ISSN: 2581-5989
PubMed - National Library of Medicine - ID: 101738774

International Journal of Dental Science and Innovative Research (IJDSIR)
IJDSIR : Dental Publication Service
Available Online at: www.ijdsir.com
Volume – 3, Issue – 1, February - 2020, Page No. : 26 - 30

Role of Endodontics in Forensic Odnotology - A Review

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Citation of this Article: Greeshma Lal Manjadiyil, Dr.Harish S Shetty, Dr Shakkira Moosakutty, Dr Jeslee Ann Jose, "Role of Endodontics in Forensic Odnotology - A Review", IJDSIR- February - 2020, Vol. – 3, Issue -1, P. No. 26 - 30.

Type of Publication: Review Article

Conflicts of Interest: Nil

Abstract

Application of endodontic data for identification of individuals in forensic odontology is on the rise. This trend can be mostly attributed to the routine radiographic recording of data and persistence of the materials employed in root canal obturation , many of which are capable of surviving an incineration attack. This article reviews the various endodontic aids that have been utilized as forensic identification evidences.

Keywords: Endodontics, Forensic Identification, Endodontic Materials.

Introduction

Endodontics is the branch of dentistry concerning dental pulp and tissues surrounding the roots of a tooth, and it is constantly guided by imaging examinations. From a forensic scope, endodontics plays a valuable role in providing solid antemortem (AM) radiographic evidence for comparison with postmortem findings in human identifications.[1]

Forensic odontology is a special branch of dentistry that works in parallel with the courts, providing evidence to elucidate civil and criminal circumstances.[2] Specifically, forensic dentists play an essential part in the identification of charred,

putrefied, decomposed bodies, as well as of skeletal remains, in which fingerprints are no longer available.[3]

The dental identification of humans is often performed through a comparative approach.[3] Basically, antemortem (AM) data obtained from records of dental treatments (e.g. radiographs, written records, dental casts, and photographs) are collected from private clinics and compared with postmortem (PM) data obtained during cadaveric examinations.[4] In this context, endodontics emerges as a potential source of AM data, once the steps of endodontic interventions are systematically recorded into the clinical files together with detailed registration of imaging examinations. [5] This specific source of AM data enables the detection of unique features, such as the radiographic morphology of the pulp chambers and root canals, the height of alveolar bone crests, the stage of root formation, and the presence of dilacerations and periapical lesions.[5,6]

This article describes the various modalities through which endodontic research and practices contribute towards forensic personal identification.

Understanding of the root canal anatomy and its variations

In the human dentition, a wide range of anatomical variations in each tooth type has been reported.[7] For instance, the occurrence of supernumerary roots in the primary and permanent human dentition is well documented and the prevalence can reach up to >30% in mandibular molars, and current reports continue to demonstrate high percentages of middle mesial canals in mandibular molars, more common occurrence of double and three canals in anterior teeth and maxillary premolars than previously reported, respectively. [8],[9],[10],[11],[12],[13] Therefore, a forensic odontologist should be aware of such anatomical variations and their radiographic landmarks, which may facilitate postmortem personal identification when compared to antemortem records.[14]

Endodontic Radiographs

Forrest and Wu,[4] 2010, have highlighted that radiographs are the most reliable source of AM data for human identifications, as they enable comparison with PM findings. In addition, tooth roots preserve morphological information for a longer time when compared with dental crowns,[4] which constantly undergo dental interventions. During endodontic treatment planning, this morphological information is radiographically recorded, and can be later used for forensic purposes.[1]

Periapical radiographs also are useful to identify root canal filling materials such as gutta-percha, silver points, root canal sealers in addition to metallic and fiber posts, and post endodontic coronal restorations. The complexity and variability in post design and placement, core material, and coronal restorations provide further individuating features to each such treated tooth.[4]

Limitations

Importantly, human identification using dental radiographs has limitations related to the type of body examined and the quality of the AM records used in the forensic odontology examination.

In the decomposed and skeletonized bodies, the teeth and dental materials present in the PM examination are more preserved and generally can be compared with the AM radiographs.[5] However, in cases of charred bodies, the teeth, and endodontic materials can be degraded, and a comparative morphological analysis would not be possible, although endodontic

materials can be tracked even when exposed to high temperatures. [15,16]

Another limitation for the success of dental identification using endodontic radiographs is the absence of these records or when they are present, they were produced in low quality, or with inadequate technique or the archiving was incorrect.[17] Therefore, the professional has an ethical and legal obligation to produce the dental radiographs (conventional or digital) and stores them properly, especially for use in forensic purposes.[18]

Three-dimensional imaging techniques utilized in endodontics

The use of CBCT and various other 3D imaging modalities is increasing. The pulp-dentinal complex shows physiological changes that mainly result in the reduction of the pulp chamber volume resulting from the continual deposition of secondary dentin. Forensic scientists have been using the decrease in size of the pulp chamber for a long time as an important marker for identifying the age of individuals.[19]

Existing projects utilize 3D diagnostic modalities to examine the relationship between age and age-related changes in pulp-tooth volume ratio with the use of micro-CT. [20],[21] Several studies have also confirmed that CBCT allows for the accurate calculation of tooth volumes, and the method is highly reproducible because of the good inter-examiner agreement. [19],[22],[23],[24]

Endodontic Materials

Teeth are components that often survive severe fires because of their particularly resistant composition, influenced by the protection provided by the soft tissues of the face. In fact, only fragments of teeth are often available, and obtaining their radiographs is therefore more important. A study examined the behavior of endodontically treated teeth under thermal stresses, and results showed that the obturation material can be recognizable till 1100°C; however, a "honeycomb" appearance (radiolucent areas within the endodontic treatments) was observed over 600°C as a result of the softening of the obturation material, which can even flow to fill the missing root canals. [25] Changes in the shape and dimension of the obturation material, especially if defective, can also be observed at lower temperatures. Broken files can also be observed at such elevated temperatures. Intracoronal restorations, such as amalgam and resin composite fillings, can also maintain their integrity at elevated temperatures. [25]

Other investigators have examined the physical changes in endodontically treated teeth in materials after their exposition to high temperatures of up to 1000°C. [26] Results showed that dental tissues and materials offer great resistance to high temperatures. However, at temperatures above 800°C, endodontic materials (gutta-percha/zinc oxide eugenol and gutta-percha/resin cement combinations) tend to change to chalk-like whitish hue, which is difficult to recognize from the incinerated dentin. [26]

Conclusion

The increase in the instances where endodontic data proves crucial in human identification suggests that the role of and endodontist might be extended beyond the lifetime of a patient. There might be situations wherein endodontic evidence might be the only source of identification due to high survival capability of dental hard tissues and endodontic materials. Hence endodontists should be keen on image protection and maintaining accurate records regarding the materials used for individual cases.

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