

Forensic Odontology



Dr. Suhail Hani Al-Amad

BDS, DCD, GradDip ForOdont,
MRACDS (Oral Med), JMC
cert. (Oral Med)

Assistant Professor of Oral
Medicine, College of Dentistry,
University of Sharjah

suhail_amad@hotmail.com

Abstract

Forensic Odontology is a relatively new science that utilizes the dentist's knowledge to serve the judicial system. Worldwide, dentists qualified in forensic science are giving expert opinion in cases related to human identification, bitemark analysis, craniofacial trauma and malpractice. Human identification relies heavily on the quality of dental records; however Forensic Odontologists can still contribute to the identity investigation in the absence of dental records through profiling the deceased person using features related to teeth.

Along with other healthcare providers, dentists encounter cases of injuries which could be non-accidental. Detection, interpretation and management are important from a legal and humanitarian point of view. Dentists should be aware of the legal impact those cases have, and should refer them to the appropriate authorities for suitable action.

This article gives an insight to Forensic Odontology and outlines some of its medico-legal applications.

Key words: Forensic Odontology, identification, violence, abuse.

The roles of any forensic scientist are to collect, preserve and interpret trace evidence, then to relay the results to the judicial authority in a form of a report. Those functions require sound knowledge in dealing with crime scenes and sufficient acquaintance in law. Forensic Odontology is the forensic science that is concerned with dental evidence.

The use of teeth as evidence is not recent. There are historical reports of identification by recognizing specific dental features as early as 49 A.C. However, Forensic Odontology, as a science, did not appear before 1897 when Dr. Oscar Amoedo wrote his doctoral thesis entitled "L'Art Dentaire en Medecine Legale" describing the utility of dentistry in forensic medicine with particular emphasis on identification.¹

Traditionally, Forensic Odontology covered various topics that can be broadly classified into human identification and injury analysis. However, tasks of Forensic Odontologists have broadened in recent years to cover issues related to child abuse and domestic violence, human rights protection and professional ethics.

This article gives a brief overview of some of the roles undertaken by Forensic Odontologists.

Human Identification

Identification is based on comparison between known characteristics of a missing individual (termed *ante-mortem* data) with recovered characteristics from an unknown body (termed *post-mortem* data).

Identification of the deceased is most commonly achieved visually by a relative or a friend who knew the person during life. This is performed by looking at characteristics of the face, various body features and/or personal belongings. However, this method becomes undesirable and unreliable when the body features are lost due to post- and peri-mortem changes (such as decomposition or incineration). Visual identification in those circumstances is subject to error. Methods of human identification that are acknowledged as scientific are fingerprint, DNA, dental and medical characteristics.² Those methods vary in complexity, but share similar level of certainty. The dental characteristics method is unique in being the easiest and quickest method of identification.

The diversity of dental characteristics is wide, making each dentition unique.³ The dental enamel is the hardest tissue in the body, and would thus withstand peri- and post-mortem damages, and so would dental materials adjoined to teeth. Being diverse and resistant to environmental challenges, teeth are considered excellent post-mortem material for identification

with enough concordant points to make a meaningful comparison.

For dental identification to be successful, ante-mortem data need to be available. This relies heavily on dental professionals recording and keeping dental notes, radiographs, study models, clinical photographs...etc. The availability of dental records will allow comparing the dental characteristics of the person during life with those retrieved from the person after death (Fig. 1).

In cases where dental records are not available, Forensic Odontology can still contribute to establishing the identity by creating a profile of how the deceased person was during life. This includes any unusual oral habits, type of diet, socio-economic status, but most importantly the age of the person at time of death.

Dental aging is based on the chronology of formation and eruption of teeth. This helps in determining the age for persons up to 15 years-old in a fairly accurate manner. After 15 years of age, dental aging relies on modifications that take place during life, such as attrition, cementum formation and root transparency.⁴ Despite being extensively studied, results of aging of this latter group remain less than optimal because those age-related modifications can be influenced by various factors, such as diet and dental pathosis.⁴

Dentists' Role in Mass Fatality Incidences

Routine identification tasks are a simple one-to-one matching process. This is not the case in disasters. Mass fatality incidences represent a big challenge to local authorities. Another challenge is the damage inflicted on infra-structure that includes hospitals, transportation, communications... etc. which impede recovery.

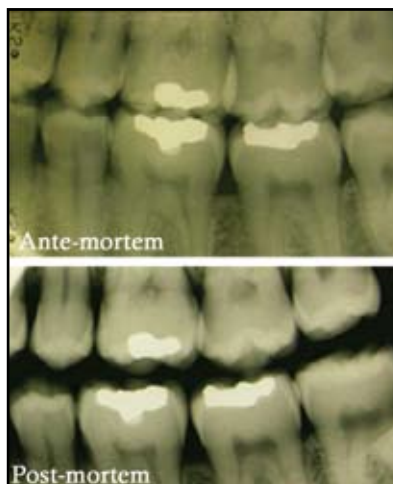
The identification of deceased victims in those circumstances necessitates putting a hierarchy system consisting of an ante-mortem, post-mortem and reconciliation teams. Those teams are headed by team leaders, with liaison officers to coordinate the work. The results are reported to an identification board which is headed by a commander, who in most cases is a senior police officer.

