Identification of Sex

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Sex

- Normally sex determination is easy from external examination, but it may be difficult in following cases :
- Intersex
- Concealed sex
- Advanced decomposition
- Skeleton

Sex differences in males and females

S. No.	Traits	Male	Female
1	Build	Larger, greater muscular development	Smaller, lesser muscular development
2	Shoulder	Broader than hip	Narrower than hip
3	Thorax	Larger, less rounded	Shorter, more rounded
4	Limbs	Longer	Shorter
5	Arms	Flatter in cross section	More rounded in cross section
6	Wrist and ankles	Stouter, less delicate	More delicate
7	Head hair	Shorter, thicker and coarser	Longer, thinner and finer

Continue….

S. No.	Criteria	Male	Female
8	Body hair	Present on face and chest	Absent
9	Pubic hair	Thick	Thin
10	Trunk	Abdominal segment smaller	Abdominal segment longer
11	Breast	Not well developed	Well developed
12	Waist	Ill defined	Well defined

Continue.....

S. No.	Criteria	Male	Female
13	Thighs	Cylindrical	Conical (shorter femur, more deposition of fat)
14	Gluteal region	Flatter	Full and rounded
15	External genitalia	Penis, scrotum	Vulva, vagina
16	Internal sex organ	Prostate, seminal vesicle etc.	Uterus
17	Gonads	Testis	Ovary
18	Larynx	Prominent, length 4.8 cm	Less prominent, length 3.8 cm

Determination of sex

- In living and dead in medico legal practices can be done by

1. Examination of external genitalia
2. Nuclear sexing
3. DNA based method
4. Skeleton

Examination of external genitalia

- Useful in cases of concealed sex. In other case may be unreliable like intersex, advanced decomposition, skeleton is found

Nuclear sexing

- A normal person has 46 chromosomes (males 44+XY & females 44 + XX)
- The sex can be determined by studying the presence of:
- Barr bodies (Sex chromatin)
- Davidson's bodies and
- 'Y' chromosomes
- Sex chromatin can be demonstrated in putrefied bodies, but not if putrefaction has reached up to cellular level
- Uterus and prostate resist putrefaction for a longer time, in advanced putrefaction, sex cab be determined by identifying uterus and prostate.

Sex chromatin (Barr body)

- It is the condensed chromatin of the inactivated X chromosome in females. It refers only to inactivated X chromosome while sex chromosomes refer to both X and Y chromosome.
- Sex chromatin is characteristic of females (30 – 40% of female cells)
- In females more than 40% of nuclei of buccal mucosa contain chromatin body (**chromatin positive**),
- in males only less than 10% of nuclei contain chromatin body (**chromatin negative**)
- It is planoconvex nuclear condensation seen at the inner surface of the nuclear membrane.
- The ideal tissues to study Barr bodies are buccal mucosa, skin, smooth muscle and cartilage.
- Present only during interphase, disappears during mitosis
- X chromosomes demonstrated by Feulgen reaction using acriflavin Schiff reagent, seen as bright yellow spot

Davidson's bodies

- In females, upto 3% of polymorphic W.B.C's (i.e. neutrophils and eosinophils) show a thin stalked drumstick like projection at the periphery of the nucleus
- This is absent in males
- Demonstrated by Jenner- Giemsa method or Feulgen method

Y – Chromosomes

The 'Y' Chromosomes present in males are fluroscent for the dye Quinacrine dihydrochloride

