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Forensic Anthropology

The study of skeletonized human remains and the time of death to try to establish the identity and cause of death of an individual
Can possibly identify the following
- Age
- Sex
- Race
- Height
- Pathologies that may be present
- Whether trauma is evident
When bones are found, the following should be answered:

- Are they really bones or some other type of material?
- Are they human bones?
- Is there only one individual present or more than one?
- How long have the bones been there?
- What is the cause of death?
- Who is this?
Forensic Anthropology: Age Determination

- **Sutures**
  - Zigzag-like cracks on the skull
  - Are separate at birth, but gradually close from the inside out
  - The older the individual, the less visible the sutures

- In toddlers and infants, length of the long bones are measured and compared to known growth curves

- After age 21, age is estimated by the level of change on the surfaces of the bones
Age Determination Using Cranial Sutures

**not very accurate**

- When you are born, skull is in several pieces that fuse together (soft spots) as you age.
- Lamboidal suture closed by 30 years (starts closing around 21 yrs.)
- Sagittal suture closed by 35 yrs.
- Coronal suture closed by 50 yrs.
Determination of Age from Bones

- Most accurate estimations from:
  - Teeth (remember teeth are bones too!)
  - Epiphyses (growth plates) fusion
  - Cranial sutures: 3 pieces when young

- Investigators use age range because people vary in how they age
  - Adults 25–40 years are very hard to determine
  - Ages 40+ years: basically wear and tear
Growth Plates - fuse at predictable time frames

Where new bone forms

growth plates are outlined in red
The commencement and completion of union takes several years. The table is only a guide for male subjects (female slightly earlier) in non-tropical climates; the two dates are partial and complete union (years).

<table>
<thead>
<tr>
<th>Bone</th>
<th>Partial</th>
<th>Complete</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head of femur</td>
<td>16-19</td>
<td>17-19</td>
</tr>
<tr>
<td>Greater trochanter</td>
<td>16-19</td>
<td>17-20</td>
</tr>
<tr>
<td>Lesser trochanter</td>
<td>16-19</td>
<td>17-19</td>
</tr>
<tr>
<td>Head of humerus</td>
<td>16-23</td>
<td>17-19</td>
</tr>
<tr>
<td>Distal humerus</td>
<td>13-16</td>
<td>16-19</td>
</tr>
<tr>
<td>Medial epicondyle</td>
<td>16-17</td>
<td>16-19</td>
</tr>
<tr>
<td>Proximal radius</td>
<td>14-17</td>
<td>16-19</td>
</tr>
<tr>
<td>Proximal ulna</td>
<td>14-17</td>
<td>16-19</td>
</tr>
<tr>
<td>Distal radius</td>
<td>18-21</td>
<td>16-19</td>
</tr>
<tr>
<td>Distal ulna</td>
<td>18-21</td>
<td>16-19</td>
</tr>
<tr>
<td>Metacarpals</td>
<td>14-17</td>
<td>16-19</td>
</tr>
<tr>
<td>Acromion</td>
<td>17-19</td>
<td>17-19</td>
</tr>
<tr>
<td>Distal femur</td>
<td>17-20</td>
<td>17-19</td>
</tr>
<tr>
<td>Proximal tibia</td>
<td>17-19</td>
<td>16-21</td>
</tr>
<tr>
<td>Proximal fibula</td>
<td>16-21</td>
<td>16-21</td>
</tr>
<tr>
<td>Distal tibia</td>
<td>16-19</td>
<td>16-21</td>
</tr>
<tr>
<td>Distal fibula</td>
<td>16-19</td>
<td>16-21</td>
</tr>
<tr>
<td>Metatarsals</td>
<td>15-17</td>
<td>16-19</td>
</tr>
<tr>
<td>Iliac crest</td>
<td>18-22</td>
<td>16-19</td>
</tr>
<tr>
<td>Primary elements pelvis</td>
<td>14-16</td>
<td>16-19</td>
</tr>
<tr>
<td>Sternal clavicle</td>
<td>23-28</td>
<td>17-19</td>
</tr>
<tr>
<td>Acromial clavicle</td>
<td>18-21</td>
<td>18-21</td>
</tr>
</tbody>
</table>

