Review Article

Proposing national identification number on dental prostheses as universal personal identification code – A revolution in forensic odontology

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Abstract

The proper identification of a decedent is not only important for humanitarian and emotional reasons, but also for legal and administrative purposes. During the reconstructive identification process, all necessary information is gathered from the unknown body of the victim and hence that an objective reconstructed profile can be established. Denture marking systems are being used in various situations, and a number of direct and indirect methods are reported. We propose that national identification numbers be incorporated in all removable and fixed prostheses, so as to adopt a single and definitive universal personal identification code with the aim of achieving a uniform, standardized, easy, and fast identification method worldwide for forensic identification.

Key words: Fixed and partial dental prostheses, forensic dentistry, forensic identification, national identification number, personal identification codes

Introduction

The proper identification of a decedent is not only important for humanitarian and emotional reasons, but also for legal and administrative purposes.[1] All possible means must be applied to achieve a scientific identification, which is sometimes extremely difficult, particularly in mass disaster situations or in matters of genocide crimes.[2,3] Regardless of the body's condition, the forensic and anthropological methods used during the different stages of the identification process must be rigorous and systematic.[4,5]

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Use of denture labeling has played a vital role in forensic dental identification in the past. The article presents a review of the past methods and technique of labeling prostheses, and proposes a new method for a standardized, uniform reporting that can be adopted universally.

Identification Process

Reconstructive identification is a prerequisite to comparative identification.[6] During the reconstructive identification process, all necessary information (physical attributes, medical and dental clues, deoxyribonucleic acid (DNA), and fingerprint) is gathered from the unknown body of the victim so that an objective reconstructed profile can be established. This reconstructed post mortem (PM) profile can then be matched with missing persons'[7] The definite establishment of identity of a body essentially comes from a detailed comparison and matching of tangible antemortem records and PM findings.[8] The final identification results depend mainly on the presence and quality of

information and in particular availability of evidences such as antemortem X-rays,[9,10] fingerprints,[11] dental records,[2,6,12] and of course DNA.[13] In 2006 Perrier, noted the effectiveness of the different methods in identifying the Phuket victims: 73% for odontology, 24% for dactyloscopy and 3% for DNA analysis[14] with similar conclusions reported by Sribanditmongkol *et al.* about reconciled Thai victims by primary evidence under TTVI (Thai Tsunami Victim Identification).[15,16]

The identification of an unknown body is more reliable if it is based on the physical evidence derived from the body itself when compared to circumstantial evidences. Therefore, the general features of the naked body should be described including sex, estimated age, height, built, color of skin, hair, and eye color. Taken together with other details, they can lead to a positive identification. Specific features, such as scars, moles, tattoos, and abnormalities, are often unique and thus extremely important if they can be matched with antemortem data. Photographs of dead bodies highlighting its face and other peculiarities must be taken for a later visual recognition of the body by the relatives.[17]

In mass causalities usually no internal autopsy is done in most cases as the external examination generally provides sufficient evidence of the cause of death. However, autopsy may be necessary as an essential part of the overall investigation of the disaster. Medical findings, for example, signs of previous fractures or surgery, missing organs such as appendix, uterus, or kidney, and implants may assist in identification.[18]

Challenges in fingerprint analysis in mass disasters

Fingerprints are unique to every person. If fingers are available with the body, they constitute the safest and fastest identification means available provided antemortem prints can be obtained for comparison. As of February 21, 2005, approximately 80% of victims examined have identifiable fingerprints. It is unfortunate that only small number of (AM) fingerprint submissions, i.e. 21% of these submissions match (PM) fingerprints recovered. This is the highest rate of success seen so far![19]

Challenges in deoxyribonucleic acid profiling

DNA profiling is done using genomic DNA and mitochondrial DNA. DNA analysis can reveal the genetic profile of the individual. DNA is analyzed using polymerase chain reaction. Postmortem DNA samples are compared with antemortem sample (stored blood, hair brush and clothing).[20]

There are many different interrelated factors and circumstances involved in each specific mass disaster scenario that may challenge the final DNA identification goal, such as: The number of victims, mechanisms of body destruction, the extent of body fragmentation, rate of DNA degradation, the body accessibility for sample collection, or type of DNA reference samples availability. The additional complication of reduced availability of direct reference samples should also be considered. The situation can also be further complicated by the rate and speed of body recovery from the sea, affecting DNA integrity in some cases. Ultra violet light, extreme pH, severe heat, microbial contamination and certain environmental conditions (high humidity) can damage molecular arrangement and make DNA unsuitable for analysis. Most collection and preservation protocols for DNA evidence focus on providing a cool, dark, dry environment, and secure from sources of chemical/biological contamination.[20]