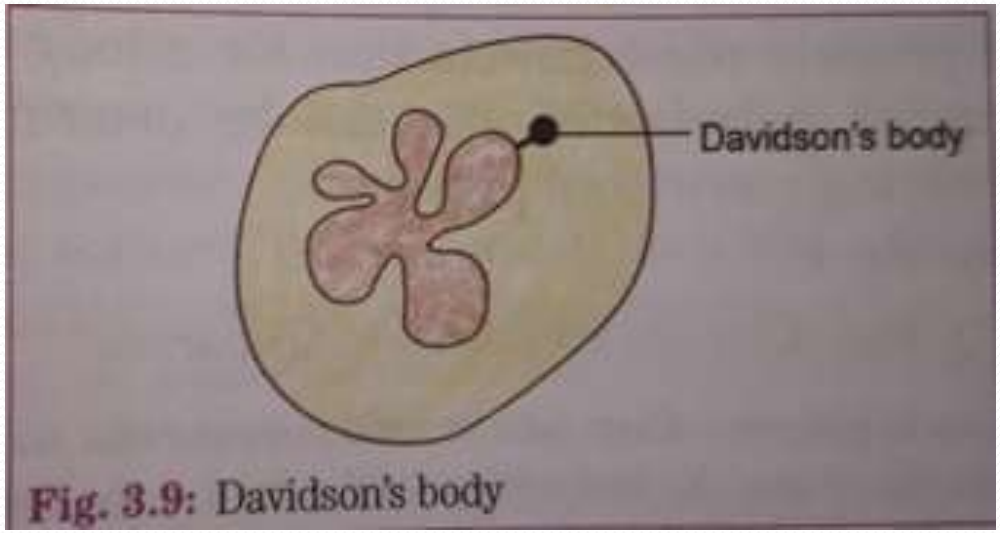


Fig. 3.9: Davidson's body

Intersex

- An intersex is an intermingling in one individual of characters of both the sexes in varying degree, including physical form, reproductive organs, hormonal profile and sexual behavior.
- Incidence is 0.018% without the inclusion of Klinefelters syndrome and turners syndrome and 1.7% with their inclusion.

➢ A person has 6 different types of sexual character

1. Sex chromatin [XX or XY]
2. Gonads [ovaries or testis]
3. Hormonal [estrogens or androgens]
4. Internal genitalia [uterus, prostate, seminal vesicle etc.]
5. External genitalia [vagina or penis]
6. Psychological attraction toward opposite sex

Classification

1. Gonadal agenesis - gonads (either ovaries or testes) fail to develop. The nuclear sex is chromatin negative.
2. Gonadal dysgenesis - External genital organs are present, but the testes or ovaries fail to develop at puberty.

- Klinefelter's syndrome
- Anatomical structure in male
- nuclear sexing is female (chromatin positive)
- The chromosomal pattern is 47XXY
- Usually undiagnosed till puberty

Continue….

- Turner's syndrome
- Anatomical structure is female
- nuclear sexing is male (chromatin negative)
- The chrosomal pattern is 45 XO
- True Hermaphroditism - A rare condition, where in external genitalia may be of both sexes, but internally there is presence of both testes & ovaries and ovotestes
- Pseudohermaphroditism - External characteristics of one sex, with gonads of opposite sex
- Male pseudohermaphroditism:
  Nuclear sex XY, sex organs & sexual characteristic of female form
- Female pseudohermaphroditism:
  Nuclear sex XX, sex organs & sexual characteristic of male form

Concealed sex

- Concealed sex is hiding ones sex by wearing clothes of the opposite sex
- Criminal often do it to avoid being caught by police. This cab be detected by physical examination.
- Concealed sex is different from transvestism, in which also the person wear clothes of opposite sex, but in the latter, there is psychological compulsion instead of a motivation to avoid detection.

DNA based methods

- Amelogenin is a protein found in developing tooth enamel
- Amelogenin is located on X [AMELX] and Y [AMELY] chromosomes
- Intron 1 AMELX is 106 bp in size, whereas in AMELY, it is 112 bp in size. This does not affect the final protein synthesis, as introns are not expressed, but forms a good basis for sex determination
- Samples from male source XY will show two bands on an agarose gel (for 106 bp and 112 bp respectively), whereas females XX will show only one band
- Since it is a PCR based method, sex can be determined from a little as 20 pg of DNA from highly mutilated body and degraded remains
- Sex can be determined from bone marrow cells even in those bones which normally show little or no anatomical differences
  eg metacarpels, metatarsals etc.

Sexing of the skeleton

- Human bones display sexual dimorphism [different shapes in sexes]
- Recognizable sex differences do not appear until after puberty except in pelvis, in which sexual dimorphism is present since fetal life

➢ Two methods for sex determination from skeleton

❑ Morphological [roughness, shapes etc, more subjective]

- Sex difference in skull are typically morphological

❑ Metric [measurements; more objective]

- Sex difference in femur is typically metric

General sex differences in human skeleton

S. No.	Criteria	Male	Female
1	General size	Larger, more massive	Smaller, less massive
2	Depressions, muscular marking, processes and ridges on bones	More prominent	Less prominent
3	Length	Longer	Shorter
4	Shaft	Rougher	Smoother
5	Medullary cavity	Shallower	Relatively wider
6	Metacarpals	Longer and broader	Shorter and narrower
7	Bone Mineral Density [BMD]	Higher	Lower
8	Weight of dry	4.5 kg	3 kg

Sex difference in human skull

S. No.	Criteria	Male	Female
1	General appearance	Larger, heavier, more massive	Smaller, lighter, less massive
2	Architecture	Rugged	Smooth
3	Walls	Thicker	Thinner
4	Surfaces	Rough	Smooth
5	Muscular ridges	More marked, especially at base and in occipital and temporal areas	Less marked

Continue.....

