

Recent Trends in Forensic Odontology : Review Article

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Abstract

Forensic odontology has a wider scope of growth and is an emerging discipline. In medico-legal matters and in the identification of the dead individual, it has developed itself as an indispensable science. Even if the deceased individual is skeletonized, decomposed, burnt, or dismembered, the dental tissues are often preserved.

Different techniques have been developed using dental tissues to determine the individual's age, sex, and ethnicity. Methods of data collection and additional technologies used in forensic dental identification have undergone major transformation. An summary of the emerging trends in traditional approaches and the latest concepts used in forensic odontology is given in this article.

INTRODUCTION

Teeth are the human body's hardest and most robust tissue. Even in major accidents, criminality, burial, or other serious exposure to the elements, they are often resistant to decomposition. For each person, the dental patterns are specific. This uniqueness is also due to the dentist's variety of treatments given. Dentition of an individual is therefore helpful for individual identification and comparison. Forensic dental identification plays a primary role in the identification of remains when the use of visual or fingerprint methods is invalidated by postmortem changes, traumatic tissue injury, or lack of fingerprint records. The history of forensic odontology goes back a long time. Dental evidence has been used in courts for the last several years.

There are three main areas of use for forensic odontology:

- (1) diagnostic and therapeutic examination and assessment of injuries to jaws, teeth, and oral soft tissues.
- (2) Identification of individuals, in particular victims in criminal and/or mass disaster investigations.
- (3) Identification, examination and evaluation of bite marks which occur in sexual assault with a certain frequency.

EVOLVING TRENDS IN CONVENTIONAL METHODS USED IN FORENSIC ODONTOLOGY

DENTAL RECORD MAINTENANCE

Most of the time, forensic dental identification depends on the availability, adequacy, and precision of antemortem dental records. Maintaining dental records is a dentist's responsibility and is an important aspect that acts as a source of information for dentists and patients, for medical, legal, administrative, and forensic purposes¹. Similar to fingerprints and DNA analysis, identification com-

parative dental analysis plays an important role. Dental records have been successfully used in many disasters, such as the World Trade Center tragedy, the December 2004 Indian Ocean tsunami disaster, etc. There are different types of dental records available, such as dental notes, dental charts, radiographs, photos, and models².

DENTAL IMAGING

Radiographs are an additional aid used for individual identification in situations where prior records are not available for reference. It is possible to obtain and compare the radiographic images of the deceased with the available antemortem radiographic image of the accused individual. Historically, in 1896, only one year after the X-ray discovery, the use of radiographs in forensic sciences was adopted.³

Digital imaging techniques such as radiovisiography make it possible to accurately analyze the spatial relationships of teeth roots and support structures on ante- and post-mortem images. Many soft products have been developed that aid in image rotation, translation and scaling, enabling the precise alignment between ante- and post-mortem radiographs, removing the need for new exposures⁴.

In forensic identification, facial images, video recordings, or smile photographs that show unique characteristics of each person often serve as a valuable aid. In this way, orthodontics acts as a source of detailed clinical records of the dental tissues that decide individual smiles.⁵

BITE MARK ANALYSIS

In violent events such as sex-related offences, child abuse incidents, and offenses involving physical altercations, such as murder, bite marks on human tissues may be detected. In situations where the attacker bites the victim or the victim bites the attacker as an act of defense, it can occur, but it should be noted

that the victim of the bite may be the suspect in the cases⁶. Male victims are bitten on the arms and shoulders most frequently, while female victims are bitten on the breasts, arms, and legs most commonly. The biting surfaces of the individual groups of teeth are distinct and function-related. And it also reveals individual features such as fractures, rotations, missing or additional teeth⁷.

DNA ANALYSIS

In the field of forensic odontology, DNA analysis is a modern technique that gains significance when traditional methods of identification fail due to the effects of heat, trauma or autolytic processes, distortions and analysis difficulties⁹. There are many biological materials that can be used to achieve DNA typing, such as blood, semen, bones, teeth, hair, and saliva. Genomic and mitochondrial DNA (mtDNA) is used in the field of forensic science. In the nucleus of each cell in the human body, genomic DNA is located¹⁰.

CHEILOSCOPY

Cheiloscopia is a method of forensic science that deals with the identification of humans on the basis of their lip traces¹¹. Sometimes we find loss of teeth and destruction of restorations when using teeth as antemortem records will lead to difficulty comparing antemortem records and postmortem records. An immutable parameter should be used to resolve these difficulties. An immutable parameter should be used to solve those difficulties.¹² Like the prints in the finger, palm and foot and lip prints, they are also recognizable and do not alter during a person's lifetime. For forensic examinations, lip prints provide ample details since the lips often have furrows and grooves. Lip prints can be taken directly from the lips at the crime scene.¹⁴