An example emphasizing the need for quick and easy methods of identification during such catastrophes was on December 26, 2004, when a 9.0 Richter scale earthquake occurred north of Sumatra Island. The result of this extensive earthquake caused a huge tsunami which later struck many countries on the coast of the Indian Ocean causing nearly 217,000 deaths and approximately 125,000 injured. The deceased bodies were recovered and transferred to these morgues by rescue teams. Without any refrigerated container or methods to preserve the bodies, the forensic teams had to examine the bodies quickly as before the corpses decomposed. The forensic teams recorded external appearances, personal belongings and specific marks on the deceased following their protocols. These early examinations were conducted with limited resources and limited cold storage for dead bodies. During the first few days when bodies were still quite intact, the identification was confirmed mainly by external appearances and physical evidences. The longer the time, the more difficult it was to identify the body due to decomposition. Few deceased were fingerprinted by forensic science police. The reasons not all the bodies were fingerprinted included lack of cooperation between relevant authorities, not enough fingerprint experts and bodies decomposition. About 86% of identification was based on dental records, about 12% is fingerprint and <0.5% relied on DNA results. The most important evidence using in body identification was dental record, especially with the victims from European countries. Fingerprint was the second most evidence used. DNA, in contrast, expected to play an important role, was found to be less useful. Not only due to its high cost, but also because it is time consuming. At the mid of April 2005, there were 2315 bodies which is about 43% of deaths in Thailand left waiting to be identified and returned to their homeland.[16]

This highlights the need to first focus on simple, inexpensive and time-efficient methods, of course without minimizing the value of fingerprints and the excellence of DNA, which are decisive in the identification process.

Dental prostheses in identification

The procedures of dental identification are acceptable because the human dentition has good postmortem

preservation. It is the hardest mineralized tissue of the human skeleton. Even dental restorations and prostheses are extremely resistant to physical and chemical deterioration. In addition, the unique morphological characteristics of human teeth and dental restorations have great individuality, whereby the availability of routine dental treatment records (especially radiographs and models) provides exacting evidence for comparison.

There have been a number of requests from individuals and dental organizations over the years to insist that dental prostheses are labeled with the patient's name or a unique number.[19] The National Health Service provide a fee for dentists who label their patients dentures, although this is often only used in instances where the wearer is a resident in a care home or other establishment with a central sterilizing system for dental prostheses. Labeled dentures can be of great assistance in the identification of individuals.[21] Other dental appliances, such as removable orthodontic braces have also been used for identification purposes.

Whittaker describes a case where a removable orthodontic appliance was used to identify a victim of a house fire.[22] In 1835, a gold denture helped identify the burnt body of Countess of Salisbury. After the Second World War, 819 of the 3000 of the unidentified dead soldiers were denture wearers. However unfortunately, only nine persons of those who wore dentures could be identified.[23]

Bagi BS mentioned in 1977 that the bodies of Hitler and his mistress Eva Brauma were identified by his dentist, using dental records. Sansare mentioned in 1995 that general Zia-Ul-Haq, late president of Pakistan, died in 1988 in a plane crash. His body was identified by his dentition.[24]

With the standard methods of forensic odontology each victim who had to be identified by comparison of postmortem and antemortem dental records required, on the average, three man-hours just for the postmortem oral examination. A complete set of antemortem dental records may take days to reach the identification center, may be incomplete or incorrect, or may not exist at all. Thus, a quicker and more accurate identification procedure for victims of mass disasters remains a goal of forensic science.[25]

The Swiss identification system

Central to the Swiss identification system is an encoded information chip sealed within the enamel of the tooth with a fire-resistant filling of red composite material. The red color ensures the rapid location of the information chip at the disaster site identification center. A micro-processing unit allows an operator, using a typewriter keyboard to place in its memory 13 alpha numeric characters such as a social security number (SSN). The characters, engraved as a series of dots, are easily read with the aid of a hand lens. The chip is sealed in a cavity prepared within the lingual enamel of the selected tooth with a red composite material filling and the acid-etch technique. This, simple, and reliable forensic identification system permits the rapid and positive identification of victims of catastrophes such as airplane accidents, battles, floods, and fires.[26]

