F50 Observations on Endodontically Treated and Restored Teeth Subjected to High Temperatures: Experimental Studies to Aid Identification Processes

Caterina Savio, DDS, and Giuseppe Merlati, DDS, Dental Materials Unit, P. Danesino, and G. Fassina, Department of Legal and Forensic Medicine, and P. Menghini, Dental Materials Unit, Department of Odontostomatology, Pavia University, P.Zzale Golgi 2, Pavia, Italy

The goal of this presentation is to improve the human identification process possibilities by the aid of forensic odontology. Particularly the authors considered carrying out an experimental study to learn more about the changes that endodontically treated and restored teeth undergo when exposed to very high temperatures, defining their behavior, morphology and X-Ray properties with the aim to edit a reference table.

In large scale disasters associated with fire the damage caused by heat can make medico-legal identification of human remains difficult and as a result teeth and their dental therapies, even undergone at very high temperature, can be helpful. Following the results of these first studies on incinerated teeth and the need of X-Rays experimental researches reported by the literature, the authors carried out a study concerning the behavior, the morphology and the X-Ray properties of endodontically treated and restored teeth exposed to a range of high temperatures with the aim to edit a reference table.

Healthy human teeth extracted at the dental clinic were dived in two groups: (1) caries free and unrestored teeth, as a control group (2**)** teeth specifically restored for the research, which were 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: two complete sets of samples (groups 1 and 2) were each subjected to one of the pre-established temperatures (200, 400, 600, 800, 1000 and 1100°C) at a rate of increase of 30°C/minute. As soon as each target heat had been reached 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.

Experiments showed that 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 physicochemical characteristics; individual components can remain recognizable and identifiable even at very high temperatures. For example, at 1100°C it was possible to recover and identify residues of amalgam restorations. At the same temperature the teeth were well recognizable and not completely destroyed thanks to their mineralized structure. Moreover it was possible to observe the endodontic sealing material at the apical surface by the microscopic analysis and all the endodontic sealing residues in the root by the radiographs. The experiments did not take into account possible factors present in real-life circumstances, i.e., the protection afforded by soft and hard tissues surrounding the dental components and/or devices, nor any other externally worn items. For example, the root of a tooth should be even more resistant to thermal insults since it is sheltered within the bone. These *in vivo* circumstances prevent direct exposure to fire. It was observed that it is important to carry out stereomicroscopic and radiographic analyses in order to identify the real presence of restorative materials and endodontic treatments, particularly when only fragments of the teeth remain available for analysis. Only at a temperature of 200°C the teeth did not show signs of fractures, whereas as the temperature raised cracks, fissures and fragmentation of crowns and roots occurred. In addition, in two cases the teeth exposed at 600°C fractured when handled. This highlights two important points: first, calcined teeth, being completely dehydrated, are very delicate, and secondly, teeth's fractures may not always came from trauma often associated to disasters but sometimes have to be related to the high temperatures caused by major fires. In the experiments all the materials 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 these experiments the authors conclude that: (1) the endodontic treatment is recognizable from 200°C till 1100°C with both the microscopic and radiographic analysis, (2) the "antemortem" and "postmortem" radiographic comparison (following the ABFO guidelines) permits constantly a positive identification, (3) the radiographic analysis could represent an important aspect in the identification process because it seems to be able to detect unchangeable and stable elements of the dental remains not recognizable by the macro-/micro-scopic study,
(4) endodontic and restorative materials seem resistant to temperatures higher than those theoretically predicted, and (5) it seems possible to reach a reasonably reliable estimation of the temperature of exposure from an analysis of the teeth and restorative material's remains.

Forensic Odontology, X-Ray, Dental Materials

 ** Presenting Author*