Review Article

Indian Journal of Forensic Odontology
Volume 9 Number 1, January - June 2016
DOI: http://dx.doi.org/10.21088/ijfo.0974.505X.9116.5

Forensic Odontologists and Mass Disasters

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Abstract

Forensic odontology is the science which utilizes the dentist's knowledge to serve the judicial system. Dentists may encounter cases of injuries, which could be non-accidental. Detection, interpretation and management are important from a legal point of view. Dentists should be aware of the legal impact those cases have, and should refer them to appropriate authorities for suitable action. Most often the role of a forensic odontologist is to establish a person's identity. Mass disaster is an unexpected event that causes severe injury and death to a number of people. Forensic dentistry plays a major role in identifying individuals in such disasters who cannot be identified by any other means. The unique nature of our dental anatomy and the placement of custom restorations ensure accuracy when the techniques are correctly employed.

Keywords: Forensic Ododntology; Dentist and Mass Disasters.

Introduction

FDI defines Forensic dentistry as, 'that branch of dentistry which, in the interest of justice, deals with proper handling of dental evidence, and with proper evaluation and presentation of dental findings' [1].

Forensic odontologists assist legal authorities by examining dental evidence in different situations. They help in identification of human remains through dental records and assisting at location of mass disaster, gender identification, age estimation of both, the living and the deceased, bite mark analysis and presenting evidence in court [2]. They're dentistry's detectives, a small group of professionals who lend their skills and training to the often grisly business of helping identify crash victims, solve rapes and catch killers [3]. 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 [4].

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Mass Fatality Incidences

According to webster's new international dictionary disaster is defined as; 'sudden calamitous event producing great material damage, loss and distress'. Mass disaster is an unexpected event that causes severe injury and death to a number of people. Mass disasters can be of three types – natural, accidental and intentional mass disasters. Examples of natural mass disasters are earthquakes and tsunami in 2004. Examples of accidental mass disasters are building fires, aircraft and train crashes. Examples of intentional mass disasters are bombing of buildings and world trade centre attack in 2001. 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. The challenges are the presence of large number of human remains, fragmented and burned remains, difficulty in determining who was involved in the disaster, acquisition of meaningful medical and dental records and legal, jurisdictional and political issues [5].

Another challenge is the damage inflicted on infra-structure that includes hospitals, transportation, communication 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 [6].

Forensic Dentist's Role in Mass Disasters

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 [6].

Transport accidents form the majority of cases in which dental identifications are needed, particularly aircraft accidents in which both fire and trauma are often severe. Fires and collapse of heavily occupied buildings are another source of multiple problems of identification [7]. The forensic odontologist is usually a member of the investigating team, the composition of which varies, depending on the nature of the disaster. Generally, the team includes a coordinator or head of the team, a pathologist and various specialists with experience related to the particular type of disaster, in addition to the forensic odontologist.

In a situation involving fire or severe trauma, physical features are often destroyed. Because teeth are heavily calcified, they can resist fire as well as a great majority of traumas. Generally, teeth and restorations are resistant to heat, unless they are exposed directly to flame. Preservation is possible in most cases [6].

Methods of Identification in Mass Disasters

The methods are physical identification, Finger prints, Dental records and DNA analysis [5].

Physical identification is less exact but capable method of identification. Photos can be taken of the victim, focusing on items like medical operations, jewellery, tattooing, scars, eye and hair color. Through finger printing victim identification success rate is fairly high as finger prints are believed to be unique for each finger. But only problem is they are less obtainable from victims due to the fast decomposition of the human body [8].

Dental records are quite reliable as dental patterns are unique for every individual. Dental identification can be confirmed within a matter of hours. Next to fingerprints, teeth are the most useful tool in determining positive identification of human remains[8] Teeth are the most durable portion of the body and have the ability to resist erosion, deterioration, and fire long after death. Teeth must be exposed to a temperature of over 500°C (932°F) to be reduced to ash. Teeth demonstrate a variety of form and varied conditions of wear, trauma, disease, and professional manipulation [9]. Approximate age and useful indications of probable sex, race, occupation, personal habits, medical history, and environment can often be revealed by analysis of only teeth [10]. Analysis of dentition generally includes examination of position and shape of fillings, presence or absence of teeth, and shape of molar roots. Usually, this information is gained through the use of radiographs [11]. Forensic odontologists also do comparative analysis between postmortem information of an unknown individual and antemortem information of a missing person. By comparing these data, an identification of the unknown individual may be reached. The forensic odontologist called to the morgue will perform many dental examination procedures, such as charting existing restorations, missing teeth and taking radiographs and photographs, just as if the decedent were a living patient in the office. However, unlike with a living patient, certain conditions, such as rigor mortis or advanced decomposition, can make the post-mortem examination rather challenging.

