

**FORENSIC ANTHROPOLOGY BEST PRACTICES  
FOR LAW ENFORCEMENT**

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## **Forensic Anthropology**

Forensic Anthropology is the “application of the science of physical or biological anthropology to the legal process” (American Academy of Forensic Anthropology – [www.aafs.org](http://www.aafs.org)). More specifically, it is the application of osteology (study of the human skeletal system) to answering questions of medico-legal importance. Forensic anthropologists are typically physical or biological anthropologists with advanced graduate degrees in Anthropology, with a specialty focus in Osteology and Forensic Anthropology (Tersigni-Tarrant and Shirley 2013). A small number (approximately 1/3 or less) are board-certified through the American Board of Forensic Anthropology (ABFA), becoming a Diplomate of the ABFA through a lengthy and rigorous oral and practical testing process. Board certification is optional for practicing Forensic Anthropologists, but may become required in the future. A listing of all Board-Certified Forensic Anthropologists can be found at [www.theabfa.org](http://www.theabfa.org). Practicing Forensic Anthropologists should also be members of AAFS (American Academy of Forensic Sciences—[www.aafs.org](http://www.aafs.org)). More information about Best Practices in Forensic Anthropology can be found at SWGANTH (Scientific Working Group in Forensic Anthropology) at [www.swganth.org](http://www.swganth.org).

The majority of Forensic Anthropologists (over 50%) work primarily as academics in college and university anthropology departments or in medical schools teaching anatomy and consulting with Medical Examiner, Coroner and Law Enforcement offices when requested. A growing minority are working full-time in these (larger) Medical Examiner offices, while the remainder are private consultants or working in association with the U. S. military (e.g., JPAC/CIL at Hickam Air Force Base in Hawaii ([www.jpac.pacom.mil](http://www.jpac.pacom.mil))).

A Forensic Anthropologist should be called in the following situations:

- Remains are questionable in terms of being human or non-human;

- Human remains are unidentifiable due to advanced decomposition, fragmentation, or damage from water, fire, or other natural or non-natural agents;
- Human remains (including those with soft tissue) exhibit trauma which requires additional consultation with regard to Time Since Injury, mechanism, sequence, or number of events.
- Human remains have undergone significant trauma (e.g., Mass Disasters, Mass Fatality Incidents);
- Child death investigations requiring estimation of Time Since Injury of antemortem fractures.

### **Goals of Forensic Anthropology**

A Forensic Anthropologist is consulted to answer the following questions (Burns 1999):

- Are the remains human? Forensic Anthropologists are specialists in the identification of fragmentary, skeletonized, or otherwise unidentifiable human remains;
- How many individuals are present? Forensic Anthropologists can determine the minimum number of individuals [MNI] present;
- What is the time since death (postmortem interval) and manner of death?;
- What is the biological profile of the individual(s)—age-at-death, sex, ancestry, stature?;
- What happened to the individual before death (antemortem), at the time of (death perimortem), and after (postmortem) death?;
- Who is the individual? Forensic Anthropologists assist in the investigation of clues regarding the specific identity of the deceased [individuation] and reconstruction of the death event.

## **Stages of Forensic Anthropological Investigation**

### **I. Field Assistance**

It is often beneficial to include a Forensic Anthropologist and/or Forensic Archaeologist in the field phase of a death investigation for the following reasons (Dirkmaat 2012):

- Forensic anthropologist and archaeologists can assist with locating and identifying human remains;
- They are particularly adept at archaeological excavation/recovery of human remains;
- A forensic anthropologist can assist with confirmation that the remains are human rather than non-human animal. If a Forensic Anthropologist is not present in the field, a digital photo of the remains can often be sent to one for initial assessment of human vs. non-human remains status;
- Forensic Anthropologists assist with determination of time since death and verifying context (prehistoric, historic, modern) of remains;
- If remains have already been located and removed from their initial context, a site visit by a Forensic Anthropologist can be beneficial in establishing interpretations of perimortem and postmortem activity and can assist in recommendations regarding future searches for additional remains.

### **II. Laboratory Analysis**

Forensic Anthropologists typically conduct the following laboratory analyses:

#### **A. Confirmation of Human Remains**

Forensic Anthropologists can confirm that suspected human remains are indeed human.

This is ascertained with the help of a knowledge and use of a comparative collection of non-

human animal remains (Adams and Crabtree 2011). The following clues assist them in a final confirmation of remains as human:

- Bone size, shape, and density—the 206 bones in the adult human body have a unique shape, which is known to students of osteology (study of the human skeletal system). Often, by process of elimination, if a bone does not have the characteristic human shape, it is likely to be non-human. Likewise, size dimensions and density can help distinguish human vs. non-human. Very large or very small remains may not be human, although caution must be applied when looking at small remains, as juvenile human bones often have a unique shape and size compared to their adult counterparts. In terms of density, non-human bones tend to be more dense than human ones, but this is not always true.
- Bone function—one of the most accurate indicators of human remains is the presence of skeletal features related to bipedalism (walking on two limbs). These features include the existence of a double curvature to the spine, double arch to the feet, short, thick and broad innominate (hip bone), and bicondylar angle to the femur. In comparison, four legged animals (quadrupedal) have a single arch to their spine, single arch to their foot, a long and narrow innominate, and no bicondylar angle to the femur;
- Bone histology (microscopic)—if the remains are very fragmentary and the above features are not visible, then microscopic analysis of bone can often aid in a final confirmation of it as human or non-human.