Forensic Odontologists have contributed to the resolution of many mass disasters. The 2004 Indian ocean tsunami is probably the most eminent example on the success of Forensic Odontologists in identifying large number of victims in short time. Nearly half of the victims in Thailand were identified by dental characteristics method alone, and Forensic Odontologists contributed to the identification of the remaining half by assisting the fingerprint, DNA and physical characteristics teams.

Weak, and even absence of dental records did not stop Forensic Odontologists from contributing to the identification of tsunami victims in Thailand. Victims with no dental records were either identified by photographic superimposition, if a photograph showing upper anterior teeth was provided⁵ (Fig. 2), or by narrowing down possible matches for the DNA and fingerprint teams through dental aging.

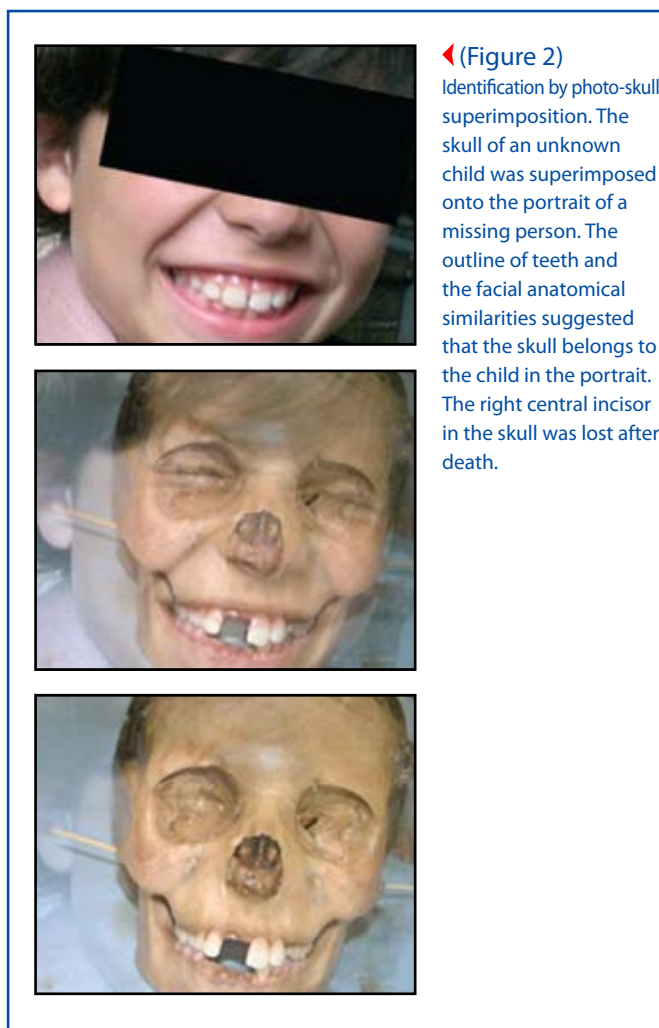
Bitemark Analysis

Injuries induced by teeth and left on objects, such as skin, have a distinctive pattern. Those patterned injuries (bitemarks) are useful to judicial authorities because they help in reconstructing



◀ (Figure 1)

Ante-mortem radiograph taken by the treating dentist and post-mortem radiograph taken by the Forensic Odontologist of the unknown deceased. There are many concordant points to establish a positive identification.



◀ (Figure 2)

Identification by photo-skull superimposition. The skull of an unknown child was superimposed onto the portrait of a missing person. The outline of teeth and the facial anatomical similarities suggested that the skull belongs to the child in the portrait. The right central incisor in the skull was lost after death.

past events that surrounded the biting process. For example, bitemarks indicate a violent interaction between the perpetrator and the victim, and they might tell us something about the criminal intentions of the perpetrator, whether sexual, child abuse, or other forms of assaults. Moreover, bitemarks are the only patterned injuries that can indicate (with different levels of certainty) who the biter was. By comparing the locations and measurements of teeth marks in a bitemark with those of the suspect(s), Forensic Odontologists can exclude or include persons suspected of causing the bitemarks.

However, several erroneous bitemark analysis, mainly from the United States courts, rendered this type of evidence

questionable.⁶ The validity of bitemark analysis has undergone decent review in the last ten years aiming at boosting the scientific weight and improving the technique in a manner that can be reproducible. New research is underway to allow digital comparison of teeth and bitemarks at a 3-dimensional level.⁷ This novel technique is aimed to overcome perspective distortion, a significant morbid factor in bitemark analysis that results from reducing 3-dimensional objects to 2-dimensional images.

Domestic Violence and Child Abuse

The World Health Organization (WHO) has declared that violence is a major and growing public health problem across the world.⁸ This landmark declaration meant that healthcare providers are involved in detecting and managing cases of violence, including abuse to vulnerable populations, i.e. children, elderly and women.

