Significance of restorations in forensic identification

Forensic dentistry is a multidisciplinary team effort relying on positive identification methodologies to identify the individuals among the large number of victims in mass disasters, fire accidents, etc. Teeth survives most natural disasters and provide a positive identification of an unrecognized body. Thus, dental restorations are successfully used in identifying the individuals, particularly when the conventional methods like visual recognition or finger prints are of not much use, especially when the remains are disfigured, mutilated, or skeletonized.

Scanning electron microscopic analysis of incinerated teeth: An aid to forensic identification

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As teeth have high resistance to environmental effects like fire, desiccation, and decomposition, forensic odontology is a reliable method in human identification, particularly when destruction of burnt victims is extensive in fire accidents.

In this study, healthy, unrestored, and restored teeth were exposed to predetermined temperatures and the changes were observed with scanning electron microscopy to determine if any finding at that temperature is significant in forensic analysis. One hundred and thirty-five teeth were extracted, disinfected in 5% sodium hypochlorite solution, and were divided into four groups. The four groups consisted of: Teeth free from pathology in group 1, teeth with ceramic-fixed crown prosthesis in group 2, teeth with class I composite restoration in group 3, and teeth with class I glass ionomer cement restorations as group 4 respectively. Samples were stored in 0.9% sodium chloride solution at room temperature to simulate oral cavity conditions. Unrestored teeth were placed in investment and exposed to predetermined temperatures of 200^{O}C, 400^{O}C, 600^{O}C, 800^{O}C, 1000^{O}C and restored teeth were exposed to 1000^{O}C. Burnt teeth samples were coated with ultrathin electrically conductive material like gold and examined under scanning electron microscope.

At higher temperatures, except cementum, enamel, dentin, composite, glass ionomer cement, and ceramic crown were identified with changes in structure and color along with instrument marks in the teeth cavities. Thus, scanning electron microscopy of severely burnt teeth, which can go unnoticed in huge fire debris, provides an useful aid in identification and analysis.

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A study of composite restorations as a tool in forensic identification

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Radioopacity is one of the basic requirements of any restorative material for radiographic diagnosis. Thus, standardized radiographic images of radioopaque composite restorations are used as an aid in forensic odontology.

In this study, 30 plastic typodont mandibular first molar teeth were chosen. In all the teeth, class II (proximo-occlusal) cavities were prepared, and filled with light cure composites. Two sets of radiographs, one to simulate ante-mortem and the other to simulate post-mortem for 30 teeth, were taken. One set of 30 radiographs representing ante-mortem was labelled as SET 1 and 10 randomly chosen radiographs from the other set representing post-mortem with two other radiographs were labelled as SET 2. Thirty dentally trained professionals were requested to match the radiographic images of SET 1 and SET 2. It was found that 15 out of 30 professionals matched the images of SET1 and SET2 correctly. On analysis of the results, statistically significant value of 0.83 was obtained, thereby proving the validity of this method.

Thus, ante-mortem and post-mortem dental radiographs can be used for successful identification, if the shape of the composite restoration is unique. However, in real life, wear and fracture of restorations, change in dentition, and radiological errors necessitiates the importance of further research in this study.

Forensic or archaeological issue: Is chemical analysis of dental restorations helpful in assessing time since death and identification of skeletonized human remains?

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The victims included in the study were individuals who were shot in a battle during Great War and World War II and whose skeletonized remains were analyzed for identification. Morphology of teeth, carious lesions, dental fillings, and orthopantomography of the present jaw were included in the dental status of the victims. Six teeth with dental fillings were further analyzed chemically and their elemental composition was determined.

The first filling had copper amalgam which gives inference that it was used till the beginning of 20th century and the presence of zinc phosphate base reveals that it was the oldest Haravard dental cement, that is still in use. The second teeth with bony destruction above the root suggest that no root canal was done to prevent odontogenic infection and it confirms poor dental work. The other two fillings were identified as conventional amalgam with low copper which were in use till 1960's. The final two fillings were of silicate groups which were in practice till the invention of composites in 1962.

Thus with the chemical analysis and based on the historic fact that dental materials of various compositions were introduced in dental practice and abandoned at certain times, it is evident that the individuals lived after 1910 and before 1960 and in a country with well-developed dental service. Therefore, it is pivotal that dental restorations help in the identification process and estimation of time since death and also the probable region where the individual lived.

Three-dimensional visualization of composite fillings for dental identification using CT images

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Post-mortem radiophotography, which gives two dimensional information of restorations, provides incorrect dental charting resulting in misidentification. Therefore, post-mortem CT imaging provides a more accurate dental identification in forensic odontology.

The aim of the study is to identify composite resins in 15 extracted human teeth based on their Hounsfield (HU) unit values on CT scans. Class I, class III, and class V cavities were prepared in molars, incisors, and premolars, and filled with different composite materials. Then, the teeth were embedded in anhydrite and examined with 16 multidetector CT scanner. The location of resin fillings was displayed on 3D images in pixels at 4000 HU. Radiolucent composite was distinguished from enamel due to dissimilar Hounsfield units (HU) but no boundary was determined between radioopaque composite and enamel. So, the composite resins were represented on multiplanar reconstruction images for image visualization.

Due to the degraded quality of the images and the CT scale limit, this method is used as an adjunct for dental identification. However, in sudden and unexpected disasters, the reconstructed 3D CT images were compared with ante-mortem radiological data in large-scale personal identification efforts.

The discrimation potential of radioopaque composite restorations for identification: Part 3

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Though restored tooth surface is regarded as a smallest unit to be considered in the identification process, recovery of a single tooth or jaw fragment may be valuable to confirm a positive identification. Thus, it is valuable to correlate the ante-mortem and post-mortem radiographic images of dental restorations and, therefore, is considered unique in the identification process.

Typodont premolar teeth were selected; cavities were prepared and restored with silver amalgam and composite resins. Of these, 30 premolar teeth with mesio-occlusal-distal composite filling were collected. Two exact dental radiographs were taken. One group of 30 radiographs was labelled as SET1 and 10 randomly chosen duplicate radiographs with 2 unmatched radiographs were labelled as SET2. Twenty trained examiners were instructed to match the SET1 and SET2 radiographs. Eighteen out of 20 trainers matched 12 fillings exactly. Thus, if ante-mortem and post-mortem radiographs of a single composite filling are available, its morphology is unique and can be used for disaster mass identification.

Dental amalgam and mercury levels in autopsy tissues

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Dental amalgam fillings have been considered to be the restoration of choice in the history of dentistry. According

to the World Health Organization (WHO), dental amalgam fillings are the most important source of inorganic mercury exposure in the general population, in comparison to mercury from other sources such as food (fish, shellfish), water, and air.

In this method of study, cadavers were screened and selected according to the presence of dental amalgam restorations in the teeth. Subjects who were not exposed to occupational or accidental exposure to mercury prior to autopsy were included. Then, the number and extension of amalgam fillings were recorded on a chart. Tissues from frontal cortex, pituitary gland, thyroid gland, and kidney were obtained, frozen, and analyzed for mercury vapour content.

Mercury levels in all the anatomic sites increased with the number of dental amalgam fillings in the oral cavity and the level was more higher in the suicide cases than in normal individuals. Moreover, maternal-to-fetus transfer of mercury from amalgam was also reported. But due to lack of histopathological studies, small sample size, and inadequate record of fish consumption during pregnancy, the study has its own limitations and further research in mercury vapour becomes necessary.

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