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The Contribution of Dentist and Dental Medical Records to Forensic Science

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Abstract: *Forensic dentistry it is the application of the art and science of dentistry which assist legal authorities through the evaluation and presentation of dental evidences in different situations, accepted by the court and the general scientific committee to resolve legal issues separating truth from untruth, contributing therefore with a scientific and objective data in legal processes. By acting into the civil, criminal and research sectors forensic dentists are playing a major role in modern criminal investigations assisting legal authorities. Natural teeth are the most durable organ of the body, constituting source of various information which should be register by the dentist on the dental records. They present what is call as dental evidence being as fingerprints, key elements in the identification and resolution of civil and criminal proceedings. By keeping accurate dental records of every patient, dentists presents as an extremely importance in the forensic team and science.*

Keywords: *Dentist; Teeth; Forensic dentistry; Dental records; Law*

INTRODUCTION

Today, a variety of professionals, such as lawyers, policemen, pathologists, anthropologists, criminalists, psychiatrics, psychologists, dentists and other experts form what is known as a forensic team [1, 2, 3]. Defined by Keiser-Neilson in 1970, forensic dentistry is the "the branch of forensic medicine which in the interest of justice deals with the proper evaluation, examination, treatment and presentation of the results of dental evidence" [4, 5, 6]. In addition, forensic dentistry applies the art and science of dentistry to assist legal authorities through the evaluation and presentation of dental evidence, accepted by the court and the general scientific community, to resolve legal issues and contribute scientific and objective data to legal processes [7, 8, 9, 10, 11]. By acting in the civil, criminal, and research sectors, forensic dentists play a major role in modern criminal investigations [12, 13, 14]. The civil dental forensic field includes malpractice and neglect; the criminal field includes identification of specimens; and research encompasses both academic courses for different specialists with undergraduate and postgraduate training, and new research endeavors [3, 7, 8, 15, 16, 17, 18]. Natural teeth in all vertebrates, including humans, are the most durable organ of the body, persisting long after other skeletal structures have decomposed and are the most often preserved structures after death [19, 20]. Therefore, teeth constitute a source of significant information, which should be registered by the dentist within a person's dental records [1, 3, 7, 21]. Because teeth are hard, stable structures with unique sizes, shapes, colors, and positions in the dental arch, they present what is called dental evidence, as unique as fingerprints [1, 3].

DENTAL EVIDENCE

Dental evidence plays the role of witness, through the dental records of an individual preserved by the dentist. The responsibility of the dentist, in collecting information for the dental record or analysis of dental evidence, consists of the following: management and maintenance of dental records; comparison of ante and postmortem dental information for identification of an individual; evaluation and analysis of patterned marks, such as bite marks on biological tissues and other material; assessment of the age and gender of an individual; and identification of violence, elder and child abuse signs and symptoms [8, 22].

Dental records form a set of data about a patient collected by the dentist. This information relates to the patient's past and current clinical history and contains a clinical physical examination report of the mouth and teeth, lifestyle habits, presence of any condition with a genetic component, any diagnostic methods required, any recommended therapeutic protocols, and a prognosis—all compiled in the form of a comprehensive document [23, 24, 25, 26, 27]. Thus, an accurate dental record is a significant legal document, which often plays a key role in forensic dentistry; and as it is in the possession of the dentist, the dentist assumes an express social and legal responsibility regarding patient records [28, 29, 30, 31, 32].

Confidentiality is one of the main principles of professional ethics. Considering this, dental records should be accessible only to the dentist and certain members of the dental team. Law professionals may only have access to dental records with a court order or patients' consent [33]. Dental records should never contain references to the patient's financial status, or to the dentist's personal opinions. In addition, the records must be maintained for 7–10 years, with secure, controlled-access storage to ensure patient privacy [4, 8, 28, 32, 34, 35]. Because dentists develop and maintain solid dental records, they become valuable members of the legal team when an individual must be identified [36, 37, 38, 39].

The identification of an individual, legally establishing a person's identity, may be formally made by the forensic dentist and may be required by legal professionals when visual recognition is not possible, particularly in cases of homicide, fire, natural mass disaster, or war [8]. According to Interpol (2009), fingerprint, comparative dental, and DNA analysis comprise the primary methods of identification [17]. Since teeth do not easily decompose after death, they are a trusted, stand-alone identifier, as described in the Interpol guidelines [2, 17, 18, 28]. Three types of dental identification procedures are considered the gold standard: comparative ante-mortem with post-mortem records of an individual; reconstructive post-mortem dental identification to assess the deceased person's ethnicity, age and gender; and the DNA profiling of oral cavity tissues when no dental records are available for comparison [10, 22, 28, 40, 41, 42, 43, 44]. Beyond the shape of teeth including the roots and their color, dentists examine dental work, such as composite and metallic fillings, fractures, prosthetics such as bridges, the mandible and maxilla configuration, and other orofacial characteristics, such as the orbits or the maxillary sinuses [43].