The WHO further distinguishes four types of violence; physical, sexual, psychological and neglect. All forms of violence can manifest in the oro-facial region, and are hence should be of concern to dentists. Prevalence of physical violence, as a cause of maxillofacial injuries, ranges from 3.3% to 41% in various countries.⁹ This wide range is probably due to different reporting thresholds in different communities. The true prevalence of violence is thus difficult to establish because of not or under-reporting this problem.

Injuries due to abuse can manifest in the oro-facial region in various forms, including fractured anterior teeth, fractured alveolar bone, lacerations of the labial and buccal mucosae, lacerations to the frenum and bruises to the lips, face and neck (Fig. 3). Non-accidental injuries have certain characteristics which help in their recognition (Table 1).¹⁰

The most common site to be non-accidentally traumatized is the head.¹¹ Therefore, injuries to the oro-facial region should raise reasonable suspicion to the treating dentist. Suspicion should lead to investigation and reporting, but the reporting must be well-thought of. On one hand, there is a necessity to report those cases to authorities. But on the other hand, reporting false cases is stigmatizing and is an unacceptable interference in the victim's personal affairs. In various countries there are laws that govern reporting of violence. Some laws penalize healthcare workers by imprisonment, and/or fines, for not reporting violence manifested on their patients.^{12,13} However, due to the sensitivity of this matter, reporting has to follow a sound mechanism, and be addressed to a proper authority with specifically-trained personnel. Readers are advised to search for the proper reporting authority in their respective countries.

Conclusion

Dental practitioners should be aware of the forensic application of dentistry. Dental records that are used to provide patients with optimal dental service could also be very beneficial to legal authorities during an identification process. Therefore, all forms of dental treatments should be recorded and kept properly. Dental clinicians, as other healthcare workers, are at the forefront in detecting signs of violence appearing on their patients. They should be aware of the criteria of abusive injuries, and the reporting mechanisms to ensure a correct response by the concerned authorities.



◀ (Figure 3)
Lacerated injury on the upper lip of a child after a smothering attempt (Courtesy of Dr. Mumen S. Haddidi).

Table 1: Features of non-accidental (abusive) injuries.

The history of the injury is vague and inconsistent with clinical findings.
Injuries appear in places away from bony prominences.
The injuries are inconsistent with the child's age-dependent activities, such as crawling, walking or playing sports.
Unexplainable delay in seeking healthcare.
The injury occurred in the absence of witnesses or a sibling is blamed for causing injury.
Evidence of neglect, such as malnutrition, head lice and poor hygiene.
Presence of other injuries and/or repeated attendance to healthcare facilities with similar complaints.
Injuries appear in groups, and of different ages.

References

- Bernstein M. Forensic odontology. In: Eckert WG. editor. Introduction to Forensic Sciences. 2nd ed. Boca Raton, FL: CRS Press; 1997, p. 304-51.
- Interpol. Disaster victim identification. Available at: URL:<http://www.interpol.int/Public/DisasterVictim/default.asp>. Accessed 5th Feb 2009.
- Adams BJ. Establishing personal identification based on specific patterns of missing, filled, and unrestored teeth. *J Forensic Sci.* 2003 May;48(3):487-96.
- Meinl A, Huber CD, Tangl S, Gruber GM, Teschler-Nicola M, Watzek G. Comparison of the validity of three dental methods for the estimation of age at death. *Forensic Sci Int.* 2008 Jul 4;178(2-3):96-105. Epub 2008 Apr 8.
- Al-Amad S, McCullough M, Graham J, Clement J, Hill A. Craniofacial identification by computer-mediated superimposition. *J Forensic Odontostomatol.* 2006 Dec;24(2):47-52.
- Bowers CM. Problem-based analysis of bitemark misidentifications: the role of DNA. *Forensic Sci Int.* 2006 May 15;159 Suppl 1:S104-9. Epub 2006 Apr 4.
- Blackwell SA, Taylor RV, Gordon I, Ogleby CL, Tanijiri T, Yoshino M, et al., 3-D imaging and quantitative comparison of human dentitions and simulated bite marks. *Int J Legal Med.* 2007 Jan;121(1):9-17. Epub 2006 Jan 4.
- World Health Organization. Prevention of violence: a public health problem. 49th World Health Assembly Resolution WHA49.25: Geneva: WHO, 1996.
- Eggensperger N, Smolka K, Scheidegger B, Zimmermann H, Iizuka T. A. 3-year survey of assault-related maxillofacial fractures in central Switzerland. *J Craniomaxillofac Surg.* 2007 Apr;35(3):161-7. Epub 2007 Jun 20.
- Mok JY. Non-accidental injury in children--an update. *Injury.* 2008 Sep;39(9):978-85. Epub 2008 Jul 25.
- Maguire S. Bruising as an indicator of child abuse: when should I be concerned? *Paediatrics and Child Health.* 2008 Dec;18(12):545-9.
- Government of Dubai. Article 273 Federal Penalties Law of the UAE Number 3. 1987. Available at: URL:<http://www.dc.gov.ae>. Accessed 5th Feb 2009.
- Jordanian Legislations. Article 207 Penalties Law of Hashemite Kingdom of Jordan. 1960. Available at: URL:<http://www.lob.gov.jo>. Accessed 5th Feb 2009.