TCDD Affects Severely the Development of Incisor Teeth in Han/Wistar Rats

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TCDD is known to have a wide variety of target tissues in the body, most of which are epithelial[1]. No studies to date have reported alterations in the structure of teeth after TCDD exposure. This may be due to general lack of any in-depth examination of the subject. However, rat incisorial teeth could conceivably provide further insight into the target specificity of TCDD since they contain both epithelial (ameloblasts, forming enamel) and ectomesenchymal (odontoblasts, producing dentin) cell types. Moreover, rat incisors erupt continuously thus enabling experiments to be carried out with adult animals. The present study set out to elucidate this so far neglected issue.

Adult male Han/Wistar (Kuopio) rats were employed (initial weight 323.7 ± 24.7 g; mean ± SD). This substrain is highly resistant to the acute lethality of TCDD, but exhibits most of its biochemical and morphological effects at the same doses as other, more susceptible strains[2-4]. A total of 12 Han/Wistar rats were given a single dose of 1000 μg/kg TCDD (dissolved in corn oil; 5 ml/kg) ip, a further 12 rats served as controls and were injected with the vehicle. The rats were maintained on R3 rat feed (Ewos, Södertälje, Sweden); both powdered and pelleted varieties were provided in the course of the experiment, but only one at a time. The rats had also free access to tap water at all times. The ambient conditions in the animal room were: temperature, 21±1°C; humidity, 55±10%; and lighting, 12h/12h. The rats were killed 110 days after the exposure.

Eleven experimental and 11 control rat heads were skinned and placed in an autoclave (120°C) for 15 min, in order to enable the removal of soft tissues and the teeth to be measured and examined. From six of these skulls (3 TCDD-exposed and 3 control rats) the mandibular right incisor teeth were extracted and after formalin fixation embedded in methylmetachrylate and serially cut into transversal sections, about 100 μm thick. One experimental and one control rat head were skinned, fixed with formalin and demineralized. The mandibular left incisors, together with the surrounding soft tissues and mandibular bone were dissected and embedded in paraffin. A series of sections (6 μm thick) were cut and stained with hematoxylin and eosin.

One of the rats dosed with TCDD died 76 days after exposure. TCDD affected body weight gain considerably (relative change from initial weight: controls 42.8±10.2%, TCDD-exposed rats −11.8±11.8%). The incisors of TCDD-treated rats were mesio-distally (mandibular incisors: experimental rats, 1.3±0.10 mm [mean±SD]; controls, 1.5±0.08 mm; $p<0.001$) and bucco-lingually (2.3±0.13 mm *vs.* 2.5±0.10 mm; $p<0.001$) significantly thinner than those of the controls. The pulps of all the mandibular incisors and of some maxillary incisors were exposed to the oral cavity at their incisal ends in TCDD-treated rats (Fig. 1). Whereas the labial surfaces of the incisors were brown in control rats, they appeared greyish and mottled in animals injected with TCDD (Fig. 2).

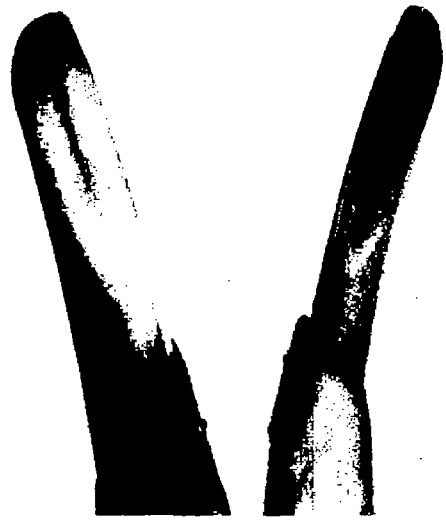
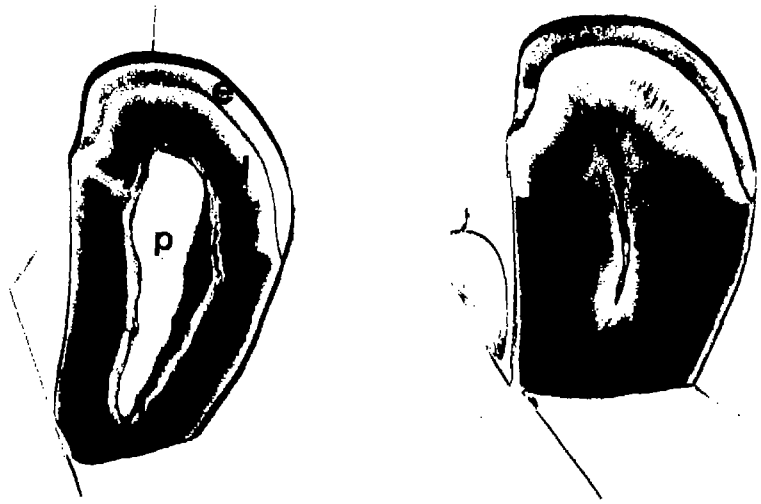


Fig. 1. *The pulp chamber of the mandibular right incisor tooth of a TCDD-treated Han/Wistar rat (right) is lingually exposed, whereas no pulp exposure is seen in the control rat incisor (left).*

Fig. 2. *The labial surface of the TCDD-treated rat incisor tooth (right) fails to display the brown pigmentation evident in the control rat tooth (left). The experimental rat incisor also appears mottled and dark, and is bucco-lingually narrower than the control rat tooth.*

Histological examination revealed that dentin of the incisal half of the affected teeth was thinner than normal with reciprocal increases in the pulp cavities (Figs. 3a & 3b). Towards the incisal ends, odontoblasts lost their polarity and dentin next to the pulp was irregular. The superficial pigmented zone of the enamel appeared thinner in the teeth of TCDD-treated rats as compared with the same structure in control animals.



Figs. 3a & 3b. *Transversal ground sections cut at a comparable level of the right mandibular incisor tooth of a control (left figure) and a TCDD-treated rat (right figure). Symbols: p, pulp chamber; d, dentin; e, enamel. At the level where lingual attrition (bottom) is detectable, a layer of irregular dentin (id), which is thickest on the lateral and lingual aspects, surrounds the fairly large pulp chamber of the TCDD-treated rat tooth. The interface between the pulp chamber and the irregular dentin is uneven, and a demarcation line is discernible between it and the regular dentin. In the control rat tooth, regular secondary dentin (sd) almost obliterates the pulp chamber.*

The present findings are the first to show that TCDD severely impairs incisor tooth formation in rats. It is of great interest that odontoblasts, which are cells of ectomesenchymal origin, appeared to be more gravely damaged than the epithelial ameloblasts. Further studies are needed to resolve the detailed pathogenesis of the alterations detected, but possible mechanisms include, apart from frank cytotoxicity, deranged vitamin A metabolism and interference with growth factors or their receptors by TCDD.

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