Age estimation should be an important part of the identification process, especially when information relating to the deceased is unavailable [12].

In the year 1950, Gustafson [13] was the first to publish a method for estimating the age of a person from the teeth, based on 6 criteria related to hard dental tissue changes that progress with advancing age: occlu-sal wear, secondary and tertiary dentin layers, cement thickness, the extent of root resorption, the length of the root transparency, and the height of gingival attachment. Gustafson assigned a score of 0-3 to all these factors (according to intensity). However, the results being subjective the scores were not included in an inte-grating scale. Lamendin et al. [14] in turn established a technique for estimating the age of an adult using single-root teeth. This system involved the measurement of two parameters related to age: gingival recession and root transparency (a phenomenon not seen before 20 years of age, and which is due to the formation of hydroxyapatite deposits within the dentinal tubules). The mean error associated with this technique is significantly lower than in the case of the method developed by Gustafson [13] (8.9±2.2 and 14.2±3.4 years, respectively).

Small variations in tooth formation and eruption among persons has made dental estimation of chronological age the primary method of age determination for younger persons. Human dentition a reliable and predictable developmental sequence, beginning about 4 months after conception and continuing to the beginning of the third decade of life when development of all the permanent teeth is completed. The use of radiographs is characteristic of techniques that involve observation of the morphologically distinct stages of mineralization. Such determinations are also based on the degree of formation of root and crown structures, the stage of eruption, and the intermixture of primary and adult dentitions [12].

The palatal rugae of an individual can be regarded as a complement in the identification of gender. A study [15] based on the methods of Thomas and Kotze [16] and Kapali et al [17] analyzed the number, length, shape and merging pattern of the palatal rugosities, and found convergent rugae to be more common in females and circular ridge morphologies to be more frequent in ma-les. Gender differences were also observed in terms of the number and length of the rugae, though statistical significance was not reached. Ano-ther alternative for the determination of gender involves the analysis of pulp tissue to establish the presence of chromosome X [18]. Lip print morphology can also help in the determination of gender. In this context, females more often present a vertical or intersection-shaped lip print pattern, while ramified or reticular lip print patterns are more frequent in males. The anatomical di-fferences at skull base level between males and females can also be of help. In this context, the male cranium is significantly larger, thicker and heavier, and of greater capacity than the female cranium, which in turn has sof-ter-contoured and smaller bone crests and protuberances [19].

Dental restorations may indicate the economic, regional, and racial background of an individual. Methods of restoration used in certain countries or regions may be rare or not used in other areas. The amount of expensive restorations found in an individual may suggest social status [20]. Early French and German anthropologists and odontologists showed that some morphological variants, such as cusp number of molars, differed between the major races of humankind [21]. The classic papers of Hrdlièka (1920) and Hellman (1928) on shovel-shaped incisors and lower molar morphology, respectively, were among the earliest studies of differences in crown trait frequencies between geographical races [22,23]. Significant correlations between racial and subracial groups and tooth size have been noted in studies. Enamel pearls occur more frequently on the premolars of Mongoloids than whites or blacks. Carabelli's cusp or tubercle is frequently demonstrated in the negative form with pits and grooves in Mongoloid populations and in the positive form with projections or tubercles in white populations [24]. Wear patterns and staining can suggest occupation or personal habits such as smoking.

DNA analysis [25] is a precise method for identification but a very time consuming and expensive process .It is also very sensitive technique with contamination problems .Usually victim samples are matched with samples taken from personal items or from known relatives.

The main DNA source is blood, though in some si-tuations this type of sample is not available for analysis. In teeth, DNA is found in the pulp tissue, dentin, cement, periodontal ligament and alveolar bone [26]. Due to the resistance of the hard tissues of the teeth to environ-mental actions such as incineration, immersion, trauma or decomposition, pulp tissue is an excellent source of DNA [27].

Pulp tissue is the most widely used option, since it is nor-mally abundant and is less vulnerable to contamination by non-human DNA. The pulp tissue samples are collec-ted in three ways: crushing, horizontal or vertical tooth sectioning, and through an endodontic access. Sweet and Hildebrand [28] were pioneers in the obtainment of DNA by tooth crushing through cryogenization.

Pulp tissue is easier to prepare and analyze than other sources. However, in many case the analyzed tooth lacks pulp tissue or may have been endodontically obturated. It also may be contaminated by microorganisms or by non-human DNA. In such cases dentin or cementum is used for DNA extraction [26].

Conclusion

Each practitioner has a responsibility to understand the forensic implications associated with the practice of his or her profession. Appreciation of the forensic field should give the dental clinician another reason to maintain legible and legally acceptable records, and assist legal authorities in the identification of victims and suspects.

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