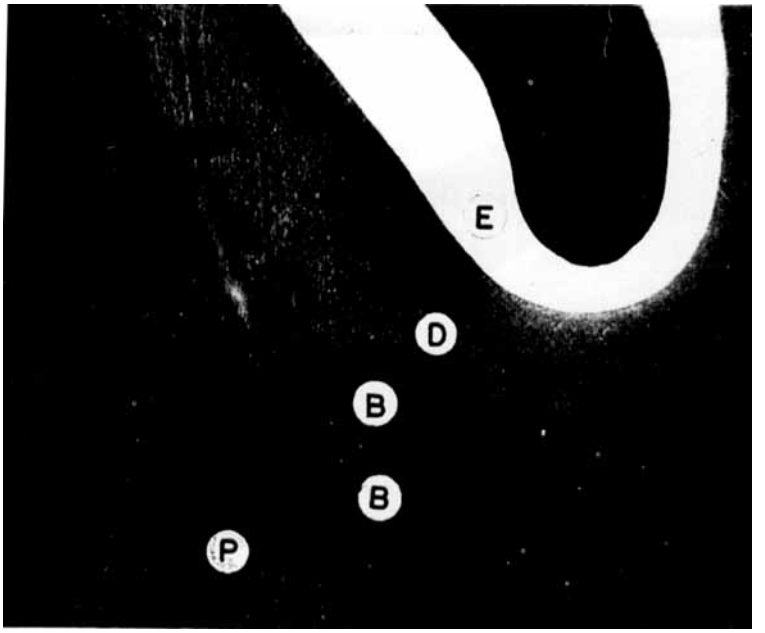

Fig. 2. Microradiograph of section similar to Fig. 1. E is the enamel. B denotes hypomineralized lines in the dentin, D. P is the pulp cavity.

corresponding to the dentin formation at times of injection (Fig. 1). The appearance of the lines was the same in animals sacrificed at 41 and 71 days of age. The sections were also examined microradiographically. Fig. 2 illustrates areas of weak hypomineralization corresponding to the lines. No similar hypomineralization could be found in the teeth from the animals receiving the lower dose. Whether the hypomineralization caused by oxytetracycline is analogous to the inhibition of skeletal formation in chick embryos following administration of tetracycline[6] is not yet known. It should be added here, that study of tooth sections from rats, which had received repeated injections of sodium fluoride to produce "calciotraumatic" lines revealed only bluish autoflorescence and no yellow lines.

Fluorescent lines were also found in a number of human teeth obtained from an 11 year old girl. The lines were located in the dentin of the crown of a shed second deciduous molar and in the

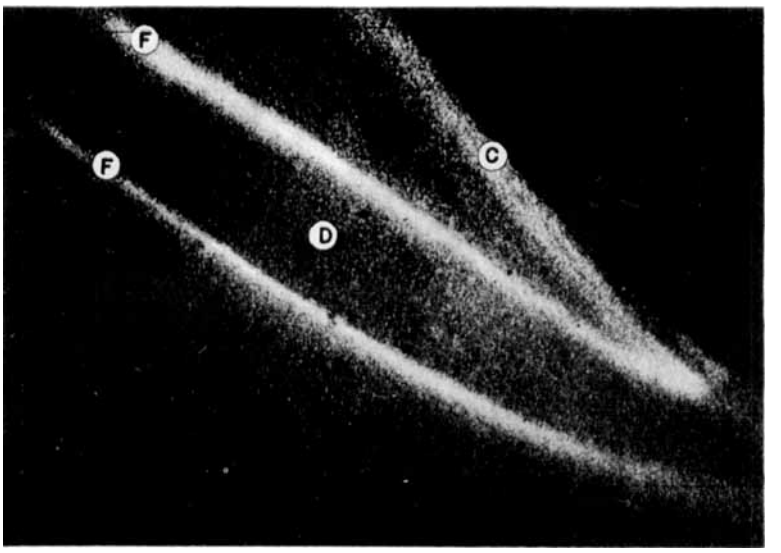

Fig. 3. Photomicrograph obtained with ultraviolet illumination of ground section of supernumerary human tooth. C is the cementum. F denotes fluorescent lines in the root dentin, D. (Original magnification × 60).

unresorbed roots of 2 maxillary deciduous cuspids and one mandibular deciduous incisor (extracted at age 11 for orthodontic reasons) as well as in the root of a supernumerary maxillary incisor (mesiodens). In Fig. 3 two heavy fluorescent lines which start at the root surface in a pulpo-coronal direction, are seen. All the teeth mentioned were from the same patient, and showed a line arrangement in identical patterns, but at varying localizations indicating the rates and stages of formation in the teeth examined. It was noted that the width of the lines was greater in the supernumerary tooth and in the deciduous incisor than in the deciduous molar and cuspids. This probably indicates a higher rate of dentin deposition in the former teeth.

