H5 Human Identification from CT and MRI Scans: Novel Approaches to an Old Problem

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After attending this presentation, attendees will learn about the various ways in which computerized tomography (CT) and magnetic resonance imaging (MRI) scans can be used for comparison with radiographs, scans and models of unknown decedents to establish personal identity.

This presentation will impact the forensic science community by demonstrating novel approaches to human identification based on CT and MRI medical records. These approaches allow multiple avenues for antemortem/postmortem radiographic comparison and address the issue of pattern recognition.

Prior to the advent and widespread use of computerized tomography (CT) and magnetic resonance imaging (MRI) techniques in clinical medicine, patients who had sustained traumatic injury to the head and face were evaluated using plain film radiography. Anthropologists used these skull series and various facial radiographic projections to compare with postmortem radiographs of unknown decedents to establish the decedent's personal identity using frontal sinuses, grooves for the middle meningeal arteries, the *sella turcica*, and other structures thought to be morphologically unique in each individual. Over the past decade, plain film radiology has been abandoned as a diagnostic tool for most head and face injuries. Instead, the more detailed and clinically useful CT and/or MRI are used. This shift in diagnostic radiology has resulted in a dearth of available plain film radiographs from which to identify putative decedents. Investigators are, instead, presenting CT and MRI studies to anthropologists, while anthropologists are generally limited to plain film technology for radiographic imaging of skeletal remains. CT and MRI scans may be available as a film series, digital imaging and communications in medicine (DICOM) images on a digital recording medium, or scan volume data.
An obvious solution is to perform a CT scan on the unidentified cranium, matching the transverse or axial images between the antemortem and postmortem scans. Volume scan data may be used to recreate, in three dimensions, a virtual model of the skull that provides further information, such as frontal sinus volumes, upon which identity may be established. However, this route towards identification is costly and dependent on the availability of CT and MRI scanners (which are usually running at capacity in clinical areas), and one must deal with the probability that the two scan formats may not be precisely aligned. Another solution is to use the antero-posterior and/or lateral "scout films," taken as part of the CT or MRI protocols, as a proxy for the antemortem "plain film" which can then be compared to postmortem images. However, scout films are small and generally become pixilated when expanded to a useable size.

More creative uses of CT and MRI scans are:

- Using axial scans of the head to capture the dental pattern of the putative decedent for comparison with a postmortem odontogram. The investigator may then use Adams et al. OdontoSearch 2.0 program to determine the relative frequency of the matching pattern, and then assign probative value of the match based on that information.[1]
- Using scan volume data to produce a three-dimensional model of the putative decedent's skull, this can be compared with the unknown specimen both metrically and via digital radiography. This method requires access to a three-dimensional model printer. Once the model is printed it can be radiographed. Comparison of this "antemortem" film with the radiographs of the unknown skull is only limited by the resolution of the printed models. In most cases; however, the model represents a faithful reproduction of most of the anatomical variants used by anthropologists to establish identity. Additionally, one may compare metrics obtained from the model, the unidentified skull, and the population from which the individual is derived.
- Evaluating scans for idiosyncratic variation, pathology or trauma that might correspond with findings based on examination of an unknown skeleton.

This presentation will use case reports to explore the various ways in which CT scans may be used to establish personal identity in forensic contexts.

Reference:

[1.] Adams BJ, Shigeta CK, Drogosch AC, Schumann RW. OdontoSearch version 2.0. Joint POW/MIA Accounting Command, Central Identification Laboratory, 2007.

Forensic Anthropology, Human Identification, Radiographic Comparison

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