



Forensic Odontology

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Introduction

Forensic Odontology, or forensic dentistry, was defined by Keiser-Neilson in 1970¹ as "that branch of forensic medicine which in the interest of justice deals with the proper handling and examination of dental evidence and with the proper evaluation and presentation of the dental findings." There are three major areas of activity embracing current forensic odontology namely:

1. The examination and evaluation of injuries to teeth, jaws, and oral tissues resulting from various causes
2. The examination of marks with a view to subsequent elimination or possible identification of a suspect as the perpetrator
3. The examination of dental remains (whether fragmentary or complete, and including all types of dental restorations) from unknown persons or bodies with a view to the possible identification of the latter²

The natural teeth are the most durable organs in the bodies of vertebrates, and humankind's understanding of their own past and evolution relies heavily upon remnant dental evidence found as fossils.³ Teeth can persist long after other skeletal structures have succumbed to organic decay or destruction by some other agencies, such as fire.⁴

Identification by dental means is not a new technique. It has been said that Nero's mistress, Sabina, in 66 A.D., satisfied herself that the head presented to her on a platter was Nero's wife as she was able to recognise a black anterior tooth.⁵

The modern forensic case started in 1897 in disaster victim identification in Paris by a general dentist.

History of Forensic Odontology in Hong Kong

The Forensic Odontology Group of Hong Kong was set up by the Founding Professor of Oral Anatomy of HKU, Prof Ron Fearnhead, in 1983, in response to a shipwreck DVI(Disaster Victim Identification) operation in the South China Sea. Hong Kong was the first permanent forensic odontology centre in SE Asia. There was a temporary facility of the US Armed Forces Central Identification Laboratory which took care of the Missing In Action and Killing In Action GIs in the

Vietnam War in the 70's. After Prof Fearnhead and Dr Philipsen left HK in 1995, the local graduates took up the group. At present, the group has three consultants, one oral radiologist, two oral radiographers, one forensic technician and twelve trainees. It is interesting to know that there are no forensic odontologists in China mainland. The training is solely on apprenticeship. The local dental authorities do not regard forensic dentistry as a branch of dentistry. They have expressed the concern that "forensic dentistry" can be performed by anyone even without a dental qualification since it is a consultation on dead bodies.^{6,7} There is no formal pathway for training in forensic odontology in Hong Kong. The College of Dentistry and College of Pathology refused to set up a pathway for any formal training while forensic pathology is under the training pathway of the College of Pathology.⁸ The Dental Council also refused to recognise the academic qualifications that are issued by the overseas institution that lead to higher qualifications in forensic pathology in the training pathway in Hong Kong.⁹ Even the dental school has stopped the teaching of forensic odontology in the undergraduate curriculum when they started the problem based learning 10 years ago.

Disaster Victim Identification

Dental identification has been regarded as one of the primary identifiers in the INTERPOL disaster victim identification protocol.¹⁰ Sometimes, it may prove to be the only method that can be used to make or disprove identification. Most recently dental identification has proved its worth in helping to identify victims from the Bali bombing and the Southeast Asia tsunami disaster 2004. As other means of identification become less effective, the importance of dental identification increases. The dental structures and dental restorations may be the only parts of the body not destroyed, and they can be used even though they may be scattered over a wide area, such as occurs in aircraft accidents, terrorist attacks, partial incineration, fragmentation, and severe decomposition.¹¹

The definite establishment of identity of a body essentially comes from a detailed comparison and matching of tangible ante mortem records and post mortem findings. It is rarely the case that the two match in all aspects, so some judgment is required. This often requires the application of logic, and unless the person dies on the day of their last dental



appointment, it always requires the investigator to grasp the temporal framework in which the ante mortem records were amassed relative to the time at which the corpse was examined.

It is important to note that there is no minimum number of concordant points that are required for a positive identification which is different from the analysis of fingerprint.¹² In some cases, a single tooth can be used for identification if it contains sufficient identifying or unique features. Equally, a full mouth series of radiographs may not reveal sufficient detail to render a positive identification.¹³ The certainty of identification conclusion lies with the forensic odontologist, who must be prepared to justify his conclusions in court.¹⁴

When ante mortem dental records are unavailable and other methods of identifications are not possible, the forensic odontologist can assist in limiting the population pool to which the deceased is likely to belong and thus increase the likelihood of locating ante mortem dental records. This process is known as post mortem profiling. The information from this process will enable a more focused search for identity. A post mortem dental profile can provide information on the age, ancestry background, sex and socio-economic status of the deceased. In rare circumstances, it is also possible to provide additional information regarding occupation, dietary habits, habitual behaviour and occasionally, on dental or systemic disease.¹⁵

