H75 The Impact of High Speed-High Resolution Three Dimensional CT Scans on Forensic Anthropology

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After attending this presentation, attendees become aware of scientific advancements involving the examination of human remains utilizing high speed/high resolution CT scans. In addition attendees will be informed on the various applications this new technology will have in forensic anthropology.

This presentation will impact the forensic community, forensic Anthropology, and forensic pathology by demonstrating new imaging technology which will allow for non-evasive anatomical examination.

In the past few years tremendous scientific advancements have been made in the field of three dimensional medical imaging. One of the greatest advancements has involved the development of Computerized Tomography scanners which can produce high resolution – three dimensional images of the human body within a matter of minutes. The new generation CT scanners utilized in hospitals and medical clinics have had an unparalleled impact on the diagnosis and treatment of living patients. Recent research by scientists at the Institute of Forensic Medicine, University of Bern, Switzerland, have pioneered a new use for the CT scanners, that being in the field of forensic pathology. Unlike in living individuals, the postmortem examination of bodies by high speed CT is not limited to regulated radiation safety levels, and therefore greater resolution can be obtained during CT scans by increasing the power/radiation levels.

In 2005 the U.S. military acquired an advanced CT unit, a GE Light Speed 16, for postmortem examinations at the Dover Port Mortuary located at Dover Air Force Base, Dover Delaware. The mortuary is a large state of the art morgue facility utilized by the Armed Forces Medical Examiner. Presently the CT unit is being utilized routinely to scan the bodies of military fatalities from around the world. Use of the CT scanner in the postmortem examination of fatalities, has provided a wealth of new information not obtainable by the two dimensional views provided by standard film or digital radiography.

One of the primary focal points of postmortem examinations is the presence of skeletal injuries. Cases involving skeletal trauma may require removal of the particular skeletal element/s in order to conduct a detailed examination. Removal of the skeletal elements and associated soft tissues may not be practical or acceptable, and therefore a limited amount of information may be obtained. Extensive fragmentation of skeletal elements can also pose many problems, as it may be very difficult to access the pattern of damage due to disruption of anatomical position. Similar problems are encountered when dealing with badly decomposed remains. In cases requiring anthropological evaluation, the skeletal element/s must be rendered free of soft tissues and decompositional debris, which requires expertise and time. The use of new generation CT scanners virtually eliminates problems associated with removal of skeletal elements and soft tissues, and provides a new level of assessment of skeletal trauma and anthropological attributes which is non-invasive.

Key attributes of the new generation CT scanner utilized at the Dover Port Mortuary, include its rapid scan speed, high resolution, three – dimensional capability, and the ability to target in on differential densities so as to provide specific imaging of various anatomical features such as skin, muscles, internal organs, the skeleton, or injury sites. The resolution obtained by the Dover CT unit is .26 mm and the average full body scan can be accomplished in as little as two minutes. Images created by the scan can be viewed in as fixed two dimensional images represented by single or multiple sectional views, two dimensional overall views, or animated threedimensional views. Highly accurate measurements can be made from two or three dimensional views of virtually any anatomical location. Measurements include linear, area, and density.

The impact of the new CT technology will have profound effects in forensic anthropology. For example in the case of a fresh body with extensive blunt force trauma to the skull, examination of the cranial fragmentation pattern may be difficult to determine as a portion of fragments may be displaced into the cranial vault, covered by soft tissues and fluids, or possibly missing. Also manual manipulation of the skull to examine a fracture site may result in collapse of the cranial fracture site thus requiring cranial reconstruction. Utilizing the new CT technology one would be able to see the actual positional state of fragmentation in a three dimensional view, and each fragment can be isolated for detailed examination of the fracture lines and edges along the fractured bone.

Anthropometric analysis of various aspects of the human body will greatly be enhanced, as the CT scans are non-invasive and will allow for detailed measurements of body parameters, and areas of the skeleton such as the cranial vault or sinuses, which are not readily accessible by calipers or other measuring tools. Osteometric data collection will be brought to such a high level that biological traits such as racial classification will become more highly refined allowing differentiation between geographical populations. Osteological changes relating to skeletal age, for the first time, can be accurately quantified, rather than relying on subjective assessment of bony changes. All of the images produced by the scanner can be easily stored and transmitted as they are in a digital format supported by most computer systems.

Although the CT units are very expensive at this time, the price will decrease over time and the units will become available for use by universities and colleges. The use of the new CT imaging technology will be a major

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new stepping stone for forensic anthropology, answering old questions and creating new ones.

Anthropology, Digital Imaging, Radiology

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