Abstract
Identification by means of dental comparison between records of a missing person and the dentition of a deceased individual depends on recognition of consistent features common to both with no unexplained discrepancies.

Individual root-treated teeth possess a constellation of distinctive radiographic features that provide excellent opportunities for analysis in this context. Root canal treatments rely heavily on radiographic imaging as part of the procedure, and require the taking of a post-treatment radiograph to confirm the result. This means that there is almost always an ante-mortem radiograph which can be used for comparison with a similar image of the post-mortem case, providing the certainty that arises from using images derived directly from the individual rather than written dental records.

We discuss the principles underlying this comparison and illustrate the use of the technique with three cases.

Methods

In a typical forensic setting, the goal of the forensic odontologist is to identify an unknown deceased individual by comparison of their dental features with the dental records of a person thought to be missing following a police investigation.

Written dental records are not the preferred basis of comparison as they are not derived directly from a person. They are merely an interpretive, indirect record of an event or an observation, which may not be contemporaneous and may have been written in part by a third party. They are prone to errors, inaccuracies and misinterpretation. This quality makes written records unreliable as the sole basis of comparison in identity identification. Furthermore, a statistical basis for identification by comparison of dental features has not been developed.

Images however, are an objective method of recording information; they do not mislead and do not record subjective impressions. In addition, they capture a wealth of specific morphological data that is far richer and more specific than information recorded in a written dental record, making them an excellent basis for a comparison. Radiographs are an excellent example of images that capture the unique morphological features of the teeth, their surrounding structures, and any dental restorations that may be present.

Due to their relative rarity and their unique expression of individual morphological features, root canal treatments are a very fruitful source of features that can be used to differentiate between dentitions and, by extension, demonstrate similarity to a high degree for identification by image comparison. Furthermore, the technique of radiographic imaging to provide a record of the outcome thus providing a post-treatment radiograph that is commonly available as part of the medical record.

The purpose of the comparison process is to establish that these radiographs originate either from the same person (identification) or from different people (exclusion).

The success of the technique is dependent on the similarity of the parameters with which the two images have been taken. Examination of the ante-mortem radiograph reveals information about the environment position, the film exposure, and the relative magnification of distortion of the image. All of these parameters need to be replicated in the post-mortem radiograph in order to render the two images directly comparable (Case 2 shows the effect of not duplicating the x-ray sensor position accurately). Commonly this necessitates a series of post-mortem images in order to obtain a satisfactory result. Initial inspection of the first radiograph usually allows assessment as to whether the morphology of the root treatment, filling and dental morphology are sufficiently similar that an exclusion cannot be determined at this stage. If the observed morphology is sufficiently similar, then subsequent radiographs are taken to improve image comparability.

Case 1

The missing person radiograph is on the left, and the image of the deceased is on the right. While a brief handwritten note was the only supplied dental record of the missing person, the radiograph demonstrated the presence of the root canal treatment in the upper left lateral incisor. Without this feature, the similarity between the handwritten note, the supplied radiograph and the post-mortem radiograph would have been insufficient to do more than state that the records were consistent with those of the deceased.

Case 2

The deceased was not visually identifiable following severe incineration. Visual examination of the dentition was not undertaken due to the fragility of the remains.

The supplied dental record of the missing person included an OPG radiograph (top). A machine to take an OPG radiograph of a deceased person was not available, so a periapical radiograph was taken of the deceased instead. In spite of the different radiographic parameters that resulted, a comparison between the two images could be made, due to the similarity of the root canal treatment in tooth 16. The corresponding radiograph of the missing person was also supplied with the dental record, and it showed the presence of a root canal treatment in tooth 16. The supplied dental record contained a number of radiographs including the one shown above (left). A radiograph of the deceased was taken without further damage to the teeth or jaw, and the comparison, shown above, is sufficient to determine that these radiographs are images of the same individual.

Case 3

Periapical radiograph of missing person

Periapical radiograph of deceased

The deceased was severely putrefied and not visually identifiable. A detailed record had been supplied by police for the missing person, and comparison of this record with the dental features of the deceased demonstrated complete consistency. A periapical radiograph (left, above) was also supplied with the dental record, and it showed the presence of a root canal treatment in tooth 16. The corresponding radiograph of the deceased (right) showed a root canal treatment in tooth 16 with features sufficient to demonstrate that the two images originated from the same individual. Providing objective confirmation of the opinion of similarity, we felt that manipulation of the jaws would further damage the teeth.

Case 4

The deceased person was severely putrefied and not visually identifiable. A dental record had been supplied by police for the missing person, and comparison of this record with the dental features of the deceased demonstrated complete consistency. A periapical radiograph (left, above) was also supplied with the dental record, and it showed the presence of a root canal treatment in tooth 16. The corresponding radiograph of the deceased (right) showed a root canal treatment in tooth 16 with features sufficient to demonstrate that the two images originated from the same individual, providing objective confirmation of the opinion of similarity.

Discussion

Following a police investigation in the matter of a routine forensic identification, a missing person will have been tentatively identified as the most likely candidate for the identity of a deceased person. The forensic odontologist is then asked to compare any available dental records of that missing person with the dental features of the deceased to determine if they are both likely to have originated from the same individual.

Thus, the dental features of the deceased are not being compared with the teeth of all other people on earth; this is a one-to-one comparison, and the possible outcomes are:

a) Confirmation: all dental features of both records exhibit correlation with no unexplained discrepancies.
b) Consistency: all dental records exhibit correlation with no unexplained discrepancies, but there are insufficient numbers of features to determine identity beyond possible doubt.
c) Insufficient Information: not enough information exists on which an opinion can be given; and

d) Exclusion: The two sets of dental records clearly originate from different individuals.

In Queensland, we will not indicate Confirmation of Identity or from different people (exclusion).

In the ideal case, post-mortem radiographs are taken in such a way that the original conditions under which the ante-mortem image was taken are duplicated as nearly as possible. In such circumstances, similarities between the two images can be demonstrated by superimposition and digital subtraction of common features. In none of the cases presented was this degree of similarity obtained, so image comparison alone is used. Superimposition is not possible in a case such as case 3, in which different types of radiographs are used.

Conclusion

We conclude that root canal treatments provide a wealth of morphological detail, providing rich data for the comparison of radiographs from an unknown missing person and an unknown deceased person to answer the question of whether the two images are derived from the same individual. In particular the root canal treatment provides a common feature that, in the cases presented, is sufficient to demonstrate identity identity.

References