## **B. Determination of MNI (Minimum Number of Individuals)**

MNI is a conservative estimate of the minimum number of individuals present based on the remains present. It is calculated in a variety of ways, the most basic of which is duplication of bony elements (e.g., two right femora = two individuals). Even in the absence of duplicated elements, it cannot be assumed that only one person is present. Inconsistencies in the biological profile (age, sex, ancestry, stature), bone morphology, color, texture, or lack of refit between adjoining elements may indicate the presence of additional individuals.

## **C. Individuation**

Forensic Anthropologists have multiple ways of identifying unknown human remains (Thompson and Black 2006). At the most basic level, a Biological Profile is assessed, including determination of age-at-death, sex, ancestry, and stature of the remains.

### **Age Determination**

Aging methods differ depending upon whether the remains are suspected to be juvenile or adult.

**Subadults**—age of children is based on evidence of skeletal and dental growth and includes the following features:

- dental eruption and calcification—infants and children from birth to age 15 can be aged based on the eruption and growth of both their deciduous (baby) and adult teeth (Algee-Hewitt 2013), so it is important to use ¼ inch mesh screens when excavating and recovering juvenile remains. Deciduous teeth can be quite tiny;

- cranial and postcranial ossification—“soft” spots (fontanelles) represent areas of cartilage which have not fully ossified (become bone). These may be present in children below the age of two. The child skeleton at various ages may consist of over 400 segments of bone (and cartilage) which have not yet undergone full ossification. The sequence of ossification is known to osteologists (Scheuer and Black 2000) and is a valuable aging tool for subadult remains;
- long bone epiphyseal closure and growth—children in their teens undergo a process of growth plate fusion in their limbs called “epiphyseal fusion.” This occurs for each limb at a known age (see McKern and Stewart 1957) and this evidence can be used to determine age for this age group. The clavicle (collarbone) represents one of the last bones in the body to undergo this process (not “fusing” until the late 20s in some cases), so this is a valuable bone to recover for determining accurate age of individuals in their late teens and twenties.

**Adults**—age of adults is based on degenerative processes of the skeleton, including:

- deterioration of the hip bone (pubic symphysis)—the front portion of the hip joint (where the two pubic bones meet) undergoes age degeneration through adulthood. The face of the pubic symphysis can be compared to casts to establish an age range for the individual;



- deterioration of the rib ends—the sternal end of the ribs (the ends which articulate with the sternum or breast bone) also deteriorate with age at a known rate
- degree of osteoarthritis—osteoarthritis is deterioration of joints between skeletal elements. As such, it can be observed at any joint, but is typically seen affecting the vertebral column, hands, feet, and major limb articulations in older adults;
- degree of dental wear, and deterioration of other skeletal regions.

Since individuals vary in terms of their genetic history, lifestyle, and aging, skeletally-derived age estimates may not be as precise as those for subadults (Milner and Boldsen 2012).

### **Sex Determination**

In a relatively complete adult skeleton, sex can be estimated with 95-98% accuracy (Garvin 2012).

**Subadults** – because children have not reached sexual maturity in their skeleton, methods to determine sex of subadult skeletons are of questionable accuracy (Tersigni-Tarrant and Shirley 2013);

**Adults** – sex of adult skeletons is based on the following regions of the skeleton:

- size and morphology (shape) of the innominates (hip bones), reflecting adaptations in females for childbirth; since these are functional adaptations related to parturition, they are more accurate and reliable indicators for sex determination than those from other regions of the body;

- robusticity of the cranium at the major muscle attachment areas—males usually manifest greater brow ridges and cranial muscle attachments;
- shape of the chin (square-shaped in males and more rounded in females)
- circumference of major long bones as well as diameter of the femoral and humeral heads. Males typically show greater dimensions.

### **Ancestry Determination**

Ancestry estimation from skeletal remains is more problematic than estimations of age or sex for a variety of reasons, ranging from the increasing prevalence of “mixed races” to ambiguity of societal perceptions of “race.” However, reasonably accurate determinations of ancestry can often be made from a consideration of crania (Rhine 1990)

**Cranium** – estimation of ancestry can be accomplished with a fair degree of accuracy from cranial morphology, specifically focused on aspects of facial shape and size (for example, observing and measuring nasal width, height, orbital shape, facial projection or prognathism) assessed either visually or metrically through a software program offered through the University of Tennessee known as FORDISC (Ousley and Jantz 2006);

**Postcranium** – aspects of femoral shape have been correlated with ancestry; however, the accuracy of these observations has not been confirmed;

### **Stature**

Long bones can be utilized to estimate maximum stature:

**Maximum Long Bone Length** – stature can be estimated by

measuring the maximum length of a long bone (those from the leg result in more precise estimations compared to the arms; even hand and foot bones can be used, with decreased accuracy) and applying these measurements to a mathematical regression formula or calculated through FORDISC. Stature estimates should always be represented by a mean and range.

