Dental Identification of Unknown Bodies

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Summary

Dental identification of unknown bodies is a well known and widely used method of identification and is especially valuable when other means of identification such as visual recognition and finger prints are not possible.

Traditionally, dental identification essentially depends on a comparison of the dental restorations present in the teeth of the deceased with the dental records of a missing person.

Difficulties are encountered in some cases when either or both of these elements are not sufficiently available to permit reliable identification. Serious damage to or complete destruction of restorations and disintegration of dental tissues as the result of extreme environmental changes, failure to recover all teeth and their included restorations, and incomplete dental records may frustrate the identification process.

An ominous challenge to dental identification however, is the result of the dramatic improvement in dental health in many countries due to the implementation of public health measures such as fluoridation with a consequent reduction in dental caries and restorations.

This paper offers some suggestions which may help to overcome some of these difficulties and explores some applications of new technology to the problems of dental identification in the future.

Keywords: *Dental identification*
Problems
Technology

Introduction

Of all aspects of forensic odontology, the most widely known and utilised is that which is concerned with the identification of unknown bodies. Indeed, to many both within the profession of dentistry and certainly among the lay public, forensic odontology is synonymous with identification of the dead by means of their teeth. Because so much has been published in text books, scientific journals and the popular press covering all facets of this fascinating field, it will be sufficient here merely to review the main principles relating to dental identification in general terms and then to focus upon a number of the problems that may be experienced in practice.

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In most modern sophisticated societies, a great deal of importance is placed upon the identification of all deceased persons. Proper identification is required for legal and humanitarian reasons. Legal events consequent upon death include civil and also criminal possibilities. Large inheritances and insurance claims may be at stake and although details of the legal systems and process involved vary from one country to another, none can be activated until identification of the deceased has been established. Deliberate falsification of an identification for fradulent gain is being attempted on an increasing scale around the world and cases of two or more unrelated families claiming to positively identify one single body in an aircraft accident in order to benefit by the insurance payout, are not unknown. These reasons and also humanitarian considerations require that identification of the dead should be absolutely reliable and completed with as much expedition as possible.

Methods of Identification

Possible methods of identification are listed as follows:

1. Visual recognition
2. Property identification
3. Scientific identification:
   (a) fingerprints
   (b) dental comparison
   (c) medical evidence

Both visual recognition of the deceased by a relative or close associate and the identification of property, such as clothing, documents and jewellery found upon the deceased person or in close proximity at the scene of death have been and indeed still are, accepted by most authorities in certain circumstances. However, either or both methods may be unreliable when a relative or friend experiences considerable stress when confronted with the decreased and thereby has his judgement seriously impaired, or where property has been unknowingly transferred. They certainly cannot be used when post-mortem changes have rendered recognition undesirable or impossible, or where identifiable property has not been found. For these reasons, the demand for scientific identification is growing.

Of the three scientific methods listed, each may alone provide sufficient evidence for positive identification. Each is limited by the availability of sufficient post-mortem material and accurate ante-mortem documentation of unique features relating to the deceased. This paper is limited to a consideration of dental means of identification or as it is sometimes termed, identification by dental comparison.

Dental Comparison

On the face of it, dental comparison affords a straightforward and apparently simple means of establishing identity. Its possibility depends upon:

(a) The resistance of dental hard tissues and restorations to changes resulting from putrefication or harsh environmental extremes
(b) The unique individual characteristics of the dentition and dental restorations (it has been estimated that the chance of two identical dentitions is in the order of 1 in 10^{20}).[1]
(c) The availability of documentation of the ante-mortem status of the dentition in the form of dental treatment records and diagnostic radiographs.

Identification may thus be achieved by comparing the dental status of the deceased with the dental records of persons believed to be missing in circumstances consistent with those in which the remains of the unknown deceased person were found. Obviously, the greater the number of coincident features, the more reliable will be the identification.

