F49 Observations on Endodontically Treated and Restored Teeth When Placed in Contact With Acids: Experimental Studies to Aid Identification Processes

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The goal of this presentation is to improve the human identification process possibilities by the aid of forensic odontology. Particularly the authors carried out an experimental study to learn more about the changes that endotontically treated, restored teeth and prosthetic devices (fixed prosthetic crown) undergo when exposed to acidic environment till the total destruction, defining their behavior and morphology with the aim to edit a reference table.

Following the authors' first study about a "mafia" crime case (where a cadaver was destroyed by the means of acids) and the need of further experimental researches pointed out by the unusual finding of an endodontic filling report, a study was carried out concerning the changes of endodontically treated teeth, restored teeth and prosthetic devices (fixed prosthetic crown) which undergone when exposed to acidic environment till the total destruction.

Various specimens were used for the study: (1) healthy, unrestored teeth, (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; and (3) teeth with a fixed prosthetic crown of metal alloy covered with aesthetic resinous material (acrylic based products or composite materials) or metal-feldspatic ceramic dental systems.

Group 2 specimens were carried out from healthy human teeth extracted because of periodontal diseases at the dental clinic. Group 3 specimens were undefined production samples resulting from extraction therapies at the dental clinic; in compliance with the rules concerning medical and dental devices in force in Italy and contained in the CE directive 93/42, the materials used have to be standardized. In effect, for these specimens it was not possible to define the exact composition, but it was possible to assign them to known groups of compounds or alloys. Before testing all the samples were stored in a sodium chloride 0,6% aqueous solution at environment temperature and full size oral radiographs were recorded. The following acids aqueous solutions have been used for the study: hydrochloric acid in a 37% solution, sulfuric acid 96%, nitric acid 65% and aqua regia (chloroazotic acid) i.e., hydrocloric/nitric acid 1:3. The samples were immersed in an amount of acid solution suitable to respect a correct volume ratio between the sample and the liquid phase (about 25 ml). The specimens were observed continually until they were completely destroyed; at differing intervals according to the changes observed, were taken from the container, washed in distilled water, dried and photographed and then placed in the acid again.

A results table was edited reporting the macroscopic findings for each specimen related to the changes observed. The unrestored teeth immersed in hydrochloric acid for 58 hours continually checked showed a progressive reduction in their volume until the complete dissolution; the restored teeth at the same time showed the dissolution of the dental tissues and the composite fillings, while the amalgam fillings, the endodontic products and the prosthetic devices were still present. The samples placed in sulfuric acid checked at intervals up to 190 hours showed a gradual breakdown in structure with the formation of a corpusculate deposit. At the same time, the amalgam, the endodontic residues and composite fillings were still present, while the prosthetic devices showed a dissolution of the resin based facing materials. In nitric acid at the 2nd hour the amalgam filling was destroyed, while the endodontic residues and the composite fillings were still present at 60 hours. In aqua regia the metallic component of the metal-ceramic systems was destroyed in 7 hours, while the ceramic component, the composite fillings and the endodontic residues were still present at 25 hours.

The experiments showed that the unrestored teeth were completely dissolved in all the acidic solutions. Comparing the statistical analysis between the four kinds of acids versus the data of the authors' first experiment it was relieved a significative ($p<0,001$) difference. It could be due to the different storage method of the samples before testing (dry environment in the first study Vs. the aqueous solution in this one).

The unexpected behavior of some restorative and prosthetic dental devices in acids is under discussion and has to be explained, while the authors would like to emphasize that it seems possible to recognize: (1) in the hydrocloric acid: the tooth colored prosthetic devices till the 25th hour, the composite fillings till the 40th hour, the amalgam fillings till the 30th hour; (2) in the sulfuric acid: the tooth colored prosthetic devices till the 110th hour, the composite fillings till the 150th hour, the amalgam fillings till the 70th hour; (3) in the nitric acid: the tooth colored prosthetic devices till the 11th hour, the amalgam fillings till the 12th hour, the composite fillings till the 8th hour; (4) in aqua regia: the composite filling till the 13th hour, the metal-ceramic prosthetic devices till the 4th hour, the amalgam fillings till the 8th hour. It has to be pointed out that the endodontic residues were still present in all the samples after the complete dissolution.

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This study may be of great help for the Forensic Odontology Science as an aid to personal identification process since it seems possible to reach a good approximation in the correlation between the time of exposure to the different acid solutions and the degradation rate of dental structures and also in the comparison of the residuals of dissolution with the antemortem known situation. The finding of the endodontic residues could represent an important aspect in the identification process because it showed to be in an acid environment an unchangeable and stable element that can assure a positive report. The experiments did not take into account possible factors present in real-life conditions: the protection provided by soft and hard tissues surrounding the dental components and/or devices, nor indeed any other externally worn items. These *in vivo* circumstances prevent direct exposure to acids. In fact, as an example, the root part of the tooth should be much more resistant to acid insults when is incorporated within the bone.

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