A1 Quantification of Radiologic Identification: Development of a Population Frequency Data Repository

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After attending this presentation, attendees will be familiar with the development of a repository of population frequency data on radiologic features used in forensic identification comparisons.

This presentation will impact the forensic science community by allowing practitioners involved in radiologic comparisons to utilize population frequency data to enhance identification comparisons by providing statistical probabilities of correct and incorrect identification.

Radiographic comparison is a reliable means of personal identification in medicolegal death investigations. As with any identification approach (such as fingerprints, DNA, dentition, etc.), a key requirement of radiologic identification is that the trait or feature being compared in the antemortem and postmortem data must be relatively rare in the general population. The more unusual a shared feature is, the greater the probability that the identification is correct (i.e., that the two datasets originated from the same person). Population frequencies describe the frequency with which a feature is found in the general population, and they form the basis for the validity of any identification approach, including comparative radiology.

Most forensic radiology comparisons involve a relatively subjective assessment of the degree of similarity between antemortem and postmortem radiologic images (whether X-ray, Computed Tomography (CT), Magnetic Resonance Imaging (MRI), or other imaging modality), typically involving a qualitative visual comparison with the conclusion regarding an identification (or exclusion) being based on the skill and experience of the practitioner. Such assessments have been shown to be reliable in the sense that practitioners can locate matches (or pairs of images from the same person) among moderately large data sets, and misidentifications (or mismatches) have been demonstrated to be rare, with the ability to identify correct matches generally varying as a function of practitioner experience. However, subjective comparisons are insufficient for quantitatively assessing the strength (or evidentiary value) of an association and cannot typically be used to determine the probability of a correct (or incorrect) identification.

Rather than concluding that antemortem and postmortem radiologic images appear similar or the same, the results of radiologic identification comparisons are ideally expressed as likelihood ratios, which describe the probability of sharing radiologic features given that the identification is correct, over the probability of sharing the features if the identification is incorrect. The implementation of quantitative methods bolsters conclusions by providing statistical support for the probability of a correct (or incorrect) identification; however, quantitative methods require the acquisition and use of population frequency data for radiographic traits used in identification comparisons. In order to assess the probability of correct identification, the frequency of the trait shared in the antemortem and postmortem data must be known or estimated. Such data are currently absent for many features or difficult to access for others, precluding the use of quantitative methods in forensic radiologic identification in most cases. For certain skeletal/radiologic features, population frequencies may be reported in the journals and texts of disparate fields, often in publications unrelated to radiologic identification, making it difficult for forensic practitioners to locate the necessary data. For other traits, their population frequencies or variations in configuration require additional study.

In an effort to resolve this problem of insufficient or inaccessible data, this study is currently working to build a repository of estimated population frequencies for commonly assessed radiologic traits. Beginning with a thorough literature review, the first phase of the project involves mining currently available publications and data (including peer-reviewed medical and anthropological research and popular medical atlases) for documented population frequencies. The next phase of the project will involve the selection and analysis of additional traits using a large dataset of postmortem CT scans available through the New Mexico Office of the Medical Investigator. The database will eventually be made available through a publicly accessible website. Practitioners will then be able to reference the database, using the estimated population frequencies in forensic comparison casework. Researchers and practitioners wishing to participate in the data collection phase are encouraged to submit references or research to this study for possible inclusion in the database.

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