Personal identity
And
Personal identification
• Recognition of a person or dead body
  • **Complete**
    – Absolute fixation of the individuality of a person
  • **Partial**
    – Ascertainment of only some facts
    – While others remain still unknown
• **Living**

  – **Civil court**
    • Insurance/pension/inheritance claims
    • Marriage /disputed sex and missing person

  – **Criminal court**
    • Absconding soldiers and criminals
    • Person accused of assault /rape /murder
    • Impersonation
    • Interchange of new born babies
• **Dead**
  
  – Fire/explosion /accidents
  – Unknown dead body found on road/fields/water
  – Decomposed/mutilated/skeletal remains
Corpus delicti

• (law) the body of evidence that constitute the offence; the objective proof that a crime has been committed (sometimes mistakenly thought to refer to the body of a homicide victim)

• In a trial of homicide, it is necessary to establish identity of the person who is dead.
• **Intact fresh bodies**
  – Visual recognition
  – Photography
  – Hair color /skin pigmentation
  – Scar/tattoos

• **Decomposed bodies**
  – Direct measurement of body height
  – Serological investigation /past surgical intervention

• **Mutilated and dismembered bodies**
  – Racial pigmentation
  – Measurement of stature is impossible

• **Skeletonized material**
Facial Appearance

• Recognition may be difficult due to alterations in the features caused by
  – Hypostasis
  – Edema
  – Muscle flaccidity
  – Pallor

• In living
  – Facial muscle tone
  – Eye contact
  – Movement
Skin pigmentation

• Yellow
• White
• Black

– Deathly pallor
– Skin slippage removes pigmented skin
– Burnt bodies
Hair color

- Original color alter after death
- Obscured by dirt/staining
- Chemical coloration and bleaching
  - Analysis in forensic science lab may be needed to confirm or eliminate
Tattoo marks

- Polynesian ta tau = mark
- Design made by needles or similar penetrating tools dipped in a dye
- Black blue or red dyes are more durable
- Color is pricked into upper dermis
- Knowledge of ethnicity, national, cultural, religious and social practices

No 13 inside the lower lip of drug
• High contrast photography
• Computer image enhancement
• Ultraviolet lamp
• Infrared photography
  – Loose epidermis should remove in decomposing bodies
– Artificial means to remove tattoo

Description of tattoo mark
Medicolegal importance

- Help in identification of person
- Race
- Religion
- Profession
- Behavioral characteristics
- Social status
- Political conviction
Identifying scars

• Arise from previous injury
• Surgical operations
• Drug users
• Vaccinations
• Diseases
• Age of scar
• Vascular – avascular
• Tender – non tender
• Soft-tough
• Reddish blue /tender and soft
• Pale or white /tender and soft
• Small and white
• Tough, white and glistening
• Stains for collagen or elastin may confirm the discontinuity in the dermis.
• Scars do not carry hair follicles, sweat glands or sebaceous glands.
Medicolegal significance of scar
Occupational marks

• Blue scar of coal miners
• Pen callosities in clerks
• Kyphosis in shoe makers
• Miners due to splinters
• Steel workers due to burns
• Cut/scar/callosities and hyperkeratosis in rough workers
• Pneumoconiosis in mining
• Pearly plaques on parietal pleura in asbestosis
• Outer surface of Left index finger
  » Constant needle pricks in tailors
Race
Race