**Epiphyseal (growth plate) Fusion: A General Guide**
Age Determination: Use of Teeth

Permanent Teeth

<table>
<thead>
<tr>
<th>Tooth Type</th>
<th>Age Tooth Comes In (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central Incisor</td>
<td>7.35</td>
</tr>
<tr>
<td>Lateral Incisor</td>
<td>8.45</td>
</tr>
<tr>
<td>Canine (Cuspid)</td>
<td>11.35</td>
</tr>
<tr>
<td>First Premolar (Bicuspid)</td>
<td>10.20</td>
</tr>
<tr>
<td>Second Premolar (Bicuspid)</td>
<td>11.05</td>
</tr>
<tr>
<td>First Molar</td>
<td>6.30</td>
</tr>
<tr>
<td>Second Molar</td>
<td>12.25</td>
</tr>
<tr>
<td>Third Molar</td>
<td>Variable 17 to 21</td>
</tr>
<tr>
<td>Third Molar</td>
<td>11.90</td>
</tr>
<tr>
<td>Second Molar</td>
<td>6.05</td>
</tr>
<tr>
<td>First Molar</td>
<td>11.20</td>
</tr>
<tr>
<td>Second Premolar (Bicuspid)</td>
<td>10.50</td>
</tr>
<tr>
<td>First Premolar (Bicuspid)</td>
<td>10.35</td>
</tr>
<tr>
<td>Canine (Cuspid)</td>
<td>7.50</td>
</tr>
<tr>
<td>Lateral Incisor</td>
<td>6.40</td>
</tr>
</tbody>
</table>

Teeth waiting to come in
Forensic Anthropology: Age Determination (continued)

- Infant skull with sutures visible
- End of this femur is rough, indicating a juvenile
## Forensic Anthropology: Gender Determination

<table>
<thead>
<tr>
<th>MALE</th>
<th>FEMALE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Narrow pelvic opening</td>
<td>Larger, circular pelvic opening</td>
</tr>
<tr>
<td>Long, narrow sacrum</td>
<td>Wide sacrum</td>
</tr>
<tr>
<td>Acute (less than $90^\circ$) subpubic angle</td>
<td>Wide subpubic angle (approximately $90^\circ$)</td>
</tr>
<tr>
<td>Larger skull overall</td>
<td>Smaller skull</td>
</tr>
<tr>
<td>Pronounced brow bone</td>
<td>Diminished brow bone</td>
</tr>
<tr>
<td>Overall robust skeleton</td>
<td>Overall slender skeleton</td>
</tr>
</tbody>
</table>
Determination of Sex: Pelvis

**FEMALE pelvis**
- Anterior view: > 90°
- Superior view: Sacrum tilted back
- Inferior view: Big Pelvic Outlet, Ilia spread wider

**MALE pelvis**
- Anterior view: < 90°
- Superior view: Sacrum tilted forward
- Inferior view: Small Pelvic Outlet, Ilia closer together
Forensic Anthropology: Gender Determination (continued)
Forensic Anthropology: Gender Determination (continued)

FEMALE PELVIC OPENING

MALE PELVIC OPENING
Forensic Anthropology: Gender Determination (continued)
Male Skull

- Large brow ridge & sloping forehead
- Developed ridge where neck muscles attach
- Square chin
- Acute angle
- Mastoid process

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Female Skull

- Sharp upper margins
- Smaller brow ridge & more vertical forehead
- Neck muscle attachment
- More pointed chin, wider angle of jaw
- Less pronounced mastoid process
Forensic Anthropology: Gender Determination (continued)

FEMALE SKULL

MALE SKULL
Forensic Anthropology: Race Determination

- Most commonly divided into 3 categories
  - Mongoloid (Asian or Native descent)
  - Caucasoid (European)
  - Negroid (African)
Forensic Anthropology: Race Determination (continued)

- Mongoloid (Asian or Native descent)
  - Flat or projected outward frontal plane
  - Small, rounded nasal cavities
  - Circular eye orbits
Forensic Anthropology: Race Determination (continued)

- Caucasoid (European)
  - Flat cranium
  - Long, narrow nasal cavities
  - Oval eye orbits
Forensic Anthropology: Race Determination (continued)

- Negroid (African)
  - Cranium projected outward
  - Wide nasal cavity
  - Square eye orbits
Forensic Anthropology: Race Determination (continued)

- All 3 Races
  - Mongoloid (Asian or Native descent)
  - Caucasoid (European)
  - Negroid (African)
Forensic Anthropology: Height Determination

