H69 A New Approach to Radiographic Comparison: Combining Morphometric and Morphoscopic Techniques

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After attending this presentation, attendees will gain a better understanding of how morphometric and morphoscopic techniques can be combined to enhance the efficiency of visual radiographic comparison methods for human identification. The goals of this presentation are to: (1) evaluate the reproducibility of a morphometric comparison method that can be utilized to abbreviate a lengthy list of potential matches; and, (2) apply the morphometric method in constructing a test to evaluate the morphoscopic comparison method.

This presentation will impact the forensic science community by promoting a new approach to radiographic comparison that will enhance the efficiency of identifying unknown individuals when the size of the potential-match list precludes a manual search.

Prior studies have validated the use of chest radiograph comparison as a method of identification, and recent morphometric approaches have used Elliptical Fourier Analysis (EFA) to examine whether clavicular morphology is diagnostic for individuation. A new metric method based on clavicular shape outline has recently been developed and validated for use at the Joint POW/MIA Accounting Command, Central Identification Laboratory (JPAC-CIL) to expedite identifications made through radiograph comparison.[1] The present study serves to strengthen the protocol of this new method.

This method uses EFA to compare clavicle shape from 3D surface scans of Postmortem (PM) human remains with 2D hand-traced outlines from Antemortem (AM) radiographs by ranking individuals using shape similarity. Because this requires manual tracing of 2D clavicle outlines, its accuracy relies upon outline reproducibility. A series of observer-variation studies were conducted to examine potential measurement uncertainty associated with tracing of clavicle outlines and trimming of the medial and lateral ends. Repeatability was assessed using Coefficient of the Variance of the Error (CVE) and by comparing the EFA ranks generated for each outline. CVE results indicate that measurement uncertainty is relatively low (<15%). EFA results demonstrate small measurement differences between observers, with the correct match ranking in the top 5% of the sample 72% of the time, and in the top 25% of the sample 94% of the time. These results are consistent with a recent study.[1]

The morphometric method was used to construct a morphoscopic test that presented examiners with a series of arrays containing images that varied in degree of morphological similarity, and thus difficulty. Degree of similarity between AM/PM images was defined through specific EFA values. AM radiographs were then morphoscopically assessed to ensure similarity in vertebral morphology. Radiographs were acquired from the medical records of unaccounted for U.S. service personnel located at the JPAC-CIL. The test consisted of five arrays, each containing one PM and five AM radiographs.

The test was administered to 42 individuals at the JPAC-CIL. Participants were asked to compare each PM image to the five AM images to determine whether a match existed. Overall rates are as follows: accuracy 85%; positive predictive value 73%; negative predictive value 94%; sensitivity 82%; and specificity 87%. The results were broken down based upon level of education, professional experience, and prior radiographic experience. In general, method performance tended to improve as level of education increased. However, participants with an MA/MS performed slightly better than those with a PhD. Participants with 10+ years of professional experience performed at higher rates than those with less experience. Interestingly, participants with no professional experience performed quite well as a group, generating higher rates than individuals with nine or fewer years of experience. Lastly, participants with prior training/experience in radiograph comparison outperformed participants with no prior training/experience.

Test results demonstrate the value of the morphoscopic comparison method for identifying unknown individuals, especially when employed by experienced analysts. Observer-variation studies of the morphometric method indicate method reliability, and when used in conjunction with the morphoscopic method, can enhance the efficiency of identifications by shortening the potential-match list. While results demonstrate the value of combining morphometric and morphoscopic methods for identification of individuals using chest radiographs, further research could investigate the applicability of this technique using skeletal elements from other body regions.

Reference:

1. Stephan CN, Amidan B, Trease H, Guyomarc'h P, Pulsipher T, Byrd J. Morphometric comparison of clavicle outlines from 3D bone scans and 2D chest radiographs: A short-listing tool to assist radiographic identification of human skeletons. J Forensic Sci 2014;In press.

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