• Clothes
• Complexion
• Hairs
• Eyes
• Lips
Hair structure

• Negroid hairs
  – Dark
  – Spiral twist
  – Elliptical cross section

• Caucasians
  – Variation in color
  – Round or ovoid in cross section

• Mongoloids
  – Less pigmented
  – Straight with cylindrical cross section
<table>
<thead>
<tr>
<th></th>
<th>Caucasian</th>
<th>mongoloid</th>
<th>Negroid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Europeans</td>
<td>Europeans</td>
<td>Chinese</td>
<td>Africans</td>
</tr>
<tr>
<td>Thin and fair</td>
<td>Thin and fair</td>
<td>Pale and yellow</td>
<td>Tough and black</td>
</tr>
<tr>
<td>Iris</td>
<td>Blue/grey</td>
<td>Black</td>
<td>Black</td>
</tr>
<tr>
<td>Hairs</td>
<td>Thin /straight</td>
<td>Straight or wavy</td>
<td>Curly and wooly</td>
</tr>
<tr>
<td></td>
<td>Light brown</td>
<td>Black color</td>
<td>Black color</td>
</tr>
<tr>
<td></td>
<td>Light brown</td>
<td>Light brown</td>
<td></td>
</tr>
<tr>
<td></td>
<td>reddish shade</td>
<td>Black color</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Light brown</td>
<td>Black color</td>
<td></td>
</tr>
<tr>
<td>Face</td>
<td>Flattened</td>
<td>Flattened</td>
<td>Small and compressed</td>
</tr>
<tr>
<td>Extremities</td>
<td>Small</td>
<td>Small</td>
<td>Longer forearm than arms</td>
</tr>
<tr>
<td></td>
<td>Small</td>
<td>Long legs than thighs</td>
<td></td>
</tr>
<tr>
<td>Teeth</td>
<td>Lower 1&lt;sup&gt;st&lt;/sup&gt; molars have 3 cusps</td>
<td>Third molar is bigger than other races</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Shovel shape incisor</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Caucasians</td>
<td>Mongoloid</td>
<td>Negroid</td>
</tr>
<tr>
<td>-------------------------</td>
<td>-----------------</td>
<td>-----------------</td>
<td>------------------------------</td>
</tr>
<tr>
<td><strong>Shape of skull</strong></td>
<td>Round</td>
<td>Square</td>
<td>Narrow and oblong</td>
</tr>
<tr>
<td><strong>Size</strong></td>
<td>Mesaticephalic</td>
<td>Brachycephalic</td>
<td>Dolichocephalic</td>
</tr>
<tr>
<td></td>
<td>Intermediate</td>
<td>Small</td>
<td>Large</td>
</tr>
<tr>
<td><strong>Cephalic index</strong></td>
<td>75-80</td>
<td>80-85</td>
<td>70-75</td>
</tr>
<tr>
<td><strong>Forehead</strong></td>
<td>Raised</td>
<td>Inclined</td>
<td>Small and compressed</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Low and wide</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Broad and wider</td>
</tr>
<tr>
<td><strong>Orbits</strong></td>
<td>Triangular</td>
<td>High and roundish</td>
<td>Square</td>
</tr>
<tr>
<td><strong>Nasal aperture</strong></td>
<td>Narrow</td>
<td>Rounded</td>
<td>Broad and wider</td>
</tr>
<tr>
<td><strong>Palate</strong></td>
<td>Triangular</td>
<td>Rounded /horse shoe shape</td>
<td>Rectangular</td>
</tr>
</tbody>
</table>
• Cephalic index

• Height index

• Nasal index
• Brachial index
• Crural index
• Humero-femoral index
Determination of Sex
Sex

Determination of sex

Presumptive evidence

★ Facial appearance
★ Body habitus
★ Hair distribution
★ Clothing
Determination of sex

Highly probable evidence

★ Examination by doctor
★ Breasts
★ External genitalia
Sex

Determination of sex

Confirmatory evidence

★Microscopy of gonads
Histologic sexing

Davidson & Smith Test

In female blood:
In male blood:
Histologic sexing

Barr bodies

Buccal, vaginal epithelial cells searched for Barr bodies. Present in female cells
SEX DIFFERENCE THROUGH BONES
General characteristics

- Bigger /stouter /4.5 kg
- Small/slender /3 kg
- Muscular ridge /depression more prominent
- Less prominent
Skull difference
Gender difference

- Mandible
- Pelvis
- Sacrum
- Thorax
Difference in long bones
## Mathematical sexing of femur

