

Forensic
Anthropology
Reading
and
Labs

Differences Between Human Bone & Animal Bone

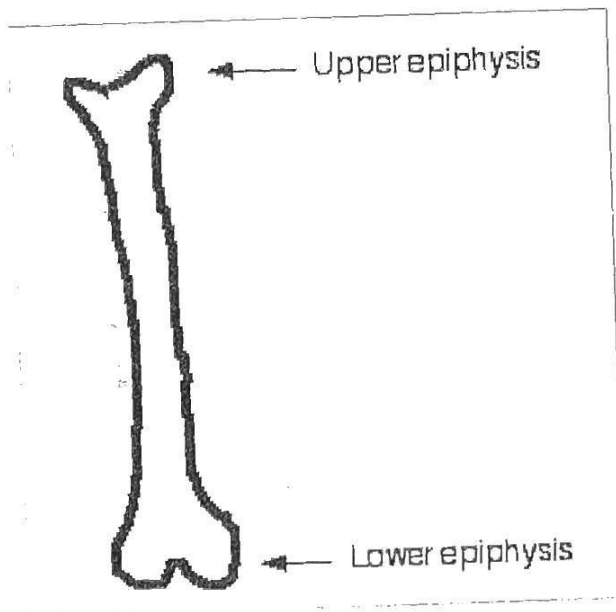
Read the following information to complete the next worksheet.

When no skull is apparent, animal bones can often be confused with human bones. Forensic anthropologists use several methods to distinguish between human and animal bone.

BONE CELLS: Human bone cells are very round, while animal bone cells are more rectangular/linear.

RIBS: Human ribs tend to be C-shaped, while most animal ribs tend to be linear/straight. The overall number of ribs in a human tends to <12 than that of an animal (ie. sheep = 13).

LIMBS: Human limbs from children (arm & leg bones) will have unfused epiphyses regions, while animal limbs will have fused epiphyses regions.



UPPER

LIMBS:

The upper arm bones of a human will have a smaller tubercle region on the upper part of the bone and also fewer projections extending from the upper part as compared to animal bones. Human arm bones also tend to be more linear/straight while animal limb bones tend to be curved.

LOWER

LIMBS:

The upper leg bone (femur) of a human has a large trochanter at its upper head portion compared to animal bones. Also, the upper head portion of a human femur is angular, while animal bones have a flat upper head portion. The lower leg bones (tibia) of animals have multiple notches upon their upper portion while human bones do not.

Lab: Skeletal Comparison of Males & Females

Name: _____ Date: _____

Problem: To compare and contrast the skeletal measurements of various body regions of adolescent males and females.

Materials:

| | |
|----------------|----------------------|
| - tape measure | - calculator |
| - ruler | - 10 female students |
| - metre stick | - 10 male students |

- Procedure:**
1. Conduct the following lab in groups of 3 to 4 students.
 2. You are going to take measurements of various body parts of 20 different students. First, take the measurements of these regions using your 3-4 group members. For the remaining 16 - 17 students you may go down to a study area (chosen by your teacher) and politely ask other students for their measurements. (Do NOT use any teachers as your test subjects as they are too 'mature' for this study.)
 3. Use any of the measurement instruments provided to measure each of the following body regions on your test subjects:
 - length of foot (cm)
 - shoulder to longest finger (cm)
 - overall height (cm)
 - hip to to foot (cm)
 - length of hand (cm)
 - head circumference (cm)
 4. Record all observations in the charts provided.
 5. Create a bar graph from data collected by placing your average skeletal measurements on the x-axis and "centimeters" on the y-axis.
 6. Each group should hand in 2 completed charts, 1 graph and 1 set of lab questions at the end of class or beginning of next class.

Lab Questions...

1. For which specific body regions did you find **similar** measurements between males & females?

2. For which specific body regions did you find ^{DISSIMILAR} measurements between males & females?

3. Name one way research conducted by Forensic Anthropologists would be similar and one way it would differ from the research you did in this lab?



BONES, BONES, BONES...

