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Forensic odontology: human identification through dental evidence

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Abstract

Forensic dentistry is a branch of dentistry that assists the justice system in solving cases by identifying bodies, contributing significantly to criminal and civil investigations. It is especially used in situations where the body is already in an advanced state of decomposition, carbonization, or skeletonization, or when there is no known identity for the corpse. This specialty analyzes dental evidence, such as teeth and the DNA present in them, comparing ante-mortem and post-mortem records, analyzing the dental arch, bite marks, and dental prostheses, which are often customized and unique. Forensic dentistry can also assist in cases of violence, mass disasters, accidents, and in identifying missing persons. The use of well-filled dental records, X-rays, and other clinical records is essential in this process, allowing for accurate and reliable analysis. This article includes literature reviews and case reports in which forensic dentistry has proven to be extremely important for resolving each situation, using different methods of human identification. The role of the dental surgeon as an expert or technical assistant has proven to be indispensable for the elucidation of various cases, reinforcing the relevance of this area in the field of forensic medicine.

Keywords: Human Identification. Dental Evidence. Forensic Expertise.

Introduction

The identification of individuals in legal contexts represents a constant challenge for forensic sciences, especially when bodies are in conditions that make traditional recognition methods impossible. In this scenario, forensic dentistry emerges as an essential tool, using dental knowledge applied to legal medicine to collaborate with justice in the elucidation of cases [1,2].

This specialty is especially effective in situations where bodies are deteriorated by processes such as decomposition, carbonization, or skeletonization, preventing identification through facial or fingerprint features. The resistance of dental tissues, combined with the uniqueness of each individual's dental arch, allows professionals in the field to perform comparisons between antemortem and postmortem records with a high degree of accuracy [3,4].

Furthermore, forensic dentistry plays a fundamental role in investigations involving violence, mass disasters, accidents, and disappearances, in which the analysis of elements such as dental prostheses, bite marks, and DNA obtained from teeth can provide crucial evidence. The proper use of dental records, radiographs, and other clinical records is indispensable in this process [5,6].

It is also observed that artificial intelligence (AI) can make complex predictions and decisions due to its ability to mimic human intelligence. Its popularity has grown exponentially in the healthcare sector, including dentistry. It is useful in all dental disciplines, including endodontics, oral medicine and radiology, periodontics, prosthodontics, oral pathology, and forensic dentistry [7].

Therefore, this article aimed to present the main identification methods used in forensic dentistry, highlighting their applicability in different contexts, as well as the importance of the dentist's role in the forensic field. In addition, real cases were described in which the work of the forensic dentist was decisive in resolving investigations, demonstrating the practical relevance of this specialty.

Methods

This work was carried out using qualitative research, with a descriptive character and an exploratory approach. As a technical procedure, a literature review was used, associated with the analysis of case reports related to the role of forensic dentistry in human identification. The bibliographic review was carried out by searching databases such as Scielo, PubMed, Google Scholar, and BVS, using keywords such as "forensic dentistry", "human identification", and "forensic odontology". Articles published in the last 10 years, in Portuguese and English, were selected. In addition to the review, case reports published in scientific journals and available in specialized literature were analyzed, in which the role of the forensic dentist was essential for the resolution of the case.

As a method of analysis, qualitative data analysis was used, based on the comparison of the identification methods presented. As this is an exclusively bibliographic research, submission to the Research Ethics Committee was not necessary.

Results and Discussion

Based on the analysis of the selected articles, it was possible to observe the diversity of methods used by forensic dentistry in the identification of corpses at different stages of decomposition and in various contexts, such as accidents, disappearances, homicides, and carbonizations. Each analyzed article evidenced the applicability of a specific method, highlighting the effectiveness of comparing antemortem and postmortem records, such as endodontic and orthodontic radiographs, custom prostheses, and unique anatomical patterns of the dental arch. Identification was possible solely through the analysis of a metal crown associated with previous clinical records, demonstrating that the uniqueness of dental treatments can even surpass the precision of DNA analysis [1-7].

