

# Study of mass loss of root canal materials under the influence of thermal radiations: forensic interest in the modeling of a fire disaster

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## ABSTRACT

In oral cavity, dental roots are protected by the alveolar bone. The endodontic material is the most preserved dental material when bodies are severely burned such as during a fire disaster or aircraft crash when important thermal radiations are involved. This study followed a previous study based on dental tissues. This work was carried out in association with the Section of Engineering Fire in the Central Laboratory of Police of Paris (LCPP) using specific tools such as the Calorimetric Cone (CC) and the ThermoGravimetric Analyzer (TGA).

The main objective of this study was to analyse the degradation of the gutta-percha in combination or not to cement zinc-eugenol oxide when teeth are submitted to different thermal radiations both macroscopic (using CC) and microscopic (using TGA) in order to define the mass loss changes and thermogram of these root canal materials. This work intended also to provide further organic tools to help investigators in the modelisation of fire scenarios.

**Material and Methods :** 27 teeth were divided into 3 groups of 9 teeth and placed into 3 plates in order to reproduce the physiological dental environment of human teeth surrounded by alveolar bone. For each plate, on the 9 teeth, 3 of them were filled only with Gutta Percha, 3 others with Gutta Percha in combination to cement zinc-eugenol oxide, the last 3 teeth were filled only with cement zinc-eugenol oxide.

Two preliminary studies using TGA were carried out on root canal material in order to determine the repeatability and reproducibility of the settings : from 25 to 800°C and a heating rate of 10°C/min. Then, the 3 plates of 9 teeth were placed under the Calorimetric Cone with 3 different thermal radiations : 20, 35 et 50 kW/m<sup>2</sup> and another TGA analysis was carried out on these burned samples.

**Results :** The results of this study bring to the reports that, when the gutta percha burns, it leaves an important quantity of residues compared with other polymers. Moreover, the gutta percha and the cement zinc-eugenol oxide revealed a reaction of mass loss between [540-765°C] which is the average temperature in a fire in Paris.

Following the previous study made on human teeth, the results found in this study are still promising in the fire investigation field and further investigations could also be made on the

alveolar bone. After a fire disaster, in the same way that the LCPP use inorganic burned materials found into a fire scene to modelise the fire scenario, such as plastic from a switch, img of dental tissues and root canal material could also be used and considered as comparison points for the LCPP in case victim(s) would be present in the fire scene. Moreover, an estimation of the distance between the source of the fire and the position of the victim would also be possible to investigate using the modelisation system in the LCPP.