Determining Ancestry from Skeletal Remains

A forensic anthropologist may be able to help determine the ancestry of a victim through an examination of the skull and other parts of the skeleton. Determining the ancestry of a victim can help law enforcement officials to determine the identity of an unknown corpse. Certain common traits can be found in the facial features of the skull of individuals from different ancestries. The human skull has the greatest number of these traits that can be used to determine the ancestry of an unknown individual.

Some skull characteristics are more common in some ancestral groups than in others. It is common practice to use three general ancestral groups: negroid, mongoloid and caucasoid, however in the past more than twenty groups have been used.

1. **Negroid** - from the Spanish word meaning "black", includes African Blacks, Caribbean and African-American.
2. **Mongoloid** - from the word Mongolian, includes those of Chinese, Japanese, Inuit and Native ancestry.
3. **Caucasoid** - referred to as "white-skinned" or of European descent, originally from the Caucasus region found in between the Black Sea and the Caspian Sea, includes Europeans, East Indians, Pakistanes and Arabs.

The determination of ancestry from skeletal remains is controversial because there are only a few skull characteristics that are unique to one particular ancestral group. Also, the assessment of ancestry from skeletal remains tentative and is not highly reliable because populations are so intermixed today. Consequently, it is difficult to determine ancestry with any degree of certainty, thus forensic anthropologists tend to make suggestions as to what ancestral group may be evident from the skeletal remains they are examining rather than conclusions.

Comparison of Cranial Features

There are several cranial features that have been found to be distinctive in the skulls of humans from different ancestries. We will just focus upon two regions of the human skull: the orbits and the nasal region. The skull has two orbits which house the eyeballs, while the nasal region is the area in and around the nose.

"Presently, there is a debate within anthropology concerning the nonexistence of race. In deference to the debate and to avoid controversy, the terms *race* and *ethnicity* are avoided in favor of the term *ancestry* to describe the genetic background of persons."

- Dr. Steven N. Byers, *Introduction to Forensic Anthropology: A Textbook*, Allyn and Bacon (2002), p.150.

Negroid (Black) Ancestry: Cranial Features

Skull of an Individual of Negroid Ancestry

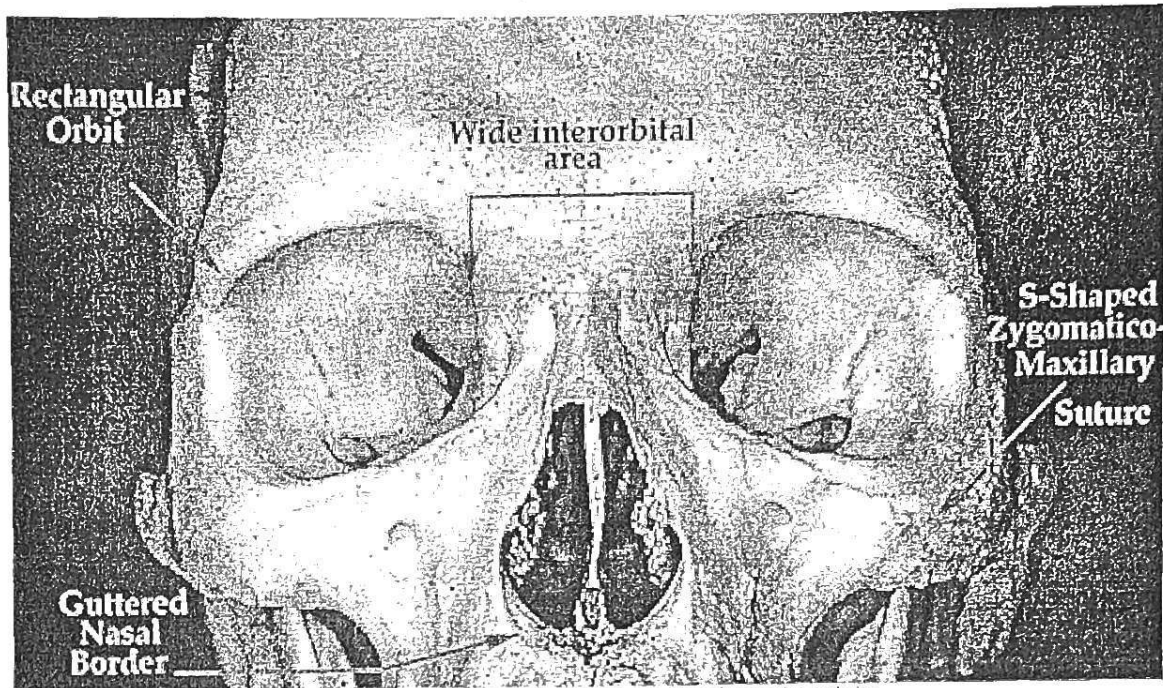


Image = University of Utah Health Sciences Center Osteointeractive website
(<http://medlib.med.utah.edu/kw/osteol/forensics/negroid/bonewade.html>)