### **Antemortem Pathologies/Anomalies/Trauma**

Human remains may exhibit pathological conditions or anomalies which individuals had before death which can aid in the identification of them. These may include:

- previous (healed) fractures;
- evidence of prior diseases, particularly those that were chronic in nature;
- evidence of prior surgery, including implants, prostheses, and other surgical hardware, often exhibiting traceable serial numbers;
- evidence of dental caries, disease, or other dental anomalies which may have been corrected with intervention

**Other antemortem** skeletal indicators may offer clues about an individual's past behaviors or habitual activities. Robust muscle attachments often leave visible effects on bone. Wolff's Law states that bone is deposited where needed and resorbed where not needed. This means that excessive use of a particular muscle may result in visible hyper-robusticity of a bony region.

**Individuation** is most often accomplished through dental comparisons of an unidentified individual's dental patterning with a suspected identity's dental records. In the absence of these

records, positive IDs can also be made through comparisons of frontal sinus patterns, documented medical pathologies, surgical implant or prosthetic tracings, or DNA (Christensen and Anderson 2013; Boyer 2012; Cabo 2012). Facial approximation and photo superimposition do not generally constitute a Positive ID in the United States, but instead are considered IDs by Preponderance of Evidence (Sauer et al. 2012). Circumstantial IDs can often be made through congruence of the Biological Profile as well as contextual information.

#### **D. Reconstructing Behavioral Events**

**Perimortem Trauma**—perimortem trauma is that which occurs at or around the time of death and is typically associated with the death event. It is most commonly represented by Projectile Trauma, Blunt Force Trauma, and Sharp Force Trauma. From trauma analyses, a Forensic Anthropologist may be able to make statements regarding number of events, sequence, orientation, and origin of the trauma (Berryman and Symes 1998; Galloway 1999; Sauer 1998).

**Postmortem Processes** (Taphonomy) are those that occur to an organism after death and can include the following:

- Natural decomposition and disarticulation of remains;
- Scores, punctures, scrapes, and cuts, as well as disarticulation and scattering from animal scavenging (typically from carnivores and rodents);
- Evidence of damage from plants in the form of root growth, etchings, punctures, and cut marks;
- Evidence of environmental damage through weathering, including the effects of the sun (e.g., bleaching), rain, erosion, fire
- Evidence of human-related taphonomy.

It is important to be able to distinguish between perimortem and postmortem taphonomic defects of the remains. For example, cut marks and fractures affecting bone may be perimortem or postmortem in nature. Trained Forensic Anthropologists should be able to differentiate these. Sources which consider these taphonomic effects in greater detail include Haglund and Sorg (1997, 2002) and Pokines and Symes (2013).

### **III. The Forensic Case Report and Court Testimony**

Upon completion of the skeletal analysis, a Forensic Anthropologist submits his or her results in a case report to the consulting agency (typically the Medical Examiner's office). Although there is no standardized case report format for Forensic Anthropologists, reports typically contain the following elements (Jantz 2013):

- Identifying information for the case, including name of decedent, case number, dates of analysis and return of remains, as well as any background information about the contextual history of the case;
- An inventory of all elements recovered and analyzed, and an assessment of MNI;
- A summary of the biological profile—age, sex, ancestry, and stature of the decedent;
- An estimate of Time Since Death for the remains;
- An analysis of antemortem, perimortem, and postmortem processes
- A statement regarding the possible identity of the decedent, if the remains are unidentified.

Forensic Anthropologists are routinely subpoenaed for court testimony in forensic cases. They should never testify beyond their expertise (for example, offer opinions about soft tissue or cause of death).

#### **IV. Summary of Best Practices**

Forensic Anthropologists should be consulted in cases involving decomposing or decomposed remains suspected of being human or in cases of burning, fragmentation, or trauma. They can also be consulted for their expert opinion regarding trauma in soft tissue cases (e.g., child death investigations) as well as Mass Fatality Incidents and Mass Disasters. Ideally, a board-certified Forensic Anthropologist who is a member of the American Academy of Forensic Sciences and who is associated with or consults with a Medical Examiner or Coroner's Office should be consulted. Beyond verification of forensic significance, a Forensic Anthropologists can assist with identification of unknown human remains through the estimation of the Biological Profile (age, sex, ancestry, stature), extraction of DNA (if applicable), and reconstruction of behavioral and biological events surrounding the individual's life and death.

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[www.radford.edu/~fsi](http://www.radford.edu/~fsi) (Radford University Forensic Science Institute)

[www.swganth.org](http://www.swganth.org) (Scientific Working Group for Forensic Anthropology)

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