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Definitely female (mm)</th>
<th>Probably female (mm)</th>
<th>Indeterminate (mm)</th>
<th>Probably male (mm)</th>
<th>Definitely male (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trochanteric oblique length</td>
<td>&lt; 390</td>
<td>→ 405</td>
<td>→ 430</td>
<td>→ 450</td>
<td>&gt; 450</td>
</tr>
<tr>
<td>Popliteal length</td>
<td>&lt; 106</td>
<td>→ 114.5</td>
<td>→ 132</td>
<td>→ 145</td>
<td>&gt; 145</td>
</tr>
<tr>
<td>Bicondylar width</td>
<td>&lt; 72</td>
<td>72-74</td>
<td>74-76</td>
<td>7-78</td>
<td>&gt; 78</td>
</tr>
<tr>
<td>Vertical diameter of head</td>
<td>&lt; 41.5</td>
<td>41.5 - 43.5</td>
<td>43.5 - 44.5</td>
<td>44.5 - 45.5</td>
<td>&gt; 45.5</td>
</tr>
</tbody>
</table>

Pearson, 1919
Less than 80 in female
Identification through Stature
# Estimation of height

## Rough guides

<table>
<thead>
<tr>
<th>Bone</th>
<th>Percentage of Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>Humerus</td>
<td>20%</td>
</tr>
<tr>
<td>Femur</td>
<td>27%</td>
</tr>
<tr>
<td>Tibia</td>
<td>22%</td>
</tr>
<tr>
<td>Spine</td>
<td>35%</td>
</tr>
</tbody>
</table>

## Formulae

- Dupertius and Hadden
- Trotter and Gleser
Estimation of stature in human remains

• Length of skeleton plus 2.5cms for thickness of soft parts
• Stature of individual is equal to the length tip of middle finger to the tip of opposite little finger
• Stature is twice from the vertex or heel to the top of symphysis pubis
• Length of one arm x 2 +30cm for clavicle +4 cms for sternum
### Dupertuis and Hadden general formulae for Europian males

<table>
<thead>
<tr>
<th>bone</th>
<th>multiplication factor</th>
<th>add factor for soft parts</th>
</tr>
</thead>
<tbody>
<tr>
<td>femur</td>
<td>2.238</td>
<td>69.089</td>
</tr>
<tr>
<td>tibia</td>
<td>2.392</td>
<td>81.688</td>
</tr>
<tr>
<td>humerus</td>
<td>2.970</td>
<td>73.570</td>
</tr>
<tr>
<td>radius</td>
<td>3.650</td>
<td>80.405</td>
</tr>
<tr>
<td>femur + tibia</td>
<td>1.257</td>
<td>69.295</td>
</tr>
</tbody>
</table>

- femur: 1.442 and
- tibia: 0.931 and
- humerus: 0.083 and
- radius: 0.480 56.006
## Dupertius and Hadden general formulae for Europian females

<table>
<thead>
<tr>
<th>bone</th>
<th>multiplication factor</th>
<th>add factor for soft parts</th>
</tr>
</thead>
<tbody>
<tr>
<td>femur</td>
<td>2.317</td>
<td>61.412</td>
</tr>
<tr>
<td>tibia</td>
<td>2.533</td>
<td>72.572</td>
</tr>
<tr>
<td>humerus</td>
<td>3.144</td>
<td>64.977</td>
</tr>
<tr>
<td>radius</td>
<td>3.876</td>
<td>73.502</td>
</tr>
<tr>
<td>femur + tibia</td>
<td>1.233</td>
<td>65.213</td>
</tr>
<tr>
<td>humerus + radius</td>
<td>1.984</td>
<td>55.729</td>
</tr>
</tbody>
</table>
## Trotter and Gleser formulae for American males

