F23 Root Morphology and Anatomical Patterns in Forensic Dental Identification: A Comparison of Computer-Aided Identification With Traditional Forensic Dental Identification

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After attending this presentation, attendees will have gained further insight into the reliability of dental radiographs for identification purposes when restorations and coronal structures are not present. The dependability of root morphology, trabecular patterns, sinus outlines, and other anatomical features for forensic identification will be discussed. The effectiveness and threshold limit of digital subtraction software for determining similarity between antemortem and postmortem dental radiographs is evaluated. The error rates for the digital evaluations are compared with the error rates of forensic odontologists comparing the same radiograph pairs by traditional visual means.

This presentation will impact the forensic community by both discussing the reliability of forensic dental identification when limited antemortem or postmortem radiographic information is available and by providing insight into the usefulness of a computer program to aid forensic dental identification.

Because of the individuality of dental patterns, the resiliency of dental structures to withstand extreme conditions, and the accessibility of antemortem dental records, forensic dental identification plays an important role in establishing the identity of unknown decedents. Dental comparisons have played vital roles in victim identification following multiple fatality incidents such as the September 2001 terror attacks, the 2004 Indian Ocean tsunami, and the 2005 Hurricanes Katrina and Rita. Forensic dental identification can be an important identification method in smaller scale cases which involve single or multiple fatalities including motor vehicle crashes, smaller scale airplane crashes, structural fires, and whenever decomposed or skeletonized bodies are found.

Dental identification is a reliable and efficient method but often relies on the uniqueness of individual features of dental restorations compared between antemortem and postmortem radiographs. Identification is more challenging in cases in which either no antemortem dental restorations exist or no postmortem restorations remain after events resulting in fragmentation or prolonged extreme heat exposure. Root morphology, bone trabecular patterns, sinus morphology, or other distinctive characteristics are the primary anatomical features used for comparisons in these cases. However, the error rate for forensic odontologists performing visual identifications in these cases has not been quantified. Studies by Clement, Dove, Anderson and others exploring the use of digital subtraction radiography to aid comparison of dental radiographs have rendered favorable results. Lehmann determined that cross covariance coefficient (CCC) was an appropriate statistical tool when used with digital subtraction radiographic comparisons. Flint et al used digital subtraction radiography to determine that there was a significant difference in CCC between images taken at different times from the same individual and those from different individuals. A web based study by Sweet and Pretty evaluated dental identification error rates and determined that comparing digital radiographs via the internet was a valid, accurate and reliable method. Clinical trials using actual forensic cases to test the usefulness of subtraction radiography and the error rates for traditional visual identification by forensic odontologists are needed. This is especially true for those cases in which there are no restorations and when coronal structures are missing postmortem and therefore not present for comparison.

Coronal structures on antemortem and postmortem dental radiographs from actual forensic identification cases were digitally removed using Adobe Photoshop (version CS3). Each case was represented by one antemortem and one postmortem radiograph. Analysis of the radiograph pairs was performed on a Toshiba Satellite notebook computer, using the Windows 98 operating system within Microsoft Virtual PC on Vista Premium operating system. Software used was UTHSCSA ImageTool Version 3.0 (developed at the University of Texas Health Science Center at San Antonio, Texas). Using the UT-ID plug-in module for ImageTool, each pair of AM-PM radiographs was registered to adjust for varying projection geometries. Subtraction radiography and pixel by pixel image comparison techniques were applied to determine the cross covariance coefficient.

A web-based participant examination was designed (using HostedTest™, Irvine CA). Participating forensic odontologists visually examined the same unregistered AM-PM radiograph pairs and established one of the four American Board of Forensic Odontology identification conclusions: positive identification, possible identification, exclusion or insufficient evidence. The same images were analyzed using UT-ID/ImageTool. Error rates for the forensic odontologists' visual identification were established and compared with the error rates using the UT-ID/ImageTool computer-aided identification method. **Identification, Dental, Computer-Aided**

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