Procedures in Dental Identification

1. *Recovery of Dental Structures*

The task of dental identification begins at the site of discovery of the body. If there are no serious post-mortem changes to the teeth and jaws, the body can be conveyed to the mortuary for examination after appropriate documentation and photography of the scene has been completed. When gross post-mortem changes affecting the teeth have occurred, such as charring, disintegration and fragmentation in fires and high impact accidents, or skeletonisation of the remains resulting in the loss of teeth from their sockets, the careful observation and photography of the dental structures in situ, and meticulous care in their recovery and conveyance to the mortuary are of the utmost importance. A forensic odontologist should attend the scene to assist in the search and recovery of materials of dental significance needed for identification.

2. *Reconstruction and Examination*

In the mortuary laboratory, reconstruction of the fragments recovered is the first step towards identification. A full dental examination must then be carried out and properly recorded on an odontogram. In some cases, it may be necessary to remove the jaws for more detailed examination and future reference. However, a decision to do this must be carefully considered in the light of any serious legal implications of the identification and of the state of the structures themselves

3. *Collection of Ante-Mortem Records*

Dental records of relevant missing persons should be sought as soon as possible after the need for a dental identification appears necessary. Such records should include all charts, radiographs and dental casts and clinical and portrait photographs as may be available.

4. *Transcription of Dental Records*

Dental records are usually kept by each dentist according to his personal recording system and notation and this may vary from dentist to dentist. Relevant information recorded on these charts must be transcribed in a code from which an odontogram is constructed in a style similar to that used for recording the ante-mortem dental examination.

5. *Comparison of Odontograms*

The two odontograms recording the ante-mortem and post-mortem data respectively are compared and, according to the degree of correspondence of the data on each odontogram, a decision on the identification is reached.

6. *Report*

A formal report including the odontograms is prepared for submission to the appropriate authority.

Problems in Identification

Dental identification does not always follow a straight-forward course. Obstacles to successful identification include the following:

1. *Condition of Material Recovered*

The condition and amount of dental material recovered will depend upon the circumstances surrounding the death and the care exercised in the collection and transport of it. Incineration produces damage to teeth ranging from mild scorching of the surface to severe charring of the enamel and dentine with crumbling of the crown, depending on the duration and temperature of the fire. Sustained very high temperatures will result in calcination of the teeth with considerable overall shrinkage. The appearance of such teeth may be ashen white to greyish white. They are usually very fragile and suffer separation of the enamel and often gross disintegration of the crowns.

In high impact accidents such as aircraft and high speed road crashes, much mechanical damage can occur and teeth and jaws can fracture and disintegrate. Failure to recover significant material may result in failure to identify. The use of a trained and experienced dental expert at the scene to recognise and recover such material is most important. If not all the dental hard tissues are recovered, then sieving of the soil or ashes may be required. Even with the greatest care, not infrequently, some of the teeth may not be found or may have been damaged beyond possible reconstruction

Proper preparation of the recovered material will assist in its reconstruction and facilitate the examination by providing a clean, clear field and eliminate unpleasant aromas of putrefaction. Soft tissue adhering to jaws and fragments of jaws should be removed without further damaging the teeth. This can be done by chemical digestion (Papain), bleaching and drying. Small fragments may require several hours of preparation, while a whole skull may need two or more days to process (see Appendix I).

Very fragile teeth and skeletonised material which cannot be handled without damage, can be treated using a method developed by the South Australian Museum.[2] This entails the impregnation of the material with resin under reduced pressure followed by drying for 24 hours Reconstruction of even a full skull from fragile fragments so treated, can be successfully carried out to permit handling in the normal way.

Errors in Examination

Errors can easily be made in the examination and recording of the post-mortem dental material. The consequences of such mistakes can be far reaching — as was demonstrated in the "Albury Pyjama Girl" case.[3] A wise precaution is to have two dentists working together, one examining and the other recording. The two roles are then reversed and the procedure repeated as an added check.

