

Forensic Anthropology

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Forensic Anthropology is the application of anthropological techniques to modern human remains for law enforcement. In general, the forensic anthropologist provides a basic biological profile of the decedent to aid in identification. This biological profile usually includes age, sex, height, ancestry, and postmortem interval. The profile can also include additional information useful for positive identification of the decedent, such as handedness or other behavioral indicators (e.g. horseback/motorcycle rider, pipe-smoker). The anthropologist may provide information about traumatic injury, including toolmark analysis. Finally, the anthropologist may assist the pathologist and investigator in the determination of cause and manner of death, although as cause of death is a medical determination, it is the forensic pathologist who has the final say in this determination. Because of their specialized training in both anthropology and archaeology, most forensic anthropologists also assist in the location and recovery of buried or surface remains which are skeletonized or scattered.

Forensic Anthropologists approach their analysis by asking a series of questions; the original ten questions (paraphrased and not in their original order) were codified in 1982 by Clyde Snow in a now classic article (Snow, 1982). The additional questions (in italics) are my own, added through experience in Los Angeles County. I have also taken the liberty of rearranging the questions to fit my preferred style of analysis.

1. *Is the specimen bone?*
2. Are the remains human?
3. *Are the remains of forensic value (e.g. are the remains recent, are the remains Native American/archaeological, are the remains medical/scientific specimens)?*
4. *What bones are present?*
5. What is the minimum number of individuals represented by the remains?
6. What was the decedent's sex?
7. What was the decedent's age?
8. What was the decedent's ancestry?
9. What was the decedent's height?
10. Are there any anatomical anomalies, pathologies, etc. which may aid in positive identification of the decedent?
11. *Are there any skeletal indicators of behavior, such as handedness, motorcycle/horseback riding, etc., which may aid in positive identification of the decedent?*
12. What is the postmortem interval (how long has the decedent been dead)?
13. What can the anthropologist contribute to determination of cause of death?
14. What can the anthropologist contribute to determination of manner of death?

I. Human vs. Nonhuman remains

It has been estimated (Bass 1995) that between 25% and 30% of cases seen by the typical Forensic Anthropologist are non-human. The determination of human vs. nonhuman is relatively simple for the anthropologist in most cases. Humans are quite anatomically distinct from other animals despite similarities in the numbers and types of bones. Human bone can be distinguished from nonhuman primarily based on two criteria: size and structure. There are few non-human animals whose adult bones are the size of human adult bones. Human subadult bones, which may be the same size as some non-human animal bones, are easily distinguished based on their maturity – bones grow in segments, which fuse together to form a single unit when the bone finishes growth. Thus, subadult human bones will be present in multiple segments, or will have “unfinished” surfaces where segments will eventually join together.

Differences in structure, or shape, are the main method for distinguishing human bones from non-human. Forensic Anthropologists are specialists in the human skeleton. They have learned the bones inside and out, and are generally able to determine even from small fragments the nature of a particular bone specimen. If a macroscopic determination proves difficult, there are also microscopic techniques available to determine human from non-human bone.

II. Forensic Value

Many different types of human remains are brought into the offices of Medical Examiners and Coroners. If these remains are skeletal or highly decomposed, it can be the job of the Forensic Anthropologist to determine their forensic value. The most commonly occurring cases in Los Angeles County of non-forensic value are prehistoric Native American remains, followed closely by medical/scientific specimens. Trophy skulls acquired during overseas action by servicemen are turning up in greater numbers as veterans of WWII, the Korean War and the Vietnam War pass away, leaving their families to dispose of their possessions. In general, the anthropologist can use the preservation of the remains, the presence of natural or artificial modifications to the teeth and skeleton, items found with the remains, and the manner of interment to assist in the determination of the forensic value of human remains.

For Native American remains, the Anthropologist looks for the color, texture, retention of organic materials and condition of the bone. Archaeological bone is generally dehydrated and has lost the waxy yellowish-white color of new bone. Bone exposed to soil will begin to take on the color of that soil. The organic portion of bone will decay, leaving the bone dry and odorless. The surface of the bone may begin to erode, depending on the acidity of the soil in which it is placed. Often there will be archaeological goods found with the remains, such as pottery, stone tools, and clothing. The teeth may be highly worn, often through the outer layer of enamel on the occlusal (biting) surface. No modern dental work will be present. Other characteristics of the face, including the structure of the zygomatic (cheek) bones (see Ancestry section below), may indicate Native American ancestry.