<table>
<thead>
<tr>
<th>bone</th>
<th>multiplication factor</th>
<th>add factor for soft parts</th>
<th>+ (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Caucasians</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>femur + fibula</td>
<td>1.31</td>
<td>63.05</td>
<td>3.63</td>
</tr>
<tr>
<td>femur + tibia</td>
<td>1.26</td>
<td>67.09</td>
<td>3.74</td>
</tr>
<tr>
<td>fibula</td>
<td>2.60</td>
<td>75.50</td>
<td>3.86</td>
</tr>
<tr>
<td>femur</td>
<td>2.32</td>
<td>65.53</td>
<td>3.94</td>
</tr>
<tr>
<td><strong>Negroes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>femur + fibula</td>
<td>1.20</td>
<td>67.77</td>
<td>3.63</td>
</tr>
<tr>
<td>femur + tibia</td>
<td>1.15</td>
<td>71.75</td>
<td>3.68</td>
</tr>
<tr>
<td>femur</td>
<td>2.10</td>
<td>72.22</td>
<td>3.91</td>
</tr>
</tbody>
</table>
Trotter and Gleser formulae
for American females

<table>
<thead>
<tr>
<th>bone</th>
<th>multiplication factor</th>
<th>add factor for soft parts</th>
<th>+ (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Caucasians</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>femur + tibia</td>
<td>1.39</td>
<td>53.20</td>
<td>3.55</td>
</tr>
<tr>
<td>fibula</td>
<td>2.93</td>
<td>59.61</td>
<td>3.57</td>
</tr>
<tr>
<td>tibia</td>
<td>2.90</td>
<td>61.53</td>
<td>3.66</td>
</tr>
<tr>
<td><strong>Negroes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>femur</td>
<td>2.28</td>
<td>59.76</td>
<td>3.41</td>
</tr>
<tr>
<td>tibia</td>
<td>2.45</td>
<td>72.65</td>
<td>3.70</td>
</tr>
<tr>
<td>femur + tibia</td>
<td>1.26</td>
<td>59.72</td>
<td>3.28</td>
</tr>
</tbody>
</table>
Estimation of Age
Medico-legal importance of Age

1 Identification
2 Criminal responsibility
3 Kidnapping/abduction
4 Rape …
5 Attainment of majority
6 Competence as witness
7 Eligibility for employment
8 Judicial punishment
9 Infanticide/criminal abortion
• **Criminal responsibility**
  – Sec 82 (under 7 years)
  – Sec 83 (7-12)

• **Punishments**
  – No punishment under 7 years of age
  – Juvenile justice system ordinance, 2000
  – Person below 18 years of age cannot be given death penalty
  – Below 15 years tried in special juvenile court
• Consent
  – Minimum age for consent is 12 years
  – Sec 89
  – Operation by doctor
  – Sec 90
• Only adult can consent for valid legal transaction and agreement
• **Marriage**
  – Male 18 years
  – Female 16 years
  – Child marriage restraint act 1929

• **Kidnapping and procuration of minor girls**
  – Sec 361 of PPC
  – Sec 366 of PPC
• Exposure and abandonment of child
  – Sec 328
• Child labor
  – Article 11(3) of constitution of Pakistan
  – Below 14 years of age in any factory or mine
• General elections
  – Minimum age 25 years
  – Membership of senate 30 years

Employment and retirement
Age estimation

- Physical appearance
- Anthropometric measurement
- Age from puberty changes
- Developmental changes in Teeth
- Assessment of age from bones
  - Ossification centers
  - Epiphyseal union
  - Degenerative changes
  - Histomorphometry
Age determination from skeleton

a  New born infants
   CR and CH lengths
   Centres of ossification
calcaneum
talus
femur – lower end
tibia – upper end

b  1 – 25 years of age
   union of epiphyses

c  over 25 years of age
   fusion of skull sutures
   ossification of hyoid
   and larynx
Estimation of Age

Intra-uterine age

0
4
8
12
36
40

weeks

pre-embryonic stage
embryonic stage
fetal stage
Estimation of Age

Intra-uterine age

Rough guide

CR (Crown-rump) length is 5 mm at the end of 5 weeks. It increases by 1 mm per day till the end of 8th week; thereafter, at 1.5 mm per day
Estimation of Age