Unfortunately, it was not possible to recover any records giving the exact timing and duration of the chlortetracycline treatments, except that the drug was given repeatedly in infancy for a viral infection. The age at the first treatment was 8 months. No similar fluorescence was found in a series of shed deciduous

teeth from other children. A few teeth were obtained from other children with histories of tetracycline administration. In these cases, however, the treatments were given so late, that the parts of the roots which were formed at the time were resorbed before shedding of the teeth.

At present the origin of the fluorescence in teeth and bone after tetracycline treatment is not fully understood. It has been suggested that either a fluorophor derived from the drug or the total unchanged drug is deposited in the mineralizing bone or dentin matrix.[1] The mechanism of the binding of the fluorescent material appears to involve complex interactions between the tetracycline nucleus, calcium and the protein matrix.[1]

In connection with the present report, it is suggested that tetracyclines may be useful as markers in studies of dentin apposition. In addition, attention is drawn to the fact that deciduous teeth from children who have received tetracycline sufficiently early in life under controlled conditions present a source of valuable information on mineralization pattern and mineralization rate of the human deciduous dentition.

SUMMARY AND CONCLUSION

Yellow fluorescent lines under ultraviolet irradiation have been described in the dentin of the first mandibular molar of rats, which received oxytetracycline injections intraperitoneally. Similar fluorescent lines were found in 5 teeth from a girl who had received chlortetracycline treatment repeatedly in infancy.

It is suggested that tetracycline may prove useful for studies of mineral deposition.

Finally, attention is drawn to the importance of shed deciduous teeth from children who have received tetracycline treatment as an important source of accurate information on mineralization rates and patterns in the human deciduous dentition.

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RÉSUMÉ

FLUORESCENCE DES ANTIBIOTIQUES À LA TÉTRACYCLINE DANS LA DENTINE

Des lignes jaunes fluorescentes visibles sous irradiation ultraviolette ont été décrites dans la dentine de la première molaire du maxillaire inférieur de rats ayant reçu des injections intrapéritonéales d'oxytétracycline. Des lignes similaires ont été trouvées dans 5 dents d'une fillette ayant reçu à plusieurs reprises pendant sa première enfance un traitement à la chlortétracycline.

Les auteurs suggèrent la possibilité de l'emploi de la tétracycline pour l'étude de minéralisation.

Enfin, les auteurs attirent l'attention sur l'importance que les dents de lait d'enfants ayant reçu un traitement à la tétracycline représentent après leur chute comme source d'informations précises sur les vitesses et les modes de minéralisation de la dentition humaine.

ZUSAMMENFASSUNG

FLUORESZENZ VON TETRAZYKLIN IM DENTIN

Die Arbeit beschreibt die Beobachtung von gelben fluoreszenten Linien, die bei ultravioletter Bestrahlung von Dentin aus dem ersten unteren Molaren von Ratten sichtbar werden, wenn die Ratten intraperitonealen Injektionen von Oxytetrazyklin bekommen haben. Ähnliche fluoreszente Linien wurden auch in 5 Zähnen eines Mädchens festgestellt, das während der Kindheit wiederholt eine Behandlung mit Chlortetrazyklin erfahren hatte.

Es wird die Vermutung aufgestellt, dass Tetrazyklin sich für das Studium von Mineralspeicherungen als nützlich erweisen wird.

Abschliessend wird darauf aufmerksam gemacht, dass ausgefallene Milchzähne von Kindern, die mit Tetrazyklin behandelt worden sind, eine wertvolle Quelle zur Erzielung genauer Aufschlüsse über Mineralisationstempo und -muster in menschlichen Zähnen bilden.

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