Labeling dental prostheses

Labeling of all dentures is recommended by most international dental associations and forensic odontologists. In fact, in some countries and certain states of the USA, the labeling of dentures is regulated by legislation.[27]

Positive identification of the denture is usually done with a tiny, discreet identification code which is embedded in the denture base.[28] The standard requirements for denture markers are that they should be biologically inert when incorporated into the denture, inexpensive, easy and quick to apply, possible to retrieve after an accident, acid resistant and survive elevated temperatures.[21] The marking must also be esthetically acceptable, visible (readable) and durable without jeopardizing the strength of the prostheses. In addition, the marking should be permanent and resistant to everyday cleansing and disinfecting agents.[29,30]

In countries where unique identification numbers are given to each individual, dentures may be marked with that number to enable positive identification.

Various methods/techniques

There are two main methods in marking dentures, namely the surface method and the inclusion method.

In the surface marking method, the marks are located on one of the denture's surface and can be done by "scribing or engraving" the denture itself. In this technique, letters, or numbers are engraved with a small round dental bur on the fitting surface of the maxillary complete denture. This engraving can cause detrimental effects such as food debris getting lodged leading to bacterial infection.[28]

Another surface marking technique, "embossing", comprises initials of the name and the surname of the patient that are scratched with a dental bur on the master cast. This technique produces embossed lettering on the fitting surface of the denture and has been associated with malignancy, possibly due to continued tissue irritation, and may not be an ideal method for denture marking. A better way is to cover the embossed marking on the denture framework with the denture base acrylic and process it to finished state and hence that it causes no irritation to the tissue.

The inclusion methods are more permanent as opposed to the relatively simple surface marking methods; however, these techniques require certain skills and are

time consuming. The marks are made using metallic or nonmetallic materials, microchips and micro labels, which are enclosed in the denture at the packing stage. Sometimes, a dislocation, wrinkling, or tear can occur proving to be a disadvantage as an identification method.[28]

Prostheses may be marked with a stainless steel metal band, paper strips, laser etching, electronic microchips, radio-frequency identification-tags, Lenticular printing, barcoding, and patient's photographs.[28]

Prevalence of various types of prosthetic dental restorations

Approximately, half of the adult population in most European countries has had some type of prosthetic dental restoration. The frequency of RDPs among adults varied between 13% and 29%, with 3-13% edentulous subjects wearing complete dentures in both jaws. The frequency of fixed restorations including crowns and fixed dental prostheses (bridges) was the highest in Sweden with 45% and Switzerland (34%). In the recent decades, there has been a slight decrease in RDP use reflecting a decline in edentulism, while more subjects had maintained a residual dentition and were wearing removable partial dentures or fixed restorations. The latter are less prevalent in countries with lower prosperity.[31]

The above data emphasizes the need to shift our focus from labeling only removable dentures to fixed prostheses. In addition, other dental appliances like removable and fixed orthodontic appliances, surgical plates and even healthy teeth can be marked with some identification code to facilitate identification.

A new proposal for labeling dental prostheses using national identification code numbers as a universal personal identification code

Forensic organizations worldwide have recommended that dental prostheses should be marked with, at a minimum, the patient's name and preferably with further unique identifiers such as a SSN.[32]

A national identification number is used by the governments of many countries as a means of tracking their citizens, permanent residents, and temporary residents for the purposes of work, taxation, government benefits, health care, and other governmental related functions. Sometimes, the number will appear on an identity card issued by a country.

The ways in which such a system is implemented are dependent on the country, but in most cases, a citizen is issued an identification number at birth or when they reach a legal age (typically the age of 18). Noncitizens may be issued such numbers when they enter the country, or when granted a temporary or permanent residence permit.

Many countries issued such numbers ostensibly for a singular purpose, but over time, they become a *de facto* national identification number. Some such examples are:

- Albania: Albanian identity number is a unique personal identification number of 10-characters in the format YYMMDDSSSC.
- Australia: Medicare card number/tax file number.
- France: French National Institute for Statistics and Economic Studies code.
- India: Permanent account number/Unique Identification Authority of India renamed as AADHAR.
- New Zealand: Inland Revenue Department number.
- Singapore: National Registration Identity Card.
- South Africa: 13-digit number (YYMMDDSSSSCAZ).
- Thailand: Population identification code a 13-digit number.
- Turkey: Turkish Identification Number (Turkish: *Türkiye Cumhuriyeti Kimlik Numarası* or abbreviated as *T. C. Kimlik No.*), an 11-digit number.
- United States: In the United States, a SSN is a nine-digit number issued to US citizens, permanent residents, and temporary (working) residents. In recent years the SSN has therefore become a *de facto* national identification number.[33]

Due to the universal and easy application we suggest the use of marking dental prostheses and appliances (removable and fixed prostheses, orthodontic appliances, implants, surgical plates [Figures 1-3]) with laser dot pen marking and healthy teeth using the Swiss identification system to incorporate the national identification number as the UPIC.