Inadequate Ante-Mortem Dental Data

Every effort must be made to obtain full dental records. Information about the names of dentists who treated or may have treated the deceased is first sought from relatives. Not infrequently, even close relatives may be unaware of the names of the dentists consulted by the deceased and it is then necessary to canvass dentists in a particular area in the hope that some of these at some time may have treated the deceased. Ideally, these names should be supplied to the forensic odontologist who can then contact the dentist(s) directly by telephone or personally for an oral description of the treatment provided, and both the dentist and forensic odontologist can discuss more meaningfully the relevance of the information. This can expedite the identification considerably and also will provide an indication about the need to seek further information. The original dental records may then be collected as soon as convenient for confirmation of the identification and kept on file for possible court exhibition. Another advantage of direct communication with the dentist is that he is likely to feel more comfortable discussing his records with a professional colleague than giving information to a

police officer. This procedure has been followed with considerable success by the writer over many years.

Errors in charting teeth treated and insufficient descriptive details about the treatment provided unfortunately are by no means rare and add further frustration to the identification procedures.

Other difficulties arise when a dentist has retired and destroyed his records, including those required for an identification. A similar problem occurs when the deceased has been treated by a series of dentists over the years, each of whom has recorded *only* the treatment he has provided, and the name of only the most recent dentist is known. There will then be insufficient antemortem information to establish identity. This problem would largely be overcome if the simple practice of recording the existing dental status of each new patient was followed by all dentists routinely. Not only would this provide useful basic information for the dentist treating the patient, but the contribution to identification would be invaluable.

In some large institutions, the cost of maintaining dental records indefinitely has demanded a policy of culling all records at regular intervals and cases have occurred where this practice has involved the destruction of records shortly before they were required for identification. Such problems may be minimised if dental records of missing persons are routinely obtained promptly and kept on file until such time as the person reappears or his remains are discovered.

In a recent experience, a dentist's assistant, on hearing that a patient of the practice had been accidentally killed in a fire, removed the chart from the file and destroyed it two hours before receiving a telephone call requesting the chart for identification of the victim!

Identification of Edentulous Bodies

Denture Identification

There are those who believe that dental identification of edentulous bodies is not possible. Frequently, dentures are present in the mouths of unknown bodies, or may be found elsewhere. If the denture can be identified and it can be shown to fit the mouth of the deceased, a reliable identification can be made. A comparison of the rugae patterns on the palate of the deceased and of the denture, can usually determine the "fit" of the denture to the deceased. However, the question of identification of the denture may present quite another problem. Details of the type, mould and shade of the teeth used, the base material and the nature of finish can assist.

The most reliable means of identification of dentures however, is for them to be permanently marked by either the name of the patient or suitable code during manufacture. This is a legal requirement in certain countries. Its universal adoption as a routine procedure would be an important contribution to identification.

Cranio-facial Superimposition

Where dental records are inadequate and a photograph of the deceased is available, photosuperimposition of the skull upon the photograph offers a possible solution. It may be argued that this is not strictly *dental* identification but it is entirely appropriate for the forensic odontologist to carry out this procedure. Indeed his training and experience in the restoration of teeth in harmony with facial features certainly qualify him to recognise and compare the characteristic features in the skull and portrait. The use of cranio-facial video superimposition offers greater potential for detailed examination and comparison than the conventional method.[4] This possibility must always be considered before deciding to remove the jaws for identification and this decision must be deferred until the existence, availability and extent of dental records has been confirmed.

Future Trends

One further problem that has begun to affect dental identification is the consequence of the growing decline in dental caries with the resulting reduction in dental restorations, particulary in those countries with fluoridation programmes. The foreseeable future may see a minority of the population with little or no evidence of dental treatment at all. Other means of identification must be explored.