The orbitals of the eyes the vast majority skulls from those individuals of black ancestry tend to be rectangular in shape. While the space between the eyes and nose (interorbital area) of a black individual tends to be wider than other races.

The first criminal case in which methods of forensic anthropology were used was in the United States in 1849. Two anatomy professors from Harvard University were asked to examine skeletal remains found in a septic tank and furnace of an anatomy lab that a Dr. George Parkman, a missing physician, worked from at Harvard University. Police suspected the bones may belong to Parkman. After analysis of the remains, it was confirmed that the bones did belong to the missing physician. This information led to the conviction of Dr. John W. Webster a Harvard chemistry professor who owed the victim money. Webster had killed and dismembered Parkman, rather than pay off his debt.

- Byers, Steven N. *Introduction to Forensic Anthropology - A Textbook*. Allyn & Bacon, 2002. (p. 5).

Mongoloid Ancestry: Cranial Features

Skull of an Individual of Mongoloid Ancestry

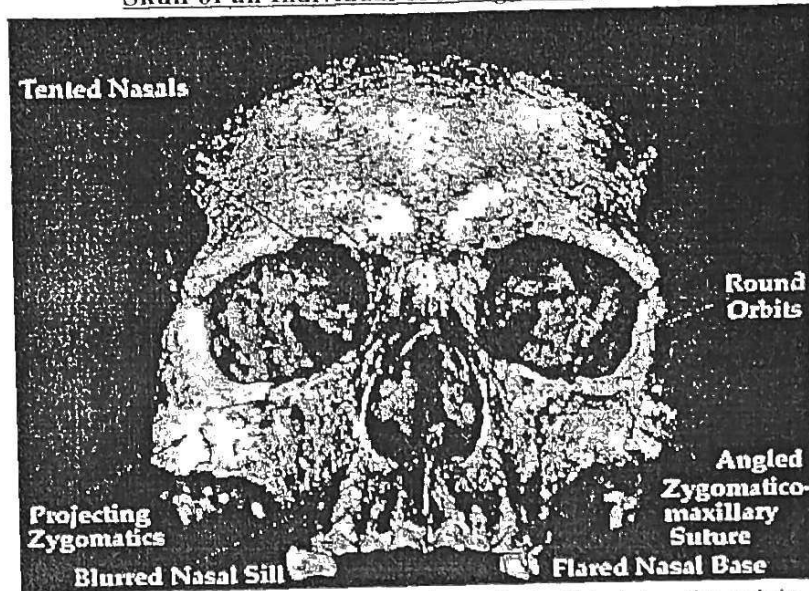


Image from University of Utah Health Sciences Center Osteointeractive website
(<http://medlib.med.utah.edu/kw/osteo/forensics/mongoloid/midface.html>)

Individuals with mongoloid ancestry tend to have eye orbits that are round in shape. Often the base of the nasal area of mongoloid individuals is flared meaning that it appears to widen out.

Prehistoric skeletal remains that have been formally buried are most often found lying in the fetal position with knees drawn up to the chest, while skeletons from remains buried during modern times, especially those from industrialized countries, are most often found lying on their backs with their limbs extended straight.

- Steven N. Beyers, *Introduction to Forensic Anthropology; A Textbook* (p. 78-79). Allyn & Bacon (2002).