Facial Reconstruction and Facial Superimposition

If the post mortem profile does not elicit the tentative identity of the deceased, it may be necessary to reconstruct the individual's appearance during life. This is the responsibility of forensic artists who utilise the dental profile to help with facial reconstruction.¹⁶ The use of ante mortem photographs to permit facial superimposition of skeletal and teeth fractures have been used in cases of identification. This technique requires the availability of suitable ante mortem photographs showing the teeth. Often, angulations and magnification impose difficulties in positioning the images.¹⁷⁻¹⁹

DNA in Forensic Odontology

The resilient nature of the dental hard tissues to environmental assaults ensure that teeth represent an excellent source of DNA material.²⁴ When conventional dental identification methods fail, this biological material can provide the necessary link to prove identity. With the advent of the polymerase chain reaction, a technique that allows amplification of DNA at pre-selected specific sites, this source of evidence is becoming increasingly popular with investigators. Comparison of DNA from the teeth of an unidentified individual can be made to a known ante mortem sample like stored blood, hairbrush, clothing, cervical smear and etc or to a parent or sibling.²⁴ A recent study has found out that mitochondrial DNA can be

sourced from dentine powder obtained via cryogenic grinding, and also via dentine in the case of root-filled tooth.²⁵⁻²⁷

Age Assessment

There are a number of medico-legal reasons for determining the age of an individual. Dental structures can provide useful indicators to the individual's chronological age. The age of children can be determined by the analysis of tooth development and subsequent comparison to development charts, usually to an accuracy of approximately 1.6 years.²⁰ The use of attrition and development of third molars have been suggested as means of ageing those individuals over 18, but both are unreliable. Newer techniques like aspartic acid racemisation²¹ and translucent dentine^{22,23} have been proposed and proved to be highly accurate in adult age assessment.

Bite Mark

Bite marks may be present following a fight between adults or children, as part of a sexual or physical assault by an adult on a child, in rape or attempted rape where bites are likely to be noted on the breasts, and between homosexuals.^{28,29} The marks, single or multiple in nature, may be of varying degrees of severity, ranging from a mild marking of the tissues to deep perforation of the epidermis and dermis, and may be found on breasts, face/head, abdomen, shoulder, upper extremity, buttocks, female genitalia, male genitalia, legs, ear, nose and neck.^{30,31} Bite mark examination is the one aspect of forensic odontology requiring an immediate response by the forensic dentist. The marks fade rapidly, both in the living and in the dead, changing appearance in a matter of hours; delay in examination may result in the loss of valuable evidence. The forensic dentist is also responsible for the examination of the dentition of those suspected of bite mark perpetration.

The traditional way of identification of bite mark was the comparison of the dentition and the injury. As with the introduction of molecular biology to dental identifications, the use of DNA in bite mark was pioneered in an effort to eliminate the subjectivity associated with conventional analysis.³²

Child Abuse

Child abuse is a non-accidental trauma or abuse inflicted on a child by a caretaker that is beyond the acceptable norm of child care.³³ The head and facial areas are frequently injured in such cases. These areas are exposed and accessible and the face and mouth are considered representative of the whole being. Human bite marks are often seen in abuse cases, frequently accompanied by other injuries. Those found in infants tend to be on different locations from those in older children or adolescents, and reflect punitive measures. [34]The marks may be ovoid or semicircular. Bites from adults will often only mark clearly from one arch, while a child who has bitten will frequently mark with both arches. Bites may be aggressive or sexual, the latter occasionally displaying suck marks. However, it is



important not to overlook the fact that the child may have bitten itself or had the arm or hand forced into the mouth to silence it.

Future of Forensic Odontology in Hong Kong

In recent years, more and more civil cases require the expertise from forensic odontology. Apart from assessment on personal injury, cases like food complaint cases from the government departments³⁵, or from the defendants³⁶ (incomplete). It is interesting to know that the Dental Service of the Department of Health of HKSAR government does not provide any expert witness service to the prosecutors of the respective departments. All cases finally lead to "no evidence to offer" from the prosecutor side and hence the government has to pay the cost of defendants which can be up to millions.⁶

Globally, other than Hong Kong, the recent spate of terrorist attacks and natural disasters in which there have been multiple fatalities has reinforced the need for trained, experienced forensic odontologists who have undergone training in DVI in order to co-ordinate the response to such events promptly and properly.³⁷ Higher qualifications can be obtained by examination from a diploma course from University of Melbourne; a diploma qualification from the Worshipful Society of Apothecaries of London and recently, a fellowship examination from the Royal College of Physicians of London. However, these qualifications will not be recognised by the Hong Kong Dental Council in the foreseeable future.

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