The pattern of lip printing depends on whether the mouth is open or closed. The lip displays well-defined grooves in the closed

mouth position; while the grooves are relatively ill-defined and difficult to perceive in the open mouth position.¹⁵ Pathology of the lip such as mucocele, postoperative changes, lack of support due to loss of anterior teeth, presence of debris or liquid on the surface of the lip, application of a thick layer of lipstick or over stretching of cellophane tape can alter lip print recording.¹⁶

RUGOSCOPY

Because of its rarity, the palatal rugae pattern acts as an alternate form of identification in case of teeth loss, due to reasons such as trauma¹⁷. Since rugae is placed internally in the oral cavity and covered by fat from the tongue and buccal pad, it remains undisturbed from heat and other attacks. The patterns of Rugae change with age and other environmental factors such as orthodontic motion.¹⁸

Materials and methods used to examine rugae patterns include maxillary arch photographs and impression, computer software programs (e.g., RUGFP-ID), calcorrugoscopy or overlay printing, stereoscopy (through which palatal rugae can be rendered with a three-dimensional [3D] image), stereophotogrammetry (which is comparatively precise)¹⁹

RECENT CONCEPTS IN FORENSIC DENTAL IDENTIFICATION

FACIAL RECONSTRUCTION

Faces are peculiar to every human being born in this world from the past. Face is crucial for human identity and is a boon to the human kind. It plays a major role in forensic sciences because of the fact that if the face of the deceased person remains unchanged, the identity of the person can be easily made without any need for forensic professionals.²⁰

Most often in major disasters and in accidents, the body of the dead person may be decomposed or skeletonized. In such cases, the only part retained may be the skull and the

other bones. Skulls can remain unaltered even for millions of years and can provide an inimitable means of identification. The cranial appearance is very much helpful in determining the sex of the individual²¹.

DENTURE IDENTIFICATION METHODS

possessing all or most of their dentition can be identified using their teeth through various methods, whereas those missing all of their teeth lack such information. In such circumstances, Victims the only identifiable remains are the victim's dentures. A denture as such without any markings is of less or no use in forensic dentistry.²³

Only if it is labelled will the dentures disclose the positive identity of an individual. One of the most easy and effective methods of identification is to mark the denture. Denture labeling approaches fall into two categories: the method of surface marking and the method of inclusion. Scribbling or engraving the denture and marking with embossed letters are the surface marking methods. Techniques of inclusion include metal identification band, computer printed denture, microlabelling system, lead paper labeling, embedding patient photograph, denture barcoding, laser etching, radiofrequency identification tags. Surface method is easy among the two categories and is relatively inexpensive. Disadvantage is they worn off and needs reapplication.²⁴

COMPARISON MICROSCOPES

In forensic sciences, the use of microscopes has an effect on precision. The presence or absence of Y-chromatin will confirm sex by examining teeth under a microscope.⁴ The phase contrast microscope is useful in analyzing age-estimated cemental annulations. The conventional microscope uses more time to re-adjust the focus and to obtain a contrast of the samples.

Forensic technology has developed a prototype Virtual Comparison Microscope to pre-

vent these issues (VCM). The comparison microscope is a method that helps simultaneously examine the specimens. It consists of two microscopes linked by an optical bridge, which has a window with a split view. VCM utilizes images from the company's BulletTrax-3D system of deformed bullets, bullet fragments, and different types of rifling. With the VCM, major marks can be easily identified in either direction while preserving a clear appearance.²⁵

TONGUE PRINTS

In its form and surface textures, the tongue is unique to each person and is the only internal organ that can be protruded from the body and easily exposed for inspection. The use of tongue prints for forensic recognition is now at an early stage. The antemortem photograph or impression of the tongue should be accessible for this approach to be effective. Together with its photographic image, the lingual impression may constitute safe methods for identifying forensic dentistry.²⁶ The tongue prints present in the human tongue have recently become a new member of the biometrics family. Using three views, such as left side view, right side view, and profile view, the tongue biometric template can be generated.

ROLE OF MAXILLARY SINUS

Its reported that the maxillary sinuses remain intact although the skull and the other bone may be badly disfigured in victims who are incinerated and therefore the maxillary sinus can be used for identification. During the foetal development the paranasal sinuses originate as invagination of nasal mucosa into the lateral nasal wall, frontal, ethmoid, maxilla and sphenoid bones. This unique development explains the enormous amount of anatomic variation.

CONCLUSION

Forensic dentistry is an upcoming branch of dentistry with a lot of potential for development. Forensic odontologists play a vital role in the investigation and analysis of dental findings at the crime scene. When the tools are correctly used, the distinctive quality of the dental anatomy and the custom restorations ensure precision. To allow comparison, a consistent effort needs to be made to computerize all the available data. To retain the dental records that will serve as antemortem details, efforts have to be made. It is the duty of each dental practitioner to consider the forensic activities associated with their dental practice.

The practicing dentists and the dental students should be made aware of the available technologies and its use in forensic dentistry. New researches have to be encouraged in the field of forensic dentistry which will pave way for incorporating newer technologies in establishing the human identity.

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