Identification Chip Systems

The embedding of a specially inscribed ceramic micro-chip carrying identification data under a restoration in selected teeth has been developed.[5] A unique radiopaque marker is included as an indication of the tooth carrying the chip and will be readily observed in an x-ray scan of the jaws. The cost of such systems at present renders them suitable for use for personnel in high risk occupations but may preclude them from routine application for the general population.

Computers

Computers already are applied to assist in dental identification. Their increasing use in the storing of dental records may help to overcome problems of "lost" or "destroyed" records and programmes for rapid retrieval and matching of dental data are already available.

Multivariate analysis of dental arch shapes offers an interesting possibility for a relatively simple method of identification. The unique characteristics of the dental arch have already been demonstrated.[6] Recordings of

the arches could be routinely procured by biting on a sheet of wax. The wax bite can be permanently recorded by Polaroid photography or by Xerox and filed as part of the dental records. When required, a comparison could be made by digitising the arch pattern of the record and comparing it with a similar record made by the dental arch of the teeth of the deceased.

Computer enhancement of photographs for cranio-facial video-superimposition has recently been developed and offers great potential for future application.[7] Bio-stereometrics and computer graphics are presently being explored.

Conclusion

Dental identification or identification by dental comparison affords a valuable tool in the armamentarium of those responsible for the identification of dead bodies. While the procedures are straightforward, in the final analysis, the method depends heavily upon the ante-mortem dental data supplied by dentists who treated the deceased. This places a heavy responsibility not only upon all dentists to keep adequate records, but also upon forensic odontologists to impress upon their colleagues in dental practice the need to be constantly aware that any detail performed in their day to day treatment may one day have enormous significance in the identification of one of their patients and their treatment records should reflect this awareness.

Acknowledgements

This paper was prepared under a special grant from the South Australian Government and the Australian Federal Police to whom grateful acknowledgement is made. Special thanks for technical and other assistance is due to Mr. T. E. Bridges, Mrs. M. Garth and Mr. T. Elliot.

REFERENCES

1. Krauss B S, Jordan R E, Abrams L: Dental Anatomy and Occulsion Williams & Wilkins, Baltimore, 1969
2. Cotton K: Reconstruction of Ancient and Friable Bone from Porous Soil Abstracts of the Second Australian Conference for Science Technology, Adelaide, 1975, 92-4.
3. Brown K A: Historical Review: The Identification of Linda Agostini. The Significance of Dental Evidence in the Albury 'Pyjama Girl' Case. Am J Forensic Med Pathol 1982, 3:131-41
4. Brown K A, Hollamby C, Clarke B J, Reynolds L: A Video Technique of Cranio-facial Photo Superimposition Abstracts of Scientific Programme The 8th International Meeting of the International Association of Forensic Sciences, Wichita, Kansas, U.S.A. The International Association of Forensic Sciences, 1978, abs. No. 119.
5. Samis P L: Systems of Identification Can Soc Forensic Sci J, 1975, 8:77-86.
6. Drummond P W Mathematic Characteristics of Dental Morphology. A Theoretical Approach to Identification in Forensic Odontology. B D S (Hons) Thesis, University of Adelaide, 1974.
7. Hall M C, Starkey G. Personal communication.

APPENDIX I
PREPARATION OF SKELETAL MATERIAL
BLEACHING OF BONES

100 milligrams Diaminoethane terra acetic acid disodium salt (EDTA)
20 milligrams L-Cysteine Hydrochloride
5% Papain — biochemical (Searle Hopking and Williams)
(5 grams/2 gallon water)

Using warm water, add Papain (optimum temperature), EDTA and Cysteine. Mix well. Sprinkle Papain powder over specimen. Add water from tap (37 °C) and bring to boil slowly Avoid inhaling fumes — it is advisable to wear protective mask and rubber gloves. Simmer for 2-3 hours. Allow to cool. Remove residual soft tissues Boil in Chloroform to remove fats, etc. (approximately 1 hour). Bleach in H_2O_2 (50 vols.) + 5 mls. concentrated Ammonia — wash over with water (running tap water — 1 hour). Dry.