Available online at www.sciencedirect.com
SCIENCE DIRECT®
Forensic Science International 156 (2006) 63–69
Forensic Science International
www.elsevier.com/locate/forsciint

Short communication

Resolution of small-scale commingling: A case report from the Vietnam War

Bradley J. Adams *, John E. Byrd

Joint POW/MIA Accounting Command, Central Identification Laboratory (formerly the U.S. Army Central Identification Laboratory), 310 Worchester Ave., Hickam AFB, HI 96853, USA

Received 21 June 2003; accepted 7 April 2004
Available online 27 October 2005

Abstract

A case is reported that involves the commingled skeletal remains of two individuals who died in a helicopter crash in 1969 during the Vietnam War. The incomplete portions of two bodies were initially recovered soon after the crash. These portions were identified by personnel at a U.S. Army Mortuary in Saigon and were returned to the next-of-kin. While searching for scrap metal in 2002, a Vietnamese citizen unexpectedly discovered human remains and personal effects interspersed with buried aircraft wreckage. The personal effects correlated with the individuals who died in the 1969 incident. These newly discovered remains and artifacts were subsequently received at the U.S. Army Central Identification Laboratory, Hawaii (CILHI) for analysis. As part of the CILHI analysis it was necessary to segregate the commingled remains into specific individuals for identification purposes. Details regarding various sorting techniques are described that provide a solid framework for systematically dealing with small-scale commingling. The sorting techniques used in the resolution of this case consist of visual pair-matching, articulation, process of elimination, osteometric comparison, and taphonomy. These techniques, when used in conjunction with each other, provided a solid basis for the individualization of most skeletal elements.

Keywords: Forensic anthropology; Physical anthropology; Commingling; Human identification; Vietnam; CILHI

1. Introduction

Resolution of commingling is a facet of many anthropological analyses, especially those involving human remains recovered from mass graves or aircraft crashes. It is often the job of physical/forensic anthropologists to determine the number of individuals represented by the commingled remains and to subsequently ''rebuild'' the individuals by sorting the remains to the greatest extent possible. Despite its importance, relatively little attention has been given to the analysis of commingled remains in the published literature. Notable exceptions are the recent publications by Ubelaker [1] and Byrd and Adams [2], both of which provide comprehensive lists of references.

An early discussion of commingling can be found in an article by Charles Snow [3] where he details the analytical procedures used in the identification of U.S. service members from World War II. Snow advocated a systematic approach to sorting that utilized existing methods such as pair-matching, articulation, and process of elimination in a series of steps. Today, the analysis of DNA sequence data provides another powerful step in the sorting process [4]. Unfortunately, the use of DNA is typically not feasible for most analyses due to the monetary costs and the logistical limitations of the procedure. Snow's gross sorting techniques form the basis of our approach, but some enhancements have

* Corresponding author. Present address: Office of Chief Medical Examiner, 520 First Ave., New York, NY 10016, USA.
E-mail address: NYCbones@hotmail.com (B.J. Adams).

0379-0738/$ – see front matter © 2005 Published by Elsevier Ireland Ltd.
doi:10.1016/j.forsciint.2004.04.088

been made. This case report will focus on the gross and metric sorting techniques that we have found to be the most useful for the analysis of commingled human remains.

The complexity of the sorting process is clearly dependent on the overall number of individuals involved in the incident and the preservation of the remains. The estimation of numbers of commingled individuals has been discussed elsewhere [5] and will not be addressed further in this case report. This report will showcase a systematic approach to sorting that utilizes several gross techniques (visual pair-matching, articulation, process of elimination, and taphonomy) and one metric technique (osteometric comparison). These procedures can be reliably and objectively applied to most instances of small-scale commingling. They are also very useful for large-scale commingling situations, but the discriminating power is likely to be reduced in many circumstances as the number of skeletons grows (i.e., differences in size and shape may not be as apparent when the number of individuals increases). Large-scale commingling also introduces many logistical problems regarding analysis [6].

2. Case history

The case discussed in this paper involves the loss of a U.S. Army Cobra helicopter that crashed in South Vietnam in March 1969. The aircraft, carrying a pilot and a gunner, crashed into a rice paddy when it lost its rotor due to hostile fire or mechanical failure (the ultimate cause was never determined). The pilot was a Caucasian male with documented statures of 66–67 in. He was 22 years, 6 months old at the time of the crash. The gunner was a Caucasian male with documented statures of 67–70 in. He was 26 years, 8 months old at the time of the crash.

A Search and Recovery team recovered partial remains from the crash site 2 days later and processed the remains through the U.S. Army Mortuary in Saigon. Portions of both men were identified based on examination of the recovered remains. The pilot was represented by primarily his upper body, and he was identified based on fingerprint comparison, clothing marked with his name and rank, and consistencies in his dental treatment records. The gunner was represented almost exclusively by a distal right tibia and a complete right foot. The identification of these remains was based on the fact that they were recovered within a combat boot marked with the individual's name.

The helicopter crash site was re-discovered in the summer of 2002 by a local Vietnamese citizen of Long Thuan Village in Long An Province who was searching for scrap metal. During his search, he discovered human remains and personal effects mixed amongst the aircraft wreckage. The salvager collected the remains and personal effects, and then contacted local Vietnamese officials. As the remains were not systematically recovered, all field provenience was lost. Eventually the CILHI was notified of the discovery and a CILHI anthropologist was dispatched to the site along with officials of the U.S. Military's Joint Task Force—Full Accounting. The American team visited the site in August and received the human remains and personal effects from the Vietnamese salvager. These items were later transported to the CILHI for analysis. The material evidence, which included identification media, indicated that the remains were likely additional portions of the pilot and gunner who had been identified from the helicopter crash in 1969.

Analysis of the human remains at the CILHI revealed that the partial remains of at least two commingled individuals were represented. As a result, sorting techniques were employed to segregate the remains into specific individuals for return to their next-of-kin.

3. Sorting techniques

We follow the sorting approach advocated by Snow [3], but with a few enhancements. The first step of the sorting process involves the determination of element representation. As part of this step, fragmentary remains should be conjoined to the greatest extent possible as this will assist in overall segregation process. Bones should then be sorted by element type, side, and size (e.g., all right femora should be organized from most gracile to most robust). Grouping elements by age criteria (e.g., lack of epiphyseal fusion) may also be helpful at this stage of the sorting process. It is important to maintain any provenience information collected during the recovery effort as this may become critical during the analytical process. Furthermore, elements that were articulated at the time of recovery should be maintained as a unit.

Once these initial steps are completed, visual pair-matching, articulation, process of elimination, osteometric comparison, and taphonomy can be systematically applied. For illustrative purposes, the analyses of the unilaterally recovered remains from Vietnam are described for each step of the process. Tables 1 and 2 provide summaries of the sorting techniques used to associate specific elements to Individuals 1 and 2.

3.1. Visual pair-matching

Visual pair-matching refers to the association of homologous (i.e., left–right) elements based on similarities in morphology. In many instances, the right and left sides will be mirror images of each other. It is important to realize that pair-matching refers to the same element type (e.g., right and left humeri). Visual matching of different skeletal elements (e.g., a humerus and a femur) based on morphology is not recommended in most instances due to the subjective nature of the procedure. (Visual matching of different element types may be possible with cases that involve a limited number of individuals who exhibit marked skeletal variation.)