

# MORPHOLOGICAL CHANGES IN TOOTH TISSUES IN EXPERIMENTAL THYROTOXICOSIS

Yu. A. Belyakov and M. S. Golinskaya UDC 616.441-008.61-092.9-07:616.314-091-07

The effect of thyrotoxicosis on the tissues of the tooth were studied in experiments on 100 Wistar and noninbred albino rats weighing initially 60-65 g. Acute and chronic thyrotoxicosis was induced by feeding the animals with thyroid in tablet form. Chronic thyrotoxicosis interfered with the mineralization of the hard tissues of the teeth (enamel hypoplasia). Thyroxine reduced the incidence of dental caries. Lesions of the neck of the teeth observed in patients with toxic goiter are presumably noncarious in character.

The study of the dental tissues in endocrine diseases and, in particular, in that widespread pathological condition toxic goiter, is of great interest. In toxic goiter all types of metabolism are disturbed. Thyroid hormones influence the metabolism and content of the various proteins in the cell structures of different organs and also in the blood serum [1, 6, 10]. Experiments have shown that thyroxine reduces the incidence of dental caries [8, 9, 11, 13, 14]. In acute thyrotoxicosis Miller found no changes in the ameloblasts and odontoblasts in rats up to the age of 16 days.

Previous investigations by the writer showed that in patients with toxic goiter the hard tissues of the tooth are specifically involved and the character of the lesions depends directly on the duration of the disease; the experiments were particularly concerned with the prolonged effects of thyroxine on dental tissues [2, 3]. The experimental investigation described below was accordingly undertaken to examine the character of the changes observed.

## EXPERIMENTAL METHOD

Wistar (30) and noninbred (70) rats weighing initially 60-65 g were used in the two series of experiments.

Acute thyrotoxicosis was induced by feeding the animals with thyroid tablets in progressively increasing doses for 30 days. A state of chronic thyrotoxicosis was obtained by feeding the rats with an average of half a tablet daily (one tablet of 0.1 g contained 0.17-0.23 mg iodine) for 100 days. In each series of the experiment a control group of rats received the ordinary animal house diet with added multivitamins, like the experimental rats. The food with additives and drinking water were given once a day, in the morning. The main criterion of the severity of the toxicosis was the clinical state of the animals (changes in body weight, activity, appetite, presence or absence of diarrhea, etc.). At the end of the periods of observation the experimental and control rats were killed by decapitation. At autopsy the jaw-bones and teeth were removed and fixed in 10% neutral formalin.

## EXPERIMENTAL RESULTS

In the experiments of series I for the first 10-15 days the rats showed an increased appetite, restless movements, and aggressiveness. Later, the appetite remained increased although the animals were lethargic and disinclined to move. The experimental animals gained in weight considerably less (by 30-40%;

---

Department of Pediatric Stomatology and Department of Pathological Physiology, Moscow Medical Stomatological Institute. (Presented by Academician of the Academy of Medical Sciences of the USSR N. A. Fedorov.) Translated from *Byulleten' Éksperimental'noi Biologii i Meditsiny*, Vol. 75, No. 1, pp. 86-88, January, 1973. Original article submitted February 16, 1972.

© 1973 Consultants Bureau, a division of Plenum Publishing Corporation, 227 West 17th Street, New York, N. Y. 10011. All rights reserved. This article cannot be reproduced for any purpose whatsoever without permission of the publisher. A copy of this article is available from the publisher for \$15.00.



Fig. 1



Fig. 2

Fig. 1. Lower incisors of a rat from the control group: hard tissues unchanged and clearly defined (thin section, 20 $\times$ ).

Fig. 2. Lower incisor of an experimental rat; dental enamel thinner than normal and its surfaces uneven (thin section; 20 $\times$ ).

$P \leq 0.02$ ) than the controls, and the Wistar rats tolerated acute thyrotoxicosis less well than the noninbred animals under the same conditions. On visual inspection of the teeth and jaws of the control and experimental animals no differences or changes of any sort were found, but brittleness and fragility of the jaws and cranial bones were noted in the experimental rats. On the investigation of thin sections of the incisors of the control and experimental animals no significant differences were found. The diet used, as recommended by the Research Institute of Endocrinology, induced dental caries in the Wistar rats, but not in the noninbred control animals. Thyroid also reduced the intensity of caries of the molars in the experimental Wistar rats ( $8.00 \pm 0.55$ ). The intensity of caries in the Wistar rats which did not receive thyroid was  $11.3 \pm 0.30$ . Bilateral sections through the molar revealed principally defects of the enamel and dentine in the fissures, corresponding to the stages of initial caries and caries of the enamel.

