

CASE REPORT

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Anthropological and Radiographic Comparison of Vertebrae for Identification of Decomposed Human Remains

ABSTRACT: This case study demonstrates the importance of involving an anthropologist in forensic situations with decomposed remains. Anthropological consultation was used in conjunction with the comparison of antemortem and postmortem radiographs to establish positive identification of unknown, decomposed remains. The remains had no traditional identifying features such as fingerprints or dental. Through anthropological analysis, it was determined the decedent was male, between 20 and 23 years at time of death and *c.* 5'2" tall. This information allowed for a presumptive identification and a request for antemortem radiographs. The missing person was identified comparing the spinous processes of the cervical and thoracic vertebrae between ante- and postmortem radiographs.

KEYWORDS: forensic science, forensic anthropology, radiographic comparison, human remains, decomposition, personal identification, spinous process

Both physical anthropology and radiography have long been used to help identify unidentified human remains (1–9). Routinely, medical examiner and coroners utilize physical anthropologists for remains that are skeletonized or nearly skeletonized. However, the application of anthropological techniques for developing biological profiles should also be used to assist in identifying decomposed, burned, and mummified remains. This case report demonstrates how a biological profile developed on remains found floating in a river allowed for a quick identification by radiographic means.

Case History

Partially skeletonized human remains were recovered under a bridge in Manhattan, New York, after floating up the East River in late July (Fig. 1). The upper extremities were disarticulated at the elbow and the lower extremities were disarticulated at the knee. Additionally, the head was disarticulated at the junction between the first and second cervical vertebrae. The disarticulated elements were not recovered. Adipocere was adherent to most of the torso, although there was no skin present. Muscles and ligaments of the back, upper torso, and thighs held the skeleton together. External genitalia were male. Multiple postmortem fractures were noted on the exposed ribs and vertebrae. There was no injury of the vertebral column from the fifth cervical through the lumbar area or of the remaining viscera, including the tracheal and laryngeal carti-

lages. This portion of the torso was protected within the adipose tissue.

Anthropological study of the remains was requested to provide a biological profile and assist in achieving an identification. The femur yielded a stature range of 62.5 ± 3.2 in., or *c.* 5 ft 2 in. Morphological examination of the pubic symphyses, the medial clavicle, and rib ends provided an age range estimated between 20 and 23 years. Postmortem interval was estimated at 1–3 months. This information was passed to the New York Police Department Missing Persons Unit. The biological profile matched a missing person report of a male, 22 years of age and 5 ft 2 in. tall, who was reported missing *c.* 5 weeks previously. He was known to be depressed and suicidal. In addition, there were multiple eyewitness reports from the day this person went missing of a young Caucasian man who matched his physical description jumping off a bridge into the East River.

Following an accident 3 years previously, this man had radiographs taken of the neck and chest, and the family was able to provide these antemortem films for comparison. The seventh cervical vertebra and the first thoracic vertebra were the most useful candidates for radiographic comparison as they provided the most visible details in the antemortem and postmortem films. Examination of the postmortem radiograph revealed the shape of the spinous processes in the two vertebrae examined clearly matched the antemortem radiograph of the missing individual (Fig. 2). The visual comparison of the antemortem and postmortem radiographs provided sufficient evidence to achieve an identification. In addition, the degree of decomposition of the remains was consistent with the time passed since this man was reported missing. The final cause and manner of death certified for this individual was drowning, suicide. The Office of Chief Medical Examiner, Department of Forensic Biology confirmed the identification by DNA analysis a few weeks later.

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FIG. 1—Partially skeletonized human remains of an unidentified male demonstrate adipocere and disarticulation at the extremities and upper cervical vertebrae, with absence of the head.

Discussion

Once a presumptive identification is made and antemortem radiographs are provided, the reliability of radiograph comparison is dependent upon a number of factors, most notably discrepancies between body orientation in antemortem radiographs and the positioning of skeletal elements in postmortem radiographs. If the unidentified remains are decomposed or incomplete, one still must try to recreate the anatomical positioning of the body exactly as it was in the antemortem radiographs. However, as shown in this study and others (10–12), identification often is possible without exact recreation of the original position. This is especially true when comparing the unique morphological features of single bones that are not dependent on articulation between elements.

Radiographic comparisons require a working knowledge of skeletal morphology, of discrete features and of bony landmarks. A study by Kuehn et al. (11) tested the accuracy of radiographic comparison for identification purposes. Four specialists from three different forensic fields compared ante- and postmortem radiographs for identification. The forensic anthropologist had the highest percentage of correct identifications compared with the other experts. The anthropologist relied more on morphology and bony landmarks than on diagnostic features or pathologies of the skeletal elements. In that study, as well as this current case, the

anthropologist proved to be valuable in recognizing similar patterns between the vertebrae of the missing individual and the remains recovered.

Currently, there is no standardization on the number of features that should be noted between antemortem and postmortem radiographs to establish an identification. However, in the absence of a distinctive deformity or fracture, the skeletal landmarks compared should be normal anatomical structures with unique features that remain stable over time and do not remodel (10,11,13). Radiographic comparison of vertebrae depends on morphological features such as transverse processes, spinous processes, pedicles, and margins of vertebral bodies (12,14–17). Reliance on common degenerative changes, such as osteophytic lipping or intervertebral space is discouraged, unless the antemortem radiograph was taken shortly before death, because pathological conditions change over time.

Summary

This case stresses the importance of involving an anthropologist in forensic situations with decomposed remains. Anthropological consultation provided otherwise unavailable information on the remains, restricted the breadth of the search, and provided a



FIG. 2—Side-by-side comparison of postmortem (left) and antemortem (right) radiographs demonstrates identical morphology, allowing positive identification of the decomposed remains. Arrows indicate the seventh cervical and first thoracic vertebra.

presumptive identification. When medical examiner/coroners are faced with unidentified human remains, anthropologists provide a direction for presumptive identifications especially if other methods, such as fingerprint or dental, are unavailable. Additionally, this case again demonstrates that variability in vertebral morphology can be used for identification (18). The widespread availability of chest radiographs and the abundance of bony landmarks on the vertebrae reinforce the value of vertebrae for identification.

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