Intra-uterine age

Hess’s Rule

Up to 5 months
Age in months = $\sqrt{\text{CR length in cm}}$

Thereafter
Age in months = $\frac{\text{CR length in cm}}{5}$
### Intra-uterine age in relation to CR length and weight

<table>
<thead>
<tr>
<th>Age</th>
<th>CR length</th>
<th>Weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 wk</td>
<td>5-8 mm</td>
<td>-</td>
</tr>
<tr>
<td>6 wk</td>
<td>10-14 mm</td>
<td>-</td>
</tr>
<tr>
<td>7 wk</td>
<td>17-22 mm</td>
<td>-</td>
</tr>
<tr>
<td>8 wk</td>
<td>28-30 mm</td>
<td>-</td>
</tr>
<tr>
<td>3 mo</td>
<td>5-8 cm</td>
<td>10-40</td>
</tr>
<tr>
<td>4 mo</td>
<td>9-14 cm</td>
<td>60-200</td>
</tr>
<tr>
<td>5 mo</td>
<td>15-19 cm</td>
<td>250-450</td>
</tr>
<tr>
<td>6 mo</td>
<td>20-23 cm</td>
<td>500-820</td>
</tr>
<tr>
<td>7 mo</td>
<td>24-27 cm</td>
<td>900-1300</td>
</tr>
<tr>
<td>8 mo</td>
<td>28-30 cm</td>
<td>1400-2100</td>
</tr>
<tr>
<td>9 mo</td>
<td>31-34 cm</td>
<td>2200-2900</td>
</tr>
<tr>
<td>10 mo</td>
<td>35-40 cm</td>
<td>3-3.4 kg</td>
</tr>
</tbody>
</table>
Comparison Of skulls

Age

At birth

Adult
Comparison Of mandibles
• Age estimation from closure of Skull sutures
Lipping of lumber vertebra
Age

Estimation of Age

- Ossification centers
Age changes in symphysis pubis
# Dating of human bones

## Ancient or modern?

<table>
<thead>
<tr>
<th>Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen content</td>
</tr>
<tr>
<td>Amino acid content (TLC)</td>
</tr>
<tr>
<td>UV fluorescence</td>
</tr>
<tr>
<td>Benzidine reaction</td>
</tr>
<tr>
<td>Immunologic activity</td>
</tr>
</tbody>
</table>
Comparative data and techniques for identification

- Anthropometry
- Finger/foot prints
- Dental pattern
- Superimposition technique
- Trace evidence comparison
• Measurements of various parts of the body do not alter after adult age
• No two persons shows the same measurements in all respects

  – Descriptive data
    • Color of hairs /iris /shape of nose /ears /chin
  – Bodily marks
    • Mole/scar/tattoo/
  – Body measurements
    • Eleven in number
Finger printing
Dactylography, Galton system
"Does man think that WE Cannot assemble his bones? Nay, WE are able to put Together his fingers in perfect order The very tips of his fingers."

[AL-QUR'AN 75:3-4]
Finger printing

Forensic Friction Ridge Examination
• Present from birth, both on epidermis and dermis
• Remain constant for the life
• Cannot be altered
• Form pattern that are absolutely individual
  – No two hands are alike
Advantages

• Applicable to all persons of all ages
• Obtained from putrefied bodies
• Transmitted form one place to another

• Automated Finger print identification system (AFIS)
• Impression may left at crime scene
• Identification of weapon
• Identification of habitual criminals
• Identification of decomposing bodies
• Prevention of impersonation
• Visible finger prints
• Latent finger prints
• Plastic finger prints
• Finger prints from dead body
• **Non porous surface**
  – Glass /marble /plastic /wood
  – Magnetic powder technique
  – Superglue fuming (cyanoacrylate)
  – Color of powder should contrast for better visibility

