

FORENSIC ODONTOLOGY AND ENDODONTICS

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ABSTRACT

Dental identification of a deceased individual is a core task in forensic odontology. The accurate recording of clinical dental procedures has become more important over time because of the increasing trend of lawsuits worldwide. Advances in endodontic imaging, root and root canal anatomy, and bio-materials have been consistently emerging in endodontic research and practice. There is an inter-relationship between endodontics and forensic personal identification. Endodontists should be aware of all available dental tools that aid in identification. The four fundamental tools for identification are dental radiographs, hard and soft dental structures, and dental materials. Dental radiographs provide a substantial non-destructive record for estimating age and sex. Moreover, maxillofacial hard and soft structures provide important tools for individual identification as they are considered the strongest structures in the human body and can withstand severe chemical and temperature changes. In addition, endodontic and restorative materials can be identified under different conditions and serve as excellent forensic identification measures. In most disasters, teeth are the only means of positive identification of an otherwise unrecognizable body, as there has been tremendous increase in the use of dental restorations that have different resistance to prolonged high temperature which is an important aid in identifying burned victims. Application of SEM/EDS in forensics was found useful in areas where there is a need for good imaging with high magnification combined with elemental analysis. The objective of this study was to analyze incineration effects on teeth and restorative materials using SEM/EDS. Materials and Method. 128 extracted teeth were collected, 96 were stored with silver amalgam, composite, and GIC of 32 each, and crown preparation was done in 32 teeth for which metalceramic crowns were prepared. These teeth were subjected to 4 different temperatures (500°C, 700°C, 900°C, and 1100°C) for 20 minutes, and they were analyzed macroscopically and by using SEM for the changes subsequent to their exposure to such high temperatures.

INTRODUCTION

Management and maintenance of dental records that comply with legal requirements. Identification of human remains by antemortem and postmortem dental information. Collection and analysis of patterned marks (bite marks) on inanimate material or injured tissue. Recognition of the signs and symptoms of human abuse. Assessment of the age of the person. Determination of sex of a person. Personal identification is very much necessary for unknown deceased person in homicide, suicide, accident, mass disasters, etc. Personal identification is also necessary for living individuals who are missing due to amnesia and culprits hiding their identity¹. Teeth are the most indestructible components of human body. These structures have the highest resistance to most environmental attacks². In mass disasters, it is not only extremely difficult to identify, but it requires skill and profound knowledge of the more apt samples to be collected that may help in identifying the victims from the available remains. Based on the dental remains, in 1897, Dr. Oscar Ameodo was able to identify the victims in a fire accident³. However, the margin of error is said to be high by simple visual (naked eye) method⁴. In some situations, offenders

may employ individual or common graves, obliterate finger prints, destroy teeth, and cremate the remains to avoid identification of a corpse or human remains. The most usual matching process is conducted based upon dental treatment such as prosthetic restorations and dental fillings. Hence, having a thorough knowledge about the possible changes in the dental materials. It also aids in identifying burnt victims². Many dental restorative materials like silver amalgam, glass ionomer cement (GIC), and composites are different chemically with distinct physical properties with varied abilities to withstand high temperatures. Due to such fundamental differences, these materials behave and respond differently when subjected to varying levels of heat. Such differences may be used as an aid in identification of exact type of restoration. Due to contrasting and variability in the results of the various studies in the past regarding the changes in the structure of teeth and restorative materials with respect to the variable temperatures, this study was undertaken to note changes along with elemental analysis⁵. Forensic applications of scanning electron microscope (SEM) are found mostly in areas where there is a need for good imaging at relatively high magnifications in combination with elemental analysis. Striking property of SEM is its ability to

combine imaging with elemental analysis together. SEM along with EDS (energy dispersive spectrometer) helps in detection of elements². Hence, in this study, SEM is used to identify the incinerated tooth with restorative materials through their chemical composition used to restore dental defects in such victims may serve as a hours 30 minutes, and for 1100°C, it was 3 hours. After reaching the set temperatures, they were incinerated for a constant period of 20 minutes. Subsequently, all the teeth were analyzed for changes macroscopically and by scanning electron microscopy. For SEM analysis, further processing was not done since the teeth were in a desiccated state. Hitachi T-300 SEM at an accelerating voltage of 20 kV was used. SEM for ultrastructural changes of teeth and EDS for chemical analysis of the restorative materials were done. The role of dental radiography in forensic identification and its relevance to root canal therapy. Forensic identification of endodontically treated teeth after heat induced alterations. The significance of dental records in medico-legal involving endodontics treatments.