The results of this investigation thus agreed with data in the literature [8, 9, 13, 14] to the effect that thyroxine reduces the incidence of dental caries. Investigation of sections through the teeth demonstrated marked hyperemia of the pulp vessels, especially capillaries and precapillaries. The layer of odontoblasts showed little change throughout, but in some places vacuolation of the cells could be seen.

In the experiments of series II increased appetite and restlessness of the animals were observed at nearly all periods of observation, but between 9 and 100 days the animals became lethargic and their mean weight was only 55-62% ( $P \leq 0.001$ ) of that of the control rats. In the region of the head and back, the hair of nearly all the animals fell out. The skin was pink in color, with scaling and a reduction in its thickness; in some cases dermatitis was present, with features of necrobiosis and necrosis. These phenomena were evidently connected with pathological changes in the peripheral nervous system and skin of the animals of the neurodystrophy type. Experimental and pathological investigations by workers [5, 7] who have described degenerative changes in the nerve cells and fibers of the Gasserian ganglia and in the mucous membrane of the mouth in thyrotoxicosis point to changes in the central and peripheral parts of the nervous system.

Investigation of the teeth of the experimental animals showed that the incisors in every case were curved and considerably smaller than in the control animals, the enamel covering was thin, and the enamel itself was dull and whitish. At the neck of the teeth on the labial surface there was a hollow. There was obliteration of the normal pattern on the biting surface of the molars of the experimental animals compared with the controls. The jaws and cranial bones in the animals in the chronic experiments were more brittle. Investigation of blocks of the jaws and teeth of the control of noninbred animals and of thin and ordinary sections revealed no pathological changes in the tissues of the teeth.

An examination of thin sections through the incisors of the experimental animals showed absence of Nasmyth's membrane and thinning and loss of structure of the enamel, with a cloudy appearance, covering the surface of the tooth unevenly. The mantle dentine was poorly calcified, the large interglobular spaces and the dentinal tubules were dilated, and the circumpulpal dentine was poorly calcified (Figs. 1 and 2).

Initial caries and caries of the enamel in the fissures and on the contact surface of the teeth were observed in the molars (thin sections). Histological sections of the teeth revealed vacuolation and reticular atrophy of the odontoblasts, dilatation of the blood vessels in the subodontoblastic layer, and so on.

Chronic thyrotoxicosis thus leads to disturbance of mineralization of the hard tissues of the teeth (enamel hypoplasia). Thyroxine reduces the incidence of dental caries. The lesions of the neck of the teeth observed in patients with toxic goiter are presumably noncarious in character.

#### LITERATURE CITED

1. T. A. Babaev, Changes in the Glycoprotein Content in the Tissues and Blood Serum of Animals with Experiment Hypo- and Hyperthyroidism and in Patients with Lesions of the Thyroid Gland. Author's abstract of candidate dissertation, Moscow (1963).
2. Yu. A. Belyakov, *Stomatologiya*, No. 6, 26 (1965).
3. Yu. A. Belyakov, The State of the Hard Tissues of the Tooth in Patients with Toxic Goiter during Pregnancy and the Puerperium. Author's abstract of candidate's dissertation, Moscow (1968).
4. M. A. Efremov, Clinical and Morphological Data on the State of the Marginal Periodontium in Thyrotoxicosis. Author's abstract of candidate's dissertation, Kalinin (1968).
5. M. A. Malygina, in: *Collective Scientific Transactions of Yaroslavl' Medical Institute* [in Russian], Yaroslavl' (1957), p. 77.
6. K. Pirot, Some Problems in Thyroid Surgery from the Standpoint of its Effect on the Parathyroid Glands. Author's abstract of candidate's dissertation, Moscow (1970).
7. M. A. Skutskii, in: *Problems in Stomatology and Maxillofacial Surgery* [in Russian], Lugansk, (1955), p. 24.
8. J. Haldi, W. Wynn, and M. L. Law, *J. Dent. Res.*, 40, 658 (1961).
9. J. Haldi, W. Wynn, and M. L. Law, *J. Dent. Res.*, 41, 398 (1962).
10. F. J. A.-H. Jurascheck, *L'exploration Dynamique du Metabolisme Phosphocalcique en Pratique Clinique*, Strasbourg (1963).
11. F. T. Y. Liu, *J. Dent. Res.*, 46, 471 (1967).
12. B. G. Miller, *J. Dent. Res.*, 4, 648 (1961).
13. J. C. Muhler and W. G. Shafer, *Proc. Soc. Exp. Biol. (New York)*, 88, 191 (1955).
14. J. C. Muhler, D. Bixler, and W. G. Shafer, *Proc. Soc. Exp. Biol. (New York)*, 93, 328 (1956).