Role of Radiology in Forensic Dentistry

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ABSTRACT

Forensic radiology is a specialized area of medical imaging utilizing radiological techniques to assist physicians and pathologists in matters pertaining to the law. Postmortem dental radiographs are the most consistent part of the antemortem records that can be transmitted during the forensic examination procedures. Pathologists regularly use radiographic images during the course of autopsy to assist them in identification of foreign bodies or determination of death. Forensic radiology can be used in suspicious death or murder, in analysis of adverse medical events, solving legal matters, to detect child abuse, drug trafficking, body identification and disease identification. Using the possibilities of radiology, special characteristics of the internal structures of the dentomaxillofacial region can be revealed. We can also detect endodontic treatments, healing extraction sockets, implants or even tooth colored restorations. Therefore, we can give answers to problems dealing with identification procedures, mass disaster and dental age estimation.

Keywords: Radiology, Forensic dentistry, Victim identification.

INTRODUCTION

Forensic dentistry (FD) deals with examination of dental evidences with proper evaluation of dental findings. Forensic dentistry is present in processes of postmortem human identification from the early procedures (general identification) comprising estimation of ethnic groups, skin color and other personal characteristics, such as height and diagnosis of skin spots or fluids present or originating from the oral cavity, or even in the definition of time and cause of the death, to the irrefutable possibility of individual identification. Radiology has been used extensively in conventional dental identification based on anatomy and by using comparison of maxillofacial skeletal landmarks in antemortem and postmortem records.

HISTORY

Application of radiology in forensic sciences was introduced in 1896, just one year following the X-ray discovery by Roentgen, to demonstrate the presence of lead bullets inside the head of a victim. Schuller in 1921, proposed the possibility of utilizing radiological images of facial sinuses for identification purposes. Hazebroucq et al in 1993, described a system for identification based on osteotomy of maxilla and mandible which can also be used for age determination. Austin and Maples (1994) have described a study for evaluating the accuracy of methods of image superimposition and concludes that with two antemortem radiographs (frontal and lateral view) and without dental data, identification can be made.

Andersen and Wensel in 1995, through antemortem and postmortem simulation, have evaluated the capacity of individual identification by analyzing the conventional bite-wing films and radiographic subtraction, based on scoring system (1-eliminated, 2-possible, 3-likely, 4-certain).

UTILIZATION OF IMAGES IN FORENSIC DENTISTRY

In forensic radiology, identification process is characterized by utilization of appropriate techniques and means to discover identity, and can be developed by skilled technicians or professionals with differentiated specific knowledge in areas of biology and with appropriate techniques to achieve human identification.

Identification is made by comparison of antemortem and postmortem radiographs. Anatomical details like shape of teeth, roots, supernumerary teeth, missing and present teeth, attrition, abrasion, coronal fracture, signs of bone resorption resulting from periodontal disease, bone pathology, diastemas, dental cavities, endodontic treatment, interradicular and intracoronal posts, implants, extraction socket and dental prostheses can be used for identification.

Accurate forensic dental identification requires point-by-point comparison of set of intraoral radiographs, which can be made as many as 18 to 21 images, in which all points of comparison must match exactly or in which differences must be explainable.

CONVENTIONAL RADIOGRAPHY vs DIGITAL RADIOGRAPHY

Digital radiography, used for a decade or more by radiologists in most hospitals, has become the solution of choice in mass
disaster assisting forensic medical examiners to quickly identify decedents. Digital radiography dramatically increases the quality and timeliness associated with use of dental radiographs in forensic dental victim identifications, particularly when combined with computer-based dental chart matching software. New digital X-ray system and portable X-ray tube heads allow odontology team to work directly at the mass fatalities.

Onsite identification with the help of digital system is especially advantageous when the body has been burned or otherwise susceptible to damage during transit. Secure satellite communication allows images to be relayed to the command center. With digital dental X-ray technology, it is possible to capture X-rays and compare them to existing digitalized dental records much more efficiently.

When digital material is copied in a lossless format, a perfect copy is created, so if important digital material is backed-up, copied, or re-archived every 10 to 20 years using then-current technology, digital information can be retained indefinitely in original form.

Decreased turnaround, increased productivity, practicality and flexibility makes digital radiography the system of choice in mass disaster compared to conventional radiography.

**COMPUTED TOMOGRAPHY**

Conventional, two-dimensional or three-dimensional computed tomography (CT) is a useful imaging method in the process of human identification, and presents innumerable advantages in this field compared to traditional radiographic projection. Firstly, because this method is free from the problem of structures superimposition beyond the plane of interest and also for allowing the visualization of small differences in density. Other advantages are image segmentation—an important resource in cases where internal points must be evaluated, easy image manipulation and quality with excellent color scale and transparency.

Anthropologically, CT has been utilized in the study of skulls and also in the forensic context, as an additional resource in the process of identification. Additional studies have demonstrated the applicability of facial reconstruction by means of 3D CT for the purpose of individual identification.

CT and MRI techniques have been refined, offering higher accuracy in identification, even in toothless individuals and in determination of age. It can also be used in assessment of degree of fitness of a weapon to a wound in cases of blunt force skull injury and also assists in depicting pattern of postmortem skull fractures. Micro-CT has been used in matching weapons to wounds in sharp force injury cases.

**OTHER APPLICATIONS**

**Radiographic Dental Implants Recognition for Evaluation in Human Identification**

Forensic dental identification is based on the morphological comparison and matching of dental records. If no previous papers are found, identification may be difficult. However, morphological features of dental implant depicted on radiographs may be used to develop a dental profile of the individual and this can narrow the search to a smaller number of individuals, or eliminate certain candidates by taking into account the dental system employed. The matching of two sets of radiographs is performed with postmortem periapical radiograph of implant against the dental implants image of various implant system stored in the archive.

**Dental Maturation Assessment by Nolla’s Technique**

Human dental growth and development have been recorded by many ways. Abou El-Yazeed et al carried out a study to assess the maturation of permanent dentition applying Nolla’s technique on a group of panoramic X-ray films (186 boys and 192 girls) of Egyptian children within the age range of 6 to 15 years. The panoramic radiographs were used for evaluation of tooth maturation on a scale from 0 to 10 (0—Absence of crypt, 1—Presence of crypt, 2—Initial calcification, 3—One-third of crown completed, 4—Two-third of crown completed, 5—Crown almost completed, 6—Crown completed, 7—One-third of root completed, 8—Two-third of root completed, 9—Root almost completed, open apex, 10—Apical end of root is completed) and the obtained data was statistically analyzed. Lower teeth were found to be ahead of upper teeth in all age groups. Results of maxillary and mandibular teeth including or excluding the third molar gave similar values.

**CONCLUSION**

Many radiological techniques are used as an aid in human identification, including the determination of sex, ethnic group and mainly age. However, the application of any of the mentioned techniques depends on the availability of a previous image record for comparison. So, it is very important that records of radiological images acquired during treatments are kept by health care professionals.

As criminology and law enforcement are advancing to keep up with a spiraling crime rate, forensic radiology has emerged as a specialized aspect of the investigations, and its potential in crime solving must be used and expanded to benefit all of mankind.
REFERENCES