- Determined by measuring the long bones and calculating from known equations
- The equations are different based on the bone, the race of the individual, and the gender
- The long bones used are the femur, radius, tibia, and humerus
Forensic Anthropology: Other Determining Factors

- A forensic anthropologist or sculptor may create facial reconstructions from skulls to help identify skeletal remains
- Pathological identities such as past surgeries, and broken bones that show healing and/or scarring
- Trauma may be studied by observing cracks, holes, or toolmarks present on bones
Excavation of Skeletal Remains

These are the guidelines provided to expose and recover remains in order to minimize damage.

Guidelines will differ based on scene conditions.
Excavation of Skeletal Remains (continued)

- Steps to excavation
  - Remove litter and vegetation if present
  - Stake out and map the exact excavation area
  - Determine the grave outline and remove the soil covering; sift each layer to check for evidence or small bones
  - Work in horizontal layers
  - Document as work continues with photography, maps, inventory, and measurements
  - Once all bones have been exposed, document them again
  - Remove each bone separately and bag it individually
**Forensic Odontology**

- **Odontology** is the study of teeth and bite marks for individual identification
  - Can estimate age by observing deciduous teeth in children and wear patterns in older adults
  - Can be compared to dental records
  - May contain DNA
  - Teeth are harder to destroy in fire than bone
  - Can be used with bite mark identification
If death has occurred, the following must be determined:

- **Cause**
  - The disease or injury responsible for initiating the sequence of events that resulted in death
  - **Examples**
    - Gunshot wound
    - Drug overdose
    - Cardiovascular disease
Human Death (continued)

- **Manner**
  - The “reason” the cause of death occurred
  - **Categories**
    - Accidental
    - Homicidal
    - Natural
    - Suicidal
    - Undetermined
Human Death (continued)

- **Mechanism**
  - The immediate physiological derangement resulting in death
  - **Examples**
    - Hemorrhage (large amount of blood loss)
    - Cardiac arrhythmia (irregular heartbeat)
<table>
<thead>
<tr>
<th>STAGE</th>
<th>CHARACTERISTICS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh</td>
<td>Immediately after death&lt;br&gt;Blood is not pumping, so it drains and pools to lower&lt;br&gt;pools creating livor mortis, or lividity&lt;br&gt;Rigor mortis, the stiffening of the muscles, can also be seen</td>
</tr>
<tr>
<td>Bloat</td>
<td>When anaerobic metabolism causes gases to build up, making a body swell or bloat&lt;br&gt;Can cause fluids to leak or “purge” from orifices</td>
</tr>
<tr>
<td>Active Decay</td>
<td>Greatest body mass loss&lt;br&gt;Most of the tissue is liquefied&lt;br&gt;Strong odors persist&lt;br&gt;Much of the maggot mass pupates</td>
</tr>
<tr>
<td>Advanced Decay</td>
<td>Little insect activity&lt;br&gt;Bones are revealed</td>
</tr>
<tr>
<td>Dry Remains</td>
<td>All that remains is dry skin, cartilage, and bones either partially or fully skeletonized</td>
</tr>
</tbody>
</table>
Forensic Entomology

- Forensic entomology is the study of insects and their life cycles to determine how long a body has been deceased.
- When a dead body is present, necrophilious insects, or insects that feed on dead tissue, will usually infest it within 24 hours.
The first and most commonly found insect is the adult blow fly, along with eggs, larvae, and pupae.
Other insects include
- Several types of beetles that can either be necrophilious or predatory on other insects
- Predator insects that prey on necrophilious insects
Omnivorous insects such as ants and wasps that may feed on the body itself, other insects, or surrounding vegetation

Indigenous insects, and/or spiders, may be present, but their presence is usually coincidental to the location of the body
Forensic Entomology (continued)

- The timeframe for lifecycle development is influenced by environmental conditions such as:
  - **Climate:** warmer speeds up lifecycle
  - **Weather:** cooler slows down lifecycle
  - **Geographical location:**
  - **Drugs or toxins present in the body:** insect absorbs it from dead tissue; i.e. cocaine stimulant speeds up lifecycle.
Resources

- Do an Internet search for the following articles:
  - forensic science central John Wayne Gacy
  - forensic anthropology by Katherine Ramsland