The use of DNA from dental pulp also proved effective, especially in contexts of carbonization or skeletonization, where other tissues were unusable. In the case analyzed, the preservation of deciduous teeth for more than 30 years allowed for the confirmation of identity through comparative genetic analysis. Another relevant example was identification by bite marks, as in the case of the criminal Ted Bundy, where the dental arches were compared with the marks left on the victim, resulting in an exact match. This type of analysis, although controversial in some countries, is still considered valid in certain legal systems [5].

The analysis of the complete dental arch, with the aid of panoramic images, molds, and orthodontic records, demonstrated a high degree of reliability, especially when multiple points of correspondence were identified. In one case, 20 coincident points were verified between the corpse and the antemortem records, allowing for identification without the need for DNA testing [5,8-10].

These results confirm that forensic dentistry, when combined with good archiving of dental records, can be decisive in human identification, even replacing more invasive or expensive methods. The variety of techniques analyzed reinforces the importance of the dentist in the forensic context and highlights the need to maintain organized, updated, and technically adequate dental records. Table 1 demonstrates the method, summary, and individual source of each case; the different dental methods showed high effectiveness in diverse contexts of human identification [11-13].

METHODS	DESCRIPTIONS
Prosthetic Analysis	Identification of a decomposing body by a metallic prosthetic crown. Comparison with antemortem records revealed greater accuracy than DNA.
Endodontic radiographs	An unidentified body after an accident was identified by endodontic radiographs. Root canals, missing teeth, and bone anatomy were compared.
Antemortem/Postmortem Comparison	Incinerated remains were identified by unique dental characteristics (braces, supernumerary teeth, molars, restorations).
Dental Arch Analysis	A carbonized body was identified by DNA from the pulp of deciduous teeth kept for 30 years by the mother of the missing victim.
Dental Pulp DNA Analysis	Ted Bundy was convicted based on a comparison between bite marks on a victim and dental impressions. Key evidence in the trial.
X-rays	A body from an accident was identified by endodontic radiographs compared with postmortem images, confirming identity with a high degree of certainty.

Table 1. Human identification through forensic odontology. Sources: [references: 1-7].

Finally, AI offers exceptional accuracy and efficiency. Studies show that AI-based automated systems perform excellently, often matching the accuracy of dental specialists, particularly in forensic odontology [14].

Conclusion

In conclusion, the analysis of the cases presented in this work concretely reinforces the importance of forensic dentistry as an essential tool for human identification. Each case demonstrated how dental elements and their records, often preserved even in

extreme conditions, can offer unique, secure, and highly reliable information. The case of prosthesis analysis shows how a simple metal crown was sufficient to positively identify a decomposing body with a higher degree of certainty than a DNA test. The use of endodontic radiographs allowed the identification of accident victims when fingerprints were unavailable, through the comparison of root canal treatments and unique anatomical patterns. The analysis of the dental arch, including characteristics such as orthodontic appliances and restorations, allowed the unequivocal identification of incinerated human remains, showing how routinely recorded clinical details can become crucial. The case of DNA extracted from dental pulp also demonstrates the strength of this field, allowing for identity confirmation from deciduous teeth stored for decades. The analysis of bite marks, as seen in the infamous Ted Bundy case, highlighted the role of forensic dentistry in the criminal context, offering compelling evidence for judicial convictions. All these examples demonstrate that the forensic dentist not only contributes technically to the legal process but also represents a vital link between science and human rights, providing answers and closure for families and authorities. Therefore, it is concluded that forensic dentistry is an indispensable field within medico-legal expertise, capable of performing excellently in complex and extreme scenarios, providing scientific support for the identification of victims and the elucidation of crimes. Investment in the training and appreciation of these professionals is essential to guarantee justice, truth, and dignity for the victims.

CRediT

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Conflict of Interest

The authors declare no conflict of interest.

Similarity Check

It was applied by Ithenticate@.

Application of Artificial Intelligence (AI)

Not applicable.

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It was performed.

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