Caucasoid (White) Ancestry: Cranial Features

Skull of an Individual of Caucasoid Ancestry

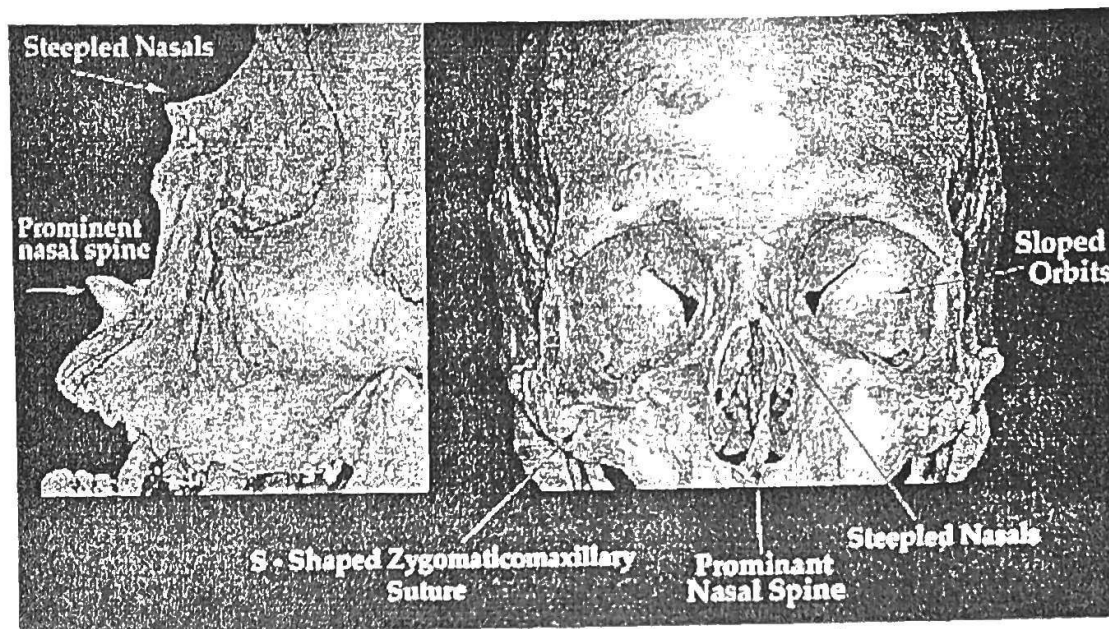


Image University of Utah Health Sciences Center Osteointeractive website
(<http://medlib.med.utah.edu/kw/osteointeractive/forensics/ceppoid/banewide.html>)

The orbitals of the eyes of those from a white ancestry tend to be sloped downwards (see image above). Another distinct skeletal facial feature of white individuals is that they often will have a large or prominent nasal spine (see above image). Yet another exclusive feature in the skull of white individuals is the auditory canal in the inner ear tends to be longer and wider than those of other races.

"It is clear that race does mean different things to different people. In the context of forensic anthropology, the term race is unambiguous."

- Dr. Stanley Rhine, Ph.D (Forensic Anthropologist - University of New Mexico)
<http://medlib.med.utah.edu/kw/osteointeractive/forensics/race.html>

BONES, BONES, BONES...

Using Bones to Determine Individual Gender

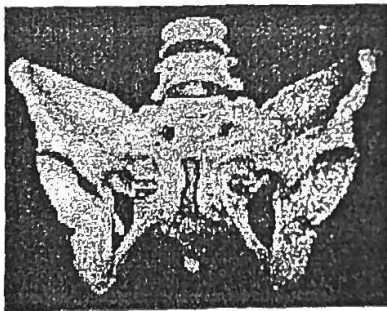
Using Bones to Determine Sex of an Individual

Clues from human bones can help distinguish the gender or sex of skeletal remains. Determining whether a skeleton is male or female is important because it helps those involved in a criminal investigation establish the identity of the remains found. By assessing multiple characteristics in a skeleton, it is possible to estimate the sex of a person. However there are cases when the sex of a person can not easily be determined by their skeleton due to human variation. The most important and reliable are of the skeleton for determining a person's sex is the pelvis. The skull may also be used, but variation in skulls may produce conflicting results.