Additionally, assessment and analysis of various marks, such as bite marks and lip prints, may also allow the identification of a particular individual's pattern. The American Board of Forensic Odontologists (ABFO) created bite mark guidelines for the collection and preservation of the marks created by both victims and suspects [35]. Accurate collection and handling of material is fundamental, to secure the chain of evidence to fulfill legal requirements and provide acceptable evidence in court [45, 46]. For accurate evidence collection and evaluation purposes, the employment of sophisticated and specialized photography techniques, impression taking, electric microscopy, or even stains of saliva or human cells for a DNA analysis may be required [47, 48]. For instance, bite marks, whether produced by a human or an animal, appear as skin lesions such as abrasions, bruises, hemorrhages, cuts or lacerations, and may vary in pattern (single or multiple) and severity (according to the perforation depth of the skin). Bite marks are the result of the specific characteristics when teeth contact either biological or non-biological tissues [48, 49, 50, 51, 52, 53, 54, 55]. Human bites are different, due to the specific teeth anatomy and their different alignments within the dental arches [11, 34, 56]. According to class characteristics, the marks of incisors are rectangular; canines are triangular or rectangular; premolars and molars are spherical or point-shaped, and their individual features such as dental rotations, spacing or even the presence and type of fractures, make every bite mark unique [4, 11, 56]. In female victims, bites are frequently found on breasts and legs, secondary to sexual aggression; in male victims, bites are mainly found on shoulders and arms [28, 49]. Violence, non-accidental trauma, or sexual and physical abuse in children, adults and the elderly can be detected by the presence of orofacial marks such as bites marks, which tend to assume different locations according to the victim's age [21, 35, 49, 56, 81, 82]. Bites from children frequently leave the mark of maxilla and mandible arches, while bites from adults frequently display only one of the arches more clearly. Bite mark evaluation demands a prompt response by the forensic dentist to preserve vital evidence, since bite marks fade rapidly—both in the living and in the dead—and change in appearance in just a few hours [41].

Additionally, rugoscopy and chelioscopy provide a database similar to a fingerprint database. For example, rugoscopy analyzes the palatal rugae, which are anatomical folds located on the anterior

region of the palate, as to their number, shape, length, and direction. These rugae are present throughout an individual's life; nevertheless, they undergo some changes, in their number or height, which might complicate the identification of an individual based only on rugae analysis [4, 57, 58, 59, 60, 61]. Cheiloscopy is the study of lip prints' elevations and depressions used to identify an individual. As with fingerprints, lip prints are constant and permanent, and they are unique to each individual. The only uniqueness exception applied to individuals who are monozygous, or identical, twins [62, 63]. Different patterns of lip grooves maybe registered and classified into five types: type I (vertical), type II (branched), type III (intersected), type IV (reticular), and type V (other). Types I and II are predominant in females, and types III and IV are more common in males [48, 55].

Ethnicity, age and gender are probably the three most important parameters to be assessed during a facial skeleton study [40, 41, 47, 64, 65]. Ethnicity determination can be achieved thorough the study of teeth. Various studies over a long period of time have been conducted on this topic [66, 67, 68, 69]. For example, there are certain features common to different populations: Europeans have a flat lingual surface on the incisor teeth, while Japanese people have ridges on the lingual surface on the incisor teeth, and both Asians and Americans have a shovel-shaped appearance on the incisors [28]. Age can be determined through the teeth's chronological development, which begins during the 4^{th} month of gestation and may extend through the early third decade of life, through such features as teeth roots' and crowns' structures, their presence or absence of teeth, tooth attrition, third molar development, and the coronal pulp cavity ratio or reduction in the volume of the pulpar cavity associated with the deposition of secondary dentine related to aging [34, 45, 70, 71, 72, 73, 74, 75]. The use of some newer techniques, such aspartic acid racemization and assessment of the translucent dentine, have proved to be highly accurate in adult age assessment [45, 71, 76, 77].

In addition, gender assessment can be made through analysis of teeth metric features, lip prints, and molecular biology techniques, which includes DNA typing through dentine and cementum extracted from the teeth [47, 64, 65]. Mediodistal and vestibulolingual tooth distances may also differentiate gender, particularly through examination of the canines, which consistently present more gender differences [78]. For example, Carabelli's tubercle tends to be larger in males, while the inter-canine distance is shorter in females than in males, and the lower canines are more narrow [79, 80]. Regarding DNA typing, the amelogenin (AMEL) gene is a sex-linked gene located on both the X and the Y-chromosomes, with similar exons' sequences and different introns' sequences. Therefore, females have two alleles showing identical AMEL genes, but males have two different genes [62, 69].

CONCLUSION

By contributing to the proper administration of law and justice, forensic dentistry plays a significant role in society. Through having a broad knowledge of dental specialties, forensic dentists are skilled in handling, evaluating, and presenting dental evidence, which are key elements in the proof of identity and the resolution of civil and criminal proceedings. Teeth are the body's hardest tissues, and variations in their features such as size, shape, and color, pathology including fractures, position in the superior and inferior arches, and restorations, make them unique witnesses, allowing the identification of individuals in ante- and post-mortem scenarios, when individuals cannot be identified by other means. Dental records form an essential service in the identification of individuals, and by keeping accurate dental records of every patient, dentists perform as a key member of the forensic, scientific team.

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