• **Porous surface**
  – Fabric/wood/paper
  – Iodine fuming
  – Ninhydrin
  – Silver nitrate
• Poroscopy and Locard’s method

  – Size, shape and arrangement for given area in each individual
Identification

by superimposition
Frontal sinus identification
Forensic odontology
• Sex
• Race
• Occupation
• Social status
• Teeth as victim of assault and weapon of offence
Dental charting

• Record of number, position and state of teeth
• Divide into four quadrant
  – Right upper
  – Left upper
  – Right lower
  – Left lower
• Extraction
• Filling
• Artificial teeth
• Prosthetic work
• Broken teeth
• Crowned teeth
• Congenital defects
• Malposition
• General condition
• In Caucasian races, the lateral incisors in the upper jaw are usually smaller than the central.
• Caucasians also have long pointed canine roots.
• Enamel pearls, small nodules of enamel on the tooth surface, are much more frequent in Mongoloid teeth.
• Small nodules on the lingual surface of maxillary molars, called 'Carabelli's cusp', are most common in Caucasian races
• The condition of bull-tooth or 'taurodontism' is most common in Mongoloid peoples:
  pulp cavity of molars is wide and deep, and the roots are fused and bent.
A congenital
• lack of the third upper molar is most common in Mongoloids
• Negroid races tend to have large teeth and often have more cusps on their molars,
Age

Estimation of Age from teeth

Primary dentition
Estimation of Age from teeth

Permanent dentition
Tooth development and eruption pattern
• Degree and extent of calcification of roots of teeth ascertained by X-ray examination.

• Attrition of teeth, i.e. *wearing off the teeth* on the grinding surface begins in the molars after middle age.

• Old age — all teeth are lost and individual becomes edentulous.
Gustafson's method of age estimation from changes in teeth

A₀ = no attrition
S₀ = no secondary dentine
P₀ = no periodontosis
C₀ = normal layer of cementum
R₀ = no root resorption

A₁ = attrition within enamel
S₁ = sec dentine in upper part of pulp cavity
P₁ = periodontosis begins
C₁ = apposition a little > normal
R₁ = resorption on small isolated spots

A₂ = attrition reaching dentine
S₂ = pulp cavity half filled
P₂ = periodontosis along first one-third of root
C₂ = great layer of cementum
R₂ = greater loss of substance

A₃ = attrition reaching pulp
S₃ = pulp cavity nearly or wholly filled with sec dentine
P₃ = periodontosis has passed 2/3 of root
C₃ = heavy layer of cementum
R₃ = great areas of cementum & dentine affected
Boyde method
Identification in mass disaster
• every accidental death is a disaster to the individual family involved and [to them] is of the same dimension irrespective of how many others were similarly affected at the same time. Every accidental death has its preventive aspects and, often, these lie in the hands of the pathologist.
• Natural
  – Non-biological
    • Earthquake, flood, drought, landslide, tsunami
  – Biological
    • Disease, epidemic

• Man inflicted
  – Accidental
    • Transportation, building collapse, mining
  – Industrial
    • Fire, release of toxic substance
  – Civil disturbance
    • Riots
  – Warfare
• disaster victim identification
• (DVI) teams.'
• These teams usually include police, pathologists, dentists, radiologists, forensic scientists, mortuary assistants, embalmers and funeral directors, with provision for finger printing, forensic toxicology and DNA analysis.
Contemporary identification method

- Visual recognition
- Personal effects
- Ante-mortem data
- External examination of the body
- Internal autopsy examination
- Dental identification
- Finger prints
- DNA identification
• Labeled with a no of recovery from the accident site
• Only one series of body numbers is used through out the investigation
• Examination of clothing
• Medical and x-ray evidence
• Blood grouping
• DNA testing
Organizational aspect

- Body recovery and search team
- Photography unit
- Morgue station
- Mortuary
- Missing person record unit
- Postmortem record unit
- Identification center
- Body release and burial section