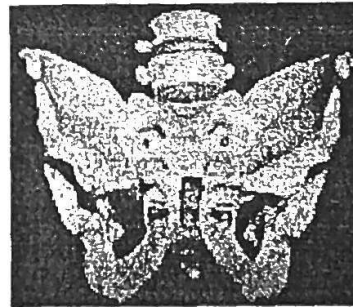
Pelvic Region

One of the most obvious distinctions between a human male and human female skeleton is the pelvic region. There are numerous features of the female pelvis that distinguishes it from the male pelvis, however in general the female pelvis appears shorter and wider than the male pelvis which appears taller and narrower. Also, overall the pelvic region of the male is larger and more rugged than the smaller and more slight female pelvic region. The features of the female pelvis can be attributed to the need for greater space for childbirth.

Human Female Pelvis



Human Male Pelvis



Images from FEATURES OF SELECTED BONES website,
©David B. Fankhauser, Ph.D., Professor of Biology and Chemistry,
University of Cincinnati Clermont College

The adult human skeleton is normally composed of 206 bones.

Limb Bones

In general, males tend to be more muscular than females therefore the muscle attachment sites and weight bearing surfaces on their limb bones tend to be larger and more pronounced. Notice in the above photo, the upper leg bone (femur) of the male (right) has a number of large ridges where the muscles attach, while the female femur does not appear to have these ridges. In addition, male femur has larger weight bearing surfaces than the female.

The Femur Bones from a Human Female (left) and a Human Male (right)

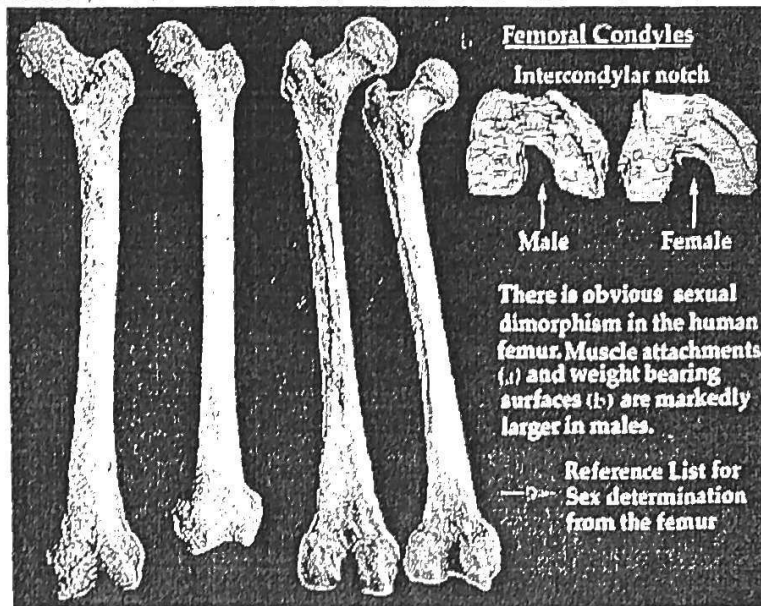


Image courtesy from University of Utah Health Sciences Center Osteointeractive website

The Skull

The human skull differs in several distinct ways in males and females. We will focus on just a few traits using the above photograph which shows two extreme examples of cranial sex differences. Firstly, the supraorbital ridges in the forehead of a female tend to be slight (gracile) and small, while the supraorbital ridges in the forehead of a male tend to be extreme. Below the eyes of a male skull there are very pronounced ridges from the facial muscle attachments, while the ridges below the eyes in a female skull tend to be more slight. The chin of males is often square and angular, while the chin of the female tends to be more curved and round. Lastly, the average size of the teeth of males tends to be larger than females.

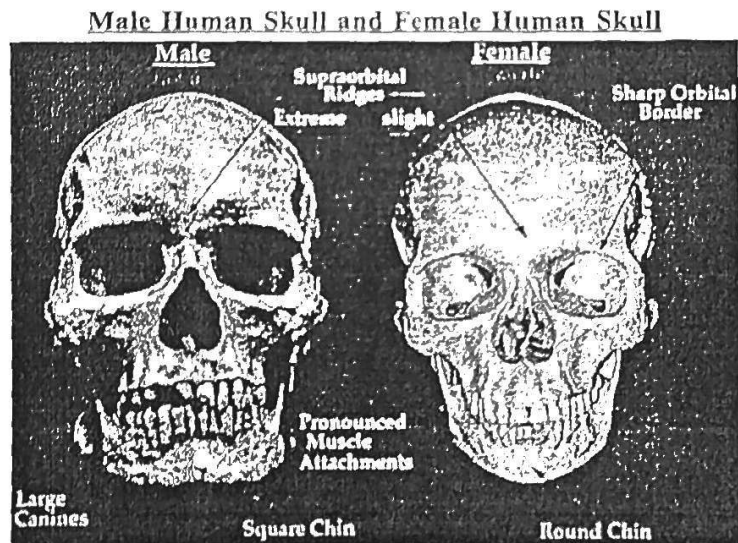


Image courtesy from University of Utah Health Sciences Center Osteointeractive website