This method may initially be a little less cost effective, but if the national organizations worldwide make it mandatory and support the idea, not only would the expenses involved in cumbersome procedures like DNA analysis would drastically be reduced, but it would facilitate easier and quicker identification of many unfortunate individuals, who fall prey to natural and manmade mass disasters.

Conclusion

India is a disaster prone country with an average of eight major natural calamities a year. While floods, cyclones, droughts, earthquakes and epidemic are frequent from time-to-time, major accidents occur in railways, mines, and factories causing extensive damage to human life and property. During all these disasters, the bodies of most of the victims are mutilated beyond recognition by visual or any other methods. Under these situations forensic dental identification is extremely valuable.[34]

In general, no thought is given as to how several hundred corpses would be found, accommodated, examined, and

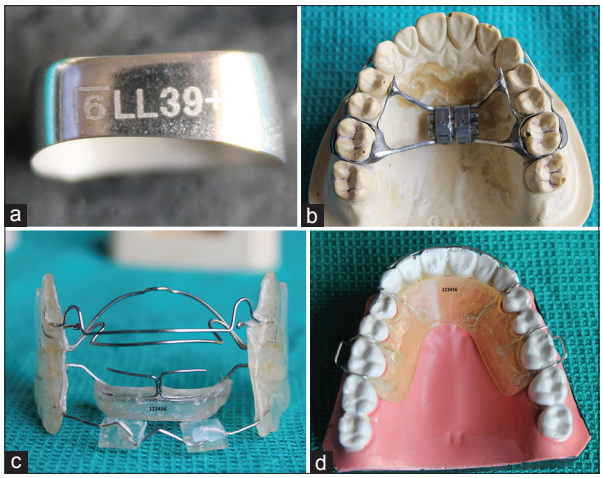

Figure 1: Materials used in orthodontic appliances coded with the identification number (a-d)

Figure 2: Materials used in prosthodontic appliances coded with the identification number (a-d)

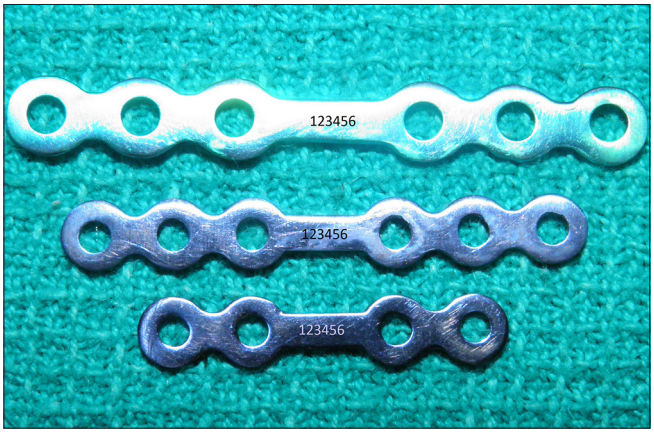

Figure 3: Surgical plates coded with the identification number

identified in a mass disaster. Therefore, in the context of identification, it is essential that every responsible public authority, forensic institute, and individual pathologist should make some forward provision for such an eventuality.

The key to success in mass disaster identification is preparedness. Globally, the recent spate of terrorist attacks and natural disasters in which there have been multiple fatalities has reinforced the need for forensic organizations worldwide recommend that dental prostheses should be marked preferably with unique identifiers. Hence, we propose that national identification numbers be incorporated in all removable and fixed prostheses, so as to adopt a single and definitive UPIC with the aim of achieving a uniform, standardized, easy and fast identification method worldwide for forensic identification. From an administrative point of view, we believe that it is imperative for national organizations and worldwide dental associations adopt a single and definitive numbering system for each unidentified body, so that we can achieve a uniform, standardized, easy, and fast identification method universally.

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