THE ROLE OF DENTAL RADIOGRAPHY IN FORENSIC IDENTIFICATION AND ITS RELEVANCE TO ROOT CANAL THERAPY

Radiographs are a rich source of antemortem-information as they record the canal morphology and aberrations. They are not susceptible to subjective errors that can occur in written documents and can easily be replicated by other operators. This is a useful feature for post-mortem comparison⁶. Compared to a non-endodontically treated tooth, an endodontically treated tooth contains more individuating information. This statement is based on the fact that a root canal treated tooth can be obturated with gutta-percha or silver points along with any of the commercially available root canal sealers⁶.

Schuller in 1921, reported the first use of dental radiography for forensic identification⁷.

Weisman in 1996 established positive identity of a burned victim by comparing ante-mortem and post-mortem radiograph of the root canal treated lateral incisor. Berkata et al reported a case in 2019 where they were able to identify an individual even in the absence of any teeth because of the extruded endodontic material that remained near the left maxillary sinus. As the appearance of the extruded obturation

material in the post mortem radiograph matched with the ante-mortem radiograph, the identity was confirmed

FORENSIC IDENTIFICATION OF ENDODONTICALLY TREATED TEETH AFTER HEAT INDUCED ALTERATIONS

At 400°C: Root canal treated samples showed dark-brown to blackish discoloration

AGE ESTIMATION BASED ON PULP CHAMBER VOLUME OF FIRST MOLARS FROM CONE-BEAM COMPUTED TOMOGRAPHY IMAGES

Age estimation of living individuals is important in forensic sciences. Analysis on the stage of dentition helps in age determination in children and adolescents but is difficult in adults as the development of permanent dentition completes. However, these methods are time-consuming and require expensive laboratory equipment and tooth extraction. Tooth extraction is unethical and impossible in living individual⁸. Analysis on dental wear is another most commonly used method for age estimation. The Drawback of the method is that the attrition level of tooth is strongly influenced by diet and personal habits⁹.

The methods based on biochemical characteristics of teeth such as amino acid racemization and carbon-14 isotope was also introduced.

CHALLENGES IN FORENSIC ODONTOLOGY IN ENDODONTICS

CHALLENGES

Degradation of dental tissue over time, especially in decayed or severely damaged teeth.

Inconsistent dental records or lack of access to prior dental treatments.

SOLUTIONS

Standardization of forensic dental record-keeping.

New techniques in imaging and 3D modeling for more accurate identification.

FUTURE DIRECTIONS IN FORENSIC ODONTOLOGY AND ENDODONTICS ADVANCEMENTS IN TECHNOLOGY:

- Use of digital radiographs, 3D imaging, and DNA analysis for enhanced accuracy.
 - Collaborations between dentists and forensic experts
- Importance of continuous education and cooperation between endodontists and forensic specialists to improve

identification processes.

CONCLUSION

Forensic odontology provides critical insights in criminal justice, and endodontics plays a pivotal role in victim identification and evidence. SEM/EDS might be employed to identify an individual positively by analyzing the various elements present in the dental remains which have been incinerated to the point where their fillings are highly fragmented by the intense heat. Though SEM has been helpful in identifying individuals from teeth, in those teeth with restorations, SEM examination along with elemental analysis may further enhance the positive identification

IMPORTANCE OF CONTINUED RESEARCH

Encouraging integration of endodontic techniques in forensic science for better accuracy and justice.

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