Website Sources:

(http://biology.elc.utah.edu/fankhauser/Labs/Anatomy&Physiology/A&P201/Skeletal/selected_bones/Bone_Features.html)

(<http://medlib.med.utah.edu/kw/osteo/forensics/sex/bonefemsex.html>)

(<http://medlib.med.utah.edu/kw/osteo/forensics/sex/bonesexdet.html>)

Reading: FORCE & Types of BONE FRACTURES

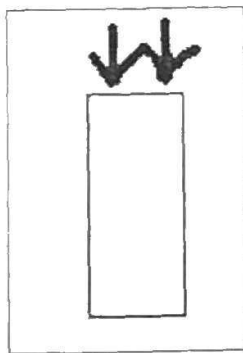
Introduction

In Forensic Science there are five main classifications of cause of death: accident, homicide, natural, suicide and unknown. Bones usually exhibit clues concerning violent deaths resulting from homicide, suicide or an accident - these manners of death will most likely cause skeletal trauma and as a result can be interpreted by a Forensic Anthropologist.

Directions of Force

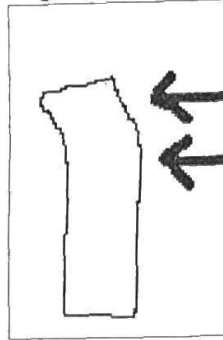
The type of break in a bone depends on the direction from the which force was applied to the bone. Thus, Forensic Anthropologists have identified 5 types of force that cause bone fractures: compression, shearing, bending, torsion, and tension.

1. COMPRESSION = A force that pushes down on bone. Fracture lines will often be numerous, wide-reaching and tend to radiate outward from the point of impact. This type of force most often occurs upon the skull and the shape of the displaced bone will likely match the instrument used to create the wound.

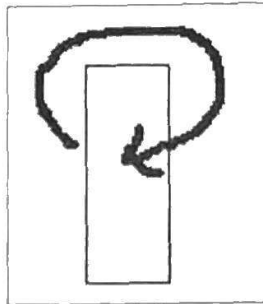


2. SHEARING = force is applied, similar to bending, by the immobilization of one bone segment. When the force is applied a linear shearing type of fracture in the bone occurs and it is usually caused by a person attempting to stop themselves from falling - thus, these usually occur in accidents rather than homicides or suicides. However, shearing forces can occur when a victim is dismembered using a sharp instrument (ie. saw).

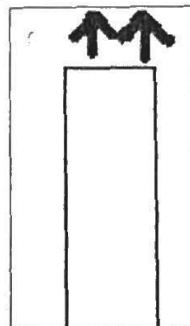
3. **BENDING** = most common; a force that impacts the bone at a right angle, causing a triangular break usually through its cross section. This type of force causes fracture lines at the point of impact or on the side opposite from the break. Usually causes complete breaks or fractures in adults, while in children infractions or 'green-stick' fractures occur. The most common fracture caused by a bending force is called a parry fracture of the ulnar bone in the arm, and can be caused when a person holds up his arms to ward off a blow; this causes inward displacement of the bone. Parry fractures are often seen in deaths resulting from a violent struggle.



4. **TORSION** = twisting forces that occur most often in accidents. One end of the bone is held stationary while the other end of the bone is twisted in some way. The fracture is caused by this spiral down the long axis of the bone. These types of forces most often occur in accidents (skiing, biking) and in forensic cases involving child abuse.



5. **TENSION** = a force that pulls on the long axis of the bone causing it to break. Tension forces most often cause dislocations of bone, but if the force is strong enough a portion of bone can break away. This type of bone injury displays few fracture lines and occurs most often in accidents rather than violent deaths.