S. No.	Criteria	Male	Female
6	Capacity	1500-1550 ml	1350-1400 ml
7	Forehead	Steeper, less rounded	Vertical, rounded
8	Glabellas	More prominent	Smaller or absent
9	Frontonasal junction	Distinct angular	Smooth curved
10	Eye orbit	Relatively smaller in size, sqarish in shape, set lower on face with rounded margins	Relatively larger in size, rounded in shape, set higher on face with sharp margins
11	Supraorbital ridges	Prominent	Less prominent

Continue.....

S. No.	Criteria	Male	Female
12	Bony ridges along the upper border of external auditory meatus	Prominent	Less prominent or absent
13	Zygomatic arch [cheek bone]	Heavier and more prominent, laterally arched	Lighter, less prominent, more compressed
14	Nasal aperture	Higher and narrower	Lower and broader
15	Frontal eminences	Small	Larger
16	Parietal eminences	Small	Larger
17	Frontal sinuses	More developed	Less developed

Continue.....

S. No.	Criteria	Male	Female
18	Maxillary sinuses	Significantly larger	Smaller
19	Occipital protuberances	Very prominent	Less prominent
20	Mastoid process	Larger in size, tip blunt, M type	Smaller in size, tip pointed, F type
21	Diagastric groove	Deeper	Shallower
22	Occipital condyles	Larger	Smaller

Continue.....

S. No.	Criteria	Male	Female
23	Palate	Larger , broader and U shape	smaller, narrower and parabolic
24	Foramina	Larger	Smaller , rounded
25	Foramen magnum	Larger, oblong	Smaller, rounded
26	Teeth	Larger	Smaller


Male
Female

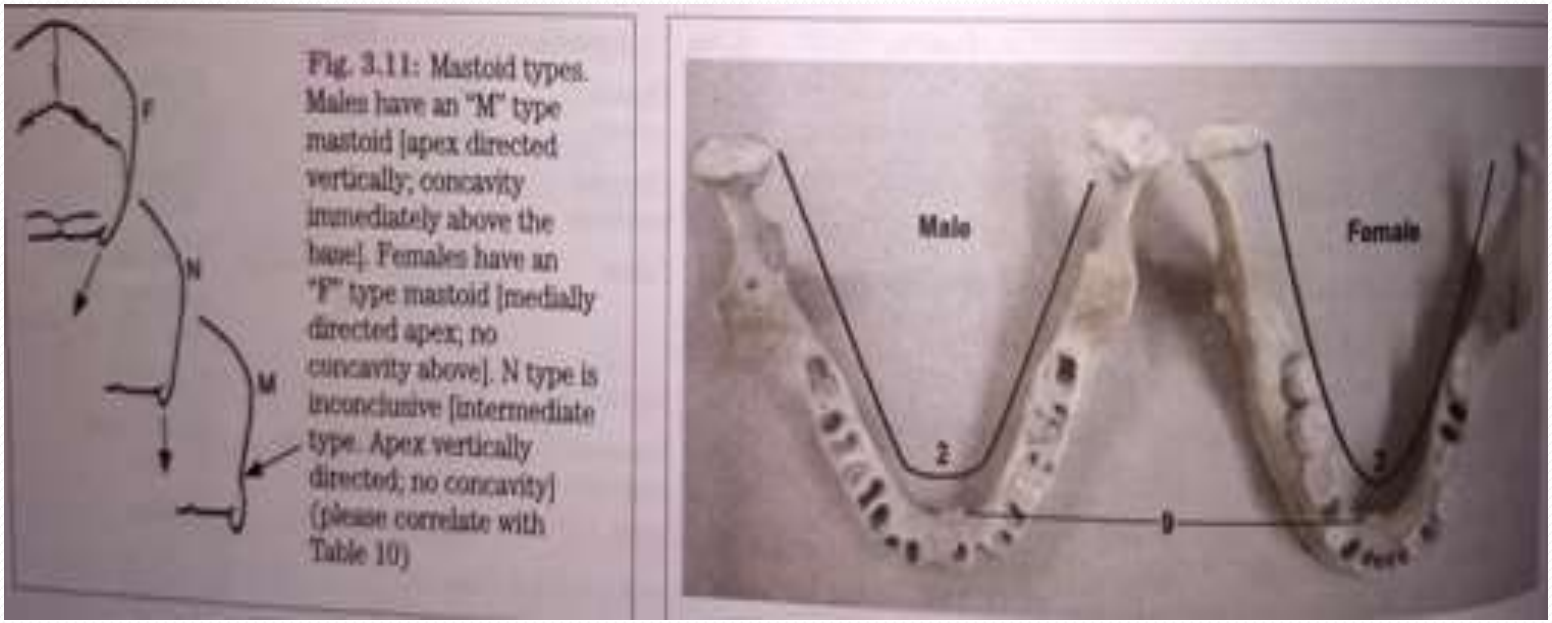
