H110 Skeletal Identification by Radiographic Comparison: Blind Tests of a Morphoscopic Method Using Antemortem Chest Radiographs

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After attending this presentation, attendees will have an appreciation for how identifications can be established using the bone morphology depicted on chest radiographs, what error rates can be expected, and why the methods form the last viable modality for the identification of many United States personnel unaccounted for from the Korean War.

This presentation will impact the forensic science community by providing data for the most rigorous validation test of a non-dental radiographic comparison method that has so far been undertaken (see methods reported below). Additionally, it demonstrates the potency that normal radiographic anatomies of the claviculae and C3-T4 vertebrae hold for the correct identification of unknown human skeletons (when of course, antemortem [AM] chest radiographs are available).

Radiographs of the chest form the second-most frequently captured x-ray image after dental radiographs; however, chest radiographs are typically easier to locate (i.e., they form part of the medical record) and, therefore, they hold greater potential forensic value. Despite this, research on chest radiographs (at least from an identification perspective) has been limited and past validation studies have been hampered by the use of simulated AM radiographs and relatively easy test protocols (multiple pair matching tasks from the same, typically small, simultaneous array [n<40 individuals]). Here we redress these limitations using twelve field-recovered skeletons, authentic AM chest radiographs (including those of >1390 non-matching individuals), postmortem radiographs taken and utilized by independent examiners, and a radiographic comparison method that employs the claviculae and C3-T4 vertebrae. Rigorous method assessments were undertaken by using: examiners who operated in the blind; a single target individual in each identification test; new non-target individuals across all tests; up to 1000 radiographs in any single simultaneous array; sequential arrays in some trials (= examiners blinded to identification universe size, no opportunity for examiners to compare array radiographs side-by-side, and no opportunity for examiners to review decisions and/or radiographs); < quarter-size 50-year-old radiographs of suboptimal image quality; skeletons in various states of preservation (including varied states of erosion/completeness, two very poorly preserved skeletons and four other skeletons that had fifty percent of one clavicular shaft missing due to prior mtDNA sampling), back-to-back tests wherever possible (to encourage examiner fatigue), and time pressures for some trials. Thus, the performance levels observed in this study should represent baseline values. Eight examiners took part in the study: two trained on the radiographic images/methods and six other untrained examiners (= persons not receiving in-depth training on methods and additionally with limited radiographic experience [especially for the chest]; and/or limited knowledge of the *in vivo* position of the thoracic human skeleton; and/or limited understanding of x-ray principles/equipment operation).

Only true positive identifications were made for the simultaneous arrays (accuracy = 100%, sensitivity = 100%; n = 6 trials). While erroneous identification responses were made during the sequential trials they were almost exclusively made by untrained examiners. That is, the accuracy, sensitivity and specificity for trained examiners was 90%, 80% and 100% respectively (n = 10 trials), whereas the accuracy, sensitivity and specificity for the untrained examiners was 35%, 50% and 29% respectively (n = 20 trials). Furthermore, untrained examiners took twice as long as trained examiners to reach identification decisions during the sequential trails, even though they performed with less accuracy (mean = 68 sec compared to 34 sec for trained examiners). Method limits were established by the very poorly preserved remains in conjunction with the sequential trials administered under an identification context; but when these very incomplete remains were tested using simultaneous arrays and/or sequential trials under exclusion/inclusion contexts, the methods retained their value in the hands of trained examiners (accuracy = 100%, specificity = 100%, n = 2 trials). In view of the purposefully imposed stringency of this study, these results indicate that AM chest radiographs hold value for skeletal identification when implemented by trained examiners, especially for moderate-to-well preserved skeletal remains. Moreover, since benchmark accuracies for other radiographic identification methods have been set using more lenient tests, we suspect that the identification power of the method reported here at least rivals (and possibly even surpasses) that for higher esteemed body regions. These results justify the employment of the method in future forensic casework and should encourage attempts to make future improvements to these methods. Additionally, the results underscore the danger for untrained practitioners to employ the technique in its current unquantified state, but they also indicate that competency can be quickly induced by training with practice sets of images (c. 100-200 individuals) administered under simultaneous formats.

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