Determining TYPES of TRAUMA from SKELETAL REMAINS

When a skeletal remains are found the actual cause of death can only be inferred by Forensic Anthropologists after the examination of the bones, due to the fact there are so many unknown factors about the type of trauma. After examining a human body medical examiners or Forensic Anthropologists will state that observed trauma is "*consistent*" with a certain cause of death. For example, if a stab wound to the torso was thought to be the cause of death, existence of this type of wound does not actually prove that it was the true cause of death. Therefore, a Forensic Anthropologist will list the cause of death as "*being consistent with death by stabbing*". Hypothetically, the person could possibly have died from other causes before he/she was stabbed.

In Forensic Science there are five main causes of death: accident, homicide, natural, suicide and unknown. Bones usually exhibit clues concerning violent deaths such as homicide, suicide or accident - these causes of death most will likely cause skeletal trauma and as a result leave clues behind for a Forensic Anthropologist to explore.

Blunt Force Trauma

An injury caused by a blow from a wide instrument with a flat or round surface - thus a wide surface area of the bone is affected. The injury usually involves bone compression, bending and shearing forces over a wide area. Fracture wounds tend to be fairly simple unless excessive force is applied - then comminuted fractures (which contains many bone fragments) occur. Weapons such as clubs cause blunt force trauma, however falling or being pushed onto on a hard surface can also cause similar injuries, such as during car, train or airplane accidents.

Projectile Trauma

An injury caused by projectile trauma have distinctive characteristics. These types of wounds exhibit complete displacement of bone with radiating fracture lines from the point of impact. The type of force caused by this type of trauma is usually a compression force, but some weapons can cause a bending force to occur. The focus of the force and the resulting bone injury caused by projectile trauma will start out small, but usually becomes diffused as the projectile passes through the bone. Projectile trauma is usually caused by bullets.

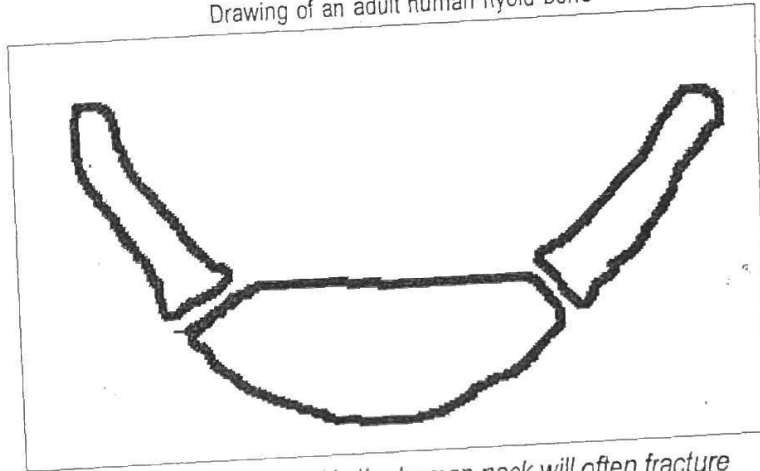


Sharp Force Trauma

An injury caused by either a compression or shearing force that is applied towards a narrow focus. When the force is perpendicular, puncture wounds in the bone will appear. If the force is applied at an angle, grazing cut marks are usually evident on the bone. Complete fractures of bone can occur when a 'chopping' type of instrument (ie. axe) is used as a weapon. Incomplete bone fractures will occur when the weapon used is a 'cutting' type of instrument (ie. knife).

Death by Strangulation

Drawing of an adult human hyoid bone



This set of bones found in the human neck will often fracture if someone has been strangled to death.

The hyoid bone is a free-floating c-shaped structure made up of three bones that covers the voice box (larynx) in the neck. In 8% of the deaths resulting from hanging the adult hyoid bone will be fractured, while in 34% of strangulation deaths fractured hyoids have been observed. Thus, if a Forensic Anthropologist observes a fractured hyoid bone it can be inferred that the possibility exists that strangulation occurred.

Unfortunately, it is difficult for Forensic Anthropologists to conclude that a strangulation has occurred in a young child because under the age of 20 the 3 bones of the hyoid have fused together in only 7% of humans.

