F41 Observations on Dental Structures and Restorative Materials Subjected to High Temperatures in an Animal Model: Experimental Preliminary Studies

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The aim of this presentation is to describe the behaviour and the changes that endodontically treated and restored teeth surrounded by soft tissues undergo when exposed to high temperatures. This to compare the results of previous in vitro observations with the results of the same experiments done in a particular animal model.

This presentation will impact the forensic community and/or humanity by describing the use of the suggested animal model which seems to be a reliable experimental method suitable to produce a reference database helpful to forensic odontology identification research.

Teeth represent an ideal identification tool in situations of advanced decomposition, destruction of soft tissues by fire, traumatic mutilation from a collision or massive trauma. Regardless the conditions of the body usually the dentition is preserved and. Not only teeth are able to withstand extremes from fire, but various restorative materials used for fillings, prosthetic devices and a large number of possible combinations of dental related characteristics are also able to adequately withstand the thermal assault. Following the results of our previous in vitro studies on dental prosthetic devices, restored and non restored extracted teeth exposed to a range of high temperatures, we decided to study in such an experimental situation the relevance of the protection given by the soft and hard tissues surrounding the teeth by the means of an animal model.

Six heads from pigs (10-12 months old) freshly slaughtered and preserved in a refrigerator have been utilised. The mandibular and maxillary teeth, all caries free, in situ, have been either considered as sound controls (group 1) or specifically restored for the research (group 2): i.e., first endodontically treated and sealed by means of an endodontic cement and gutta-percha (condensation technique), then restored with amalgam or composite fillings. Before the high temperatures testing, periapical radiographs of all the samples were recorded. The tests of exposure to heat were carried out in a oven: each mandible and the respective maxilla surrounded by the belonging soft tissues were subjected to one of the prestablished temperatures (200, 400, 600, 800, 1000 and 1100°C) reached at a rate of increase of 30°C/minute. At the target temperature, the samples were removed from the oven and allowed to cool to room temperature. Finally the specimens were examined macroscopically, observed by stereomicroscopy and periapical radiographs of all the samples were taken. The results table was edited reporting the macroscopic, microscopic and x-rays findings for each specimen related to the different temperature levels of exposure and the results discussed and compared with the observations drawn from the experiments previously carried on human extracted teeth.

Our experiments showed that at 200°C the surface portion of the soft tissues was partially burnt, the dental tissues and the dental restorations did not show signs of alteration. At 400°C, the outer soft tissues were partially carbonised and the inner soft tissues were preserved; the crowns were intact showing only a slight colour change of the enamel surface and the fillings were intact. At 600°C, the outer soft tissues were completely carbonised and the inner soft tissues were preserved showing a vitreous-like coating substance; the crowns showed a non uniform change of colour tending to light brown; the fillings were in place showing a marginal fissure. At 800°C, some portions of the outer soft tissues were completely carbonised and the exposed portions of the hard tissues were calcinated; the inner soft tissues were partially carbonised; the crowns showed a change of colour from grey to black and the enamel showed some fractures; the fillings were in place showing a large marginal fissure and both the amalgam and the composite fillings were dark grey. At 1000°C, the soft tissues were completely destroyed and the hard tissues were calcinated; the crowns showed an enamel portion yellowgreyish and it was visible a white part of the roots; the crowns showed deep fractures and the cracks spread over the roots; some fillings were in place remarkably altered in the shape showing a state changing. At 1100°C, the hard tissues were partially destroyed; some crowns were partially disintegrated showing a chalky white colour with pinkish spots and some fillings resulted still in place even if remarkably altered in the shape and showing signs of a state changing.

The results of these preliminary studies show that it is possible to compare the effects of the same heat exposure in the animal model with the results of the our previous studies on extracted human teeth since (1) the dental tissues, endodontic treatments and restorative materials undergo a range of changes which correlate well with the various temperatures of exposure. These changes are a consequence of the nature of the materials and their physiochemical characteristics, individual components can remain recognisable and identifiable even at very high temperatures. For example, after exposure at 1100 °C it is possible to recover and identify residues of amalgam restorations. At the same temperature the teeth are well recognisable and not completely destroyed thanks to their mineralised structure. (2) It is possible to observe the endodontic sealing material

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surface by microscopic analysis and all the endodontic sealing residues in the root by the radiographs.

On the other hand, differences are detectable as stronger damages of the dental structures and of the restorative materials when extracted human teeth are used. For this, the animal model seems to best simulate the real life conditions. In our experiments all the samples were exposed to a single, brief, thermal insult. In real life various factors can further modify recovered remains: the duration of the exposure to fire, the way in which the fire develops, the rate of increase of temperature, and substances used to extinguish the fire.

From our experiments we conclude that the use of the suggested animal model seems to be a reliable experimental method suitable to produce a reference database helpful to forensic odontology identification researches.

Forensic Odontology, Identification, Animal Model

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