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Role of forensic odontology in human identification: A review

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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, bite mark 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.

Keywords: Forensic odontology, human identification

Introduction

Forensic Odontology is a relatively new science that utilizes the dentist's knowledge to serve the judicial system. It has three major thrust areas which includes [1].
1. Diagnostic and therapeutic examination
2. The identification of individuals,
3. Identification, examination and evaluation of bite mark

Human identification is predicated on comparison between glorious characteristics of a missing individual (Ante-mortem data) with recovered characteristics of an unknown body (post-mortem data) [2].

Identification of the deceased is generally done visually by a relative or an acquaintance, who knew the person throughout life. This is often performed by staring at the characteristics of the face, varied body options and/or personal belongings. However, this technique becomes undesirable and unreliable once the body options are lost because of post- and peri-mortem changes (such as decomposition or incineration). Visual identification in those circumstances is subject to error. Ways of human identification that are acknowledged as scientific are are foot and fingerprint, DNA profiling, dental and medical characteristics (scars, tattoos, birthmarks, implants, amputations, Prosthesis) [3]. Those methods vary in complexity, but share a similar level of certainty. The dental characteristics method is unique in being the easiest and quickest method of identification.

The dental characteristics technique is exclusive in being the simplest and fastest technique of identification. The diversity of dental characteristics is wide creating every dentition distinctive [2]. Being numerous and resistant to environmental challenges, teeth are considered wonderful post-mortem material for identification.

For dental identification to be successful, ante-mortem information is prerequisite. This depends heavily on skilled dental examination, recording and keeping safe these dental hard and soft tissue findings, radiographs, study models, clinical images etc. The availability of dental recordings or data's can enable examination of the dental characteristics of the person during life with those retrieved from the person after death [4].

In cases wherever dental records don't seem to be available, forensic dentistry can still contribute to establishing the identity by making a profile of how the decedent was during life. This includes any uncommon oral habits, kind of diet, socioeconomic standing, most significantly the age of the person at the time of death [5].

Dental aging is predicated on the chronological basis of the formation and eruption of teeth. This helps in estimating the age for persons up to fifteen years-old. After fifteen years age, dental aging depends on modifications that represents throughout life like attrition, cementum formation and root transparency [6].

Dentist's role

Routine identification tasks are an easy matching method. This is not in the case of disasters. Mass fatality incidences represent an enormous challenge to local native authorities. Another challenge is that the damage inflicted on basic infrastructure that include hospitals, transportation services, communications methods etc. that impedes 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 the many mass disasters.

The 2004 Indian ocean tsunami wave is perhaps the foremost eminent example of the success of forensic Odontologists in distinctively identifying an oversized range of victims in brief time. Nearly ½ of the victims in Thailand were recognised by dental characteristics techniques alone, contributing to the identification of tsunami victims in Thailand [7].

Bitemark analysis

Injuries elicited by teeth and left on objects, such as skin, have a distinctive pattern.

Those patterned injuries (bite marks) are useful to judicial authorities because they help past events that surrounded the biting process [8]. For example, bite marks 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, bite marks are the sole patterned injuries that may indicate (with totally different levels of certainty) who the biter person was.

By comparing the locations and measurements of teeth marks in a bite mark with those of the suspect questionable [9]. Recent research studies have taken to compare digital comparison of teeth and bite marks at a 3-dimensional level.

This novel technique is aimed to beat perspective distortion, a significant morbid consideration in bitemark analysis that results from reducing three-dimensional objects to 2-dimensional pictures [10].

The first incidence of bite mark identification happened in 1692 which was termed Salem Witch Trials. One of famous publicized bite mark case which paved the path for bite mark evidence to be used in courts was the case involving serial killer Theodore (Ted) Bundy, who was convicted based on bite-mark analysis by the US judicial system [11]. First time ever in history of criminal prosecution in India, death sentence was given to the accused was the Delhi gang rape case where the forensic odontologist linked the dentition of the two accused to the bite marks on the victim [12].

Lip prints (Cheiloscopy)

Cheiloscopy is a forensic investigation technique that deals with identification of humans based on lips traces [13]. While using teeth as antemortem record, sometimes, we find loss of teeth and destruction of restorations may lead to difficulty in comparing the antemortem records and postmortem records. Similar to the prints present in the finger, palm and foot, and lip prints are also unique and do not change during the life of a person. Lip prints provide sufficient information for forensic investigations as the lips also possess furrows and grooves. Lip prints can be obtained at the crime scene either directly from the lips of the deceased or from the clothing, cups, glasses, cigarettes, windows, or doors. Lip prints have to be collected within 24 hours of time of death to reduce inaccurate knowledge that might result from post mortem alterations of lip. Lip print pattern depends on whether or not mouth is opened or closed. In closed mouth position, lip shows well-defined grooves; whereas in open mouth position, the grooves are relatively ill defined and hard to interpret [14]. This feature helps to identify an individual's gender [15].

Rugoscopy/Palatoscopy

Palatoscopy or palatal rugoscopy is the name given to define an identity of the person through the study of palatal rugae. The use of lip prints was first recommended in 1932 by Edmond Locard in France [12] development of Palatal rugae start developing in the third months of intra-uterine life from the calcified mesenchymal tissue wrapping. The exact arrangement, configuration, and orientation takes place by approximately 12 to 14 weeks of prenatal life and remains robust until the oral-mucosal structures regress after the demise of the person. The palatal rugae display distinctive features that can be used in conditions when it is challenging to recognize a deceased person through fingerprints and dental hard tissue records [16]. Rugae patterns change with age and other environmental influences such as orthodontic movements, tooth extraction, cleft palate surgery, periodontal surgery, and impacted canine eruption [17].

DNA analysis

The dental tissues are an excellent source of DNA because of their resistance against environmental attacks such as incineration, immersion, trauma, and decomposition. This biological material may provide the necessary link to demonstrate identity when conventional methods of dental identification fail. This evidence source is becoming increasingly popular among researchers with the advance of the polymerase chain reaction (PCR), a technique that enables DNA amplification at a preselected location. The antemortem specimen from any DNA source, including toothbrush and hairbrush or blood samples, biopsy, clothing or another individual item that has belonged to the deceived, is here matched with the DNA extracted from a human remains at disaster sites [18].

Age determination

Age determination is also formulated based on the degree of formation of crown and root structures, the stage of eruption, and the intermixture of primary and adult dentitions. It also helps in identification if an individual is having a comprehensive dental record and presence of any uniqueness like decay, malposition, overlapping, rotations, and restorations/fillings with different materials, diastema/gaps and dentures/Implants, etc. [19].

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. This landmark declaration meant that health care providers are involved in detecting and managing cases of violence, including abuse to vulnerable populations, i.e. children, elderly and women. The WHO further distinguishing four types of violence; physical, sexual, psychological and neglect [20]. All forms of violence can manifest in the oro-facial region, and are hence should be of concern to dentists. 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 [21].

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 authority.

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