Scientific or medical specimens are generally bleached white by chemical processing. There is often hardware attached to the bone (e.g. nails and springs to hold the mandible to the cranium). There may be polishing of the bone due to extensive handling, and grayish “dirt” may be imbedded in the bone from storage. Such specimens may also have a coating of varnish or other preservative on them.

III. Minimum number of individuals

The minimum number of individuals present may be determined in several ways. The simplest is to examine the remains for duplication of elements. It is obvious that the presence of three skulls indicates the presence of three individuals. Similarly, the presence of two right third metatarsals (foot bones) indicates the presence of at least two individuals.

When elements are not duplicated, the anthropologist looks for differences in size, age, structure, and preservation of bone to determine the number of individuals present. Although preservation and size are not definitive in some cases (e.g. there are medical conditions which may reduce the size of one of a set of paired bones), they are clues to be used by the trained anthropologist. In some cases, however, DNA analysis may be required to determine the minimum number of individuals present.

IV. Sex, Age, Ancestry and Height

The determination of sex, age, ancestry and height are intertwined. Formulae for the determination of age are dependant on sex and to some extent ancestry; formulae for the determination of sex are dependant on relative age (adult vs. subadult); formulae for the determination of ancestry are dependant on sex and age; formulae for determination of stature are dependant on age, sex and ancestry. The Anthropologist is trained to examine the skeleton as a whole, make immediate decisions on relative age and probable sex, and proceed to estimate more precisely age, sex, ancestry and stature based on those initial impressions.

For adults, if most of the skeleton is present, these categories are relatively easy to determine. For children, they are much more problematic – sex differences do not appear until puberty, and sex cannot be accurately assigned for the remains of children. Ancestry, often referred to as race (see discussion below) is also problematic for children, and estimation of height is more difficult than for adults.

Determination of sex is best accomplished through examination of the pelvis, although examination of the entire skeleton provides the greatest accuracy (between 90% and 100% accuracy is reported by various authors). Although personal error rates are generally low (as low as 3%), accuracy in sex determination using morphology of the pelvis alone is documented at between 90% and 95%, generally (works cited in Byers, 2002:171). With use of morphology of the skull only, accuracy of 80%-90% is documented (Byers, 2002:171), while with morphology of long bones only, accuracy drops to 80% (Byers, 2002:171). Some metric techniques may raise the accuracy beyond

these reported percentages. For example, use of specific measurements of long bones is also reported to be 89%+ accurate through use of FORDISC 2.0, a statistical program devised at the University of Tennessee, Knoxville, using the Forensic Data Bank (a computer database of information on modern skeletons started in 1986 and continuing today).

To determine sex from the pelvis, a series of classic morphological differences are examined (Figure 1). The pelvis is the best single indicator of sex because of the process of birth in females. The female pelvis is generally wider, to allow for birth of a human infant. Traits such as the shape of the pelvis outlet, the subpubic angle and the greater sciatic notch are used to determine sex based on the pelvis. Additionally, measurements may be taken of the pelvis, providing up to 91% accuracy if the ancestry of the skeletal material is known (accuracy of pelvic measurements drops to around 66%, much lower than morphological analysis, if ancestry is unknown).

Sex may also be estimated based on traits of the skull (Figure 2) and measurements of long bones with high levels of accuracy.

Age determination for subadults is relatively accurate during infancy and childhood, with decreasing accuracy (and increasing age ranges) once puberty is reached. As stated previously, bone does not form as a single unit, but rather in parts; the “main” portion of a long bone is called the diaphysis, while the end caps are referred to as epiphyses. Epiphyses fuse to diaphyses at fairly regular rates, and by comparing which bones are fused and which are not, a relatively accurate age may be determined (Figure 3). For infants and fetuses, measurements of the diaphyses provide age ranges. The formation and eruption of deciduous (baby) and permanent dentition may also be used to determine age in subadults.

Age determination in adults is more problematic. Once the skeleton has completed formation, age can be determined by examining morphological traits of the pubic symphysis (Figure 3), the sternal ends of the right ribs 3-5, the auricular surface of the ilium, and (although with much less accuracy), cranial suture closure.

Attribution of ancestry is difficult to assess at best. The Anthropologist is attempting to provide information which will assist law enforcement in the positive identification of the decedent, and one question always asked concerns the “race” of the decedent. However, biological “races” simply do not exist within the human population. Race as it exists today is primarily a social category. Anthropologists attempt to assess, primarily from biological markers of the cranium, information on the potential ancestry of decedents. It is extremely important to note, however, that accuracy in determination of ancestry varies tremendously between individuals. The categories of White, Black, Asian and Native American are traditionally used to avoid any confusion with ethnicity (the cultural group with which the decedent was affiliated). In Southern California, individuals of Hispanic

heritage may be placed into either the White or the Native American category, depending on the extent of admixture in their background.

Analysis of facial morphology is the primary method of assessing ancestry. Even with a cranium in good condition, many Anthropologists will not assess ancestry unless the features are highly indicative of one of the four groups mentioned above. Figure 4 details traits generally used in determination of ancestry. In addition to these morphological characteristics, FORDISC 2.0 contains a feature which uses cranial and postcranial measurements to assess ancestry; the utility of this statistical program in Southern California has recently been questioned, however (Robertson, 2000)

Estimation of stature in adults requires the presence of one or more long bones, preferably complete (although there are formulae which allow estimation of height from incomplete bones, they are less accurate than estimation from complete long bones). Accurate measurement of the bone is essential, and proper equipment must be used to ensure accuracy. Formulae are dependant on both sex and race, and if either is unknown the potential range of height for the decedent must reflect the missing information.

V. Postmortem interval

Estimation of time since death is probably the most difficult assessment made by anthropologists. It is extremely useful to investigators to have this estimate in order to narrow both the pool for positive identification and for the investigation of homicides. Unfortunately, determination of postmortem interval is dependant on a wide variety of factors which influence the process of decomposition. These factors include, among others, temperature, rainfall, relative humidity, the weight and build of the decedent, clothing and other materials around the decedent (e.g. plastic tarps, garbage bags), the depth of burial (including surface remains), the accessibility of the remains to animal scavengers, and insect activity. Because Southern California contains such a variety of environments, from mountain to desert to coastal, estimation of postmortem interval is highly problematic. Each case must be examined carefully for the presence of soft tissue, the state of soft tissue preservation (wet or mummified), the amount of grease remaining in the exposed bone, sunbleaching and cracking, and so on. In general, skeletonization can occur in as little as weeks in a desert environment, while mountain environments may take more time (unless animal scavenger activity is noted).

VI. Recovery

For recovery of skeletonized remains it is always preferable to have a Forensic Anthropologist present. Generally, law enforcement agencies will contact the Department of Coroner to retrieve both surface and subsurface remains in Los Angeles County. Other counties have differing procedures. From an anthropological perspective, it is important to be there from the beginning of a recovery – determination of postmortem interval is greatly improved by the anthropologist being at scene. Additionally, because of specialized training not only in identification but also in the recovery of both surface-scattered remains and buried remains, the presence of a Forensic

Anthropologist at scene improves the chances of full recovery of the decedent and all associated evidence.

In Los Angeles County, a Forensic Anthropologist is deployed to the scene of mass fatality incidents, some special decedent recoveries, buried body recoveries, decedent searches, and any other case deemed necessary. Once recovery is accomplished, the Anthropologist begins observations and analysis to construct a biological profile to aid in the identification of the decedent.

Recovery of surface remains involves a search of the area, requiring specialized knowledge concerning drainage patterns, scavenger activity and ranges, and human skeletal anatomy. Cadaver dogs, dogs specially trained to locate decomposing human remains, are often employed. Surface scattered remains are mapped, photographed, and recovered.

Recovery of buried remains requires all of the knowledge listed above for surface remains, plus knowledge of archaeological techniques of excavation and sifting. All soil from within a grave site is sifted through a minimum of 1/4 inch screening to maximize evidence and skeletal recovery. The remains are excavated in levels, with the entire decedent exposed and photographed *in situ* prior to removal of the body or elements, depending on the state of preservation. The soil from beneath the remains will also be sifted. Proper techniques and equipment are vital to the recovery of all remains and evidence.

Never attempt recovery at night unless artificial light would be required at any time of day (e.g. excavation underneath a house). Regardless of the power of lighting employed, it will never be equal to natural lighting.

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Figure 1. Determination of sex using the pelvis. Drawings from Bass (1995) and Ubelaker (1989).

Figure 2. Sex determination using the skull. Drawings from Bass (1995) and Ubelaker (1989).

Figure 3. Determination of age. Drawings from Bass (1995) and Ubelaker (1989).

Figure 4. Determination of ancestry from the skull. Drawings from Bass (1995).