H89 New Method of Identification Based on Computer-Assisted Radiograph Comparison

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After attending this presentation, attendees will have received a detailed description of the basis for the computer-assisted radiograph comparison method, explanation of the proposed practical application of the method in medical examiner/coroner offices, and a discussion of the pilot study results.

The presentation will impact the forensic science community by introducing a new and practical identification method that is responsive to the recent National Academy of Science Report recommendations and post-*Daubert* evidence admissibility standards.

A crucial need exists for a statistically validated, time-sensitive, and relatively inexpensive scientific identification method for routine use in the medical examiner/coroner setting. Medical examiner/coroner reliance on scientific identification extends far beyond the completely unknown medicolegal decedent. Tentatively identified decedents are often unrecognizable due to disfiguring facial trauma, charring, or advanced decomposition. In cases of multiple fatalities, scientific identification methods are used because there is increased potential for incorrect assignment of identity. In the aftermath of a mass fatality event, scientific identification of the casualties becomes paramount. This presentation describes a new quantitative approach to identification achieved through modification of existing clinically-tested computer technology. Attendees will receive a detailed description of the basis for the computer-assisted radiograph comparison method, the proposed practical application of the method in medical examiner/coroner offices, and a discussion of the pilot study results.

The foundation of the proposed identification method is "Quantitative Motion Analysis" (QMA®) software (Medical Metrics, Incorporated). The performance of the software has been validated in multiple clinically based peer-reviewed studies of spinal biomechanics and spinal treatments. QMA® allows for computer-assisted matching of specific skeletal elements, such as vertebral bodies, by tracking them through multiple radiographic images. The first step in transforming QMA® into a forensic identification tool has been to program the software to generate quantitative match scores for a statistically sufficient number of tracked skeletal elements per comparison.

The ongoing pilot study began with the development of a processing algorithm that provides QMA® with the ability to successfully calculate the required match scores. The fourth cervical vertebra (C4) was selected as the first test element. The goal of this initial work was simply to develop and test the algorithm, a time- consuming process that required testing of a large number of rejected algorithms. Once a satisfactory algorithm was developed, it was tested on five unique sets of lateral cervical radiographs or fluoroscopic images of 10 individual subjects. The anonymized radiographs were assembled from archived spine research image sets. There were no implants or surgical alterations in any of the views. The sets of images were of subjects between the ages of 22 and 89 years, loosely grouped into "younger" and "older" subjects for comparison purposes. Each set of images contained two different images of the same index subject and an array of nine images from nine different subjects. During the QMA® tracking process, variations in magnification between images were adjusted so that the C4 was approximately the same size in all of the images. Following the tracking process, a region of interest was defined

around the C4, the images were rotated so that the endplates were approximately horizontal, and histogram equalization was applied to all of the images, using the combined histogram for the entire set of images. This process standardized the orientation of the vertebrae and equalized brightness and contrast of the images in each set. A contrast enhancement filter was then applied that maximized contrast for horizontally aligned image features. This filter weights the contribution of the vertebral endplates more heavily than other features. An image match score was then calculated between the first image and each of the other images in the set.

For each set of 10 images, the maximum match score was returned for the two index images, representing a correct comparison match for the index subject in each set. The maximum score was scaled to 100 and all other match scores were normalized to that score. After normalization, all matches returned a score of 99-100 and non-match scores ranged from 77-98. The results of the pilot study show that QMA® can successfully be adapted to establish positive identification in the medical examiner/coroner system.

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Radiograph Identification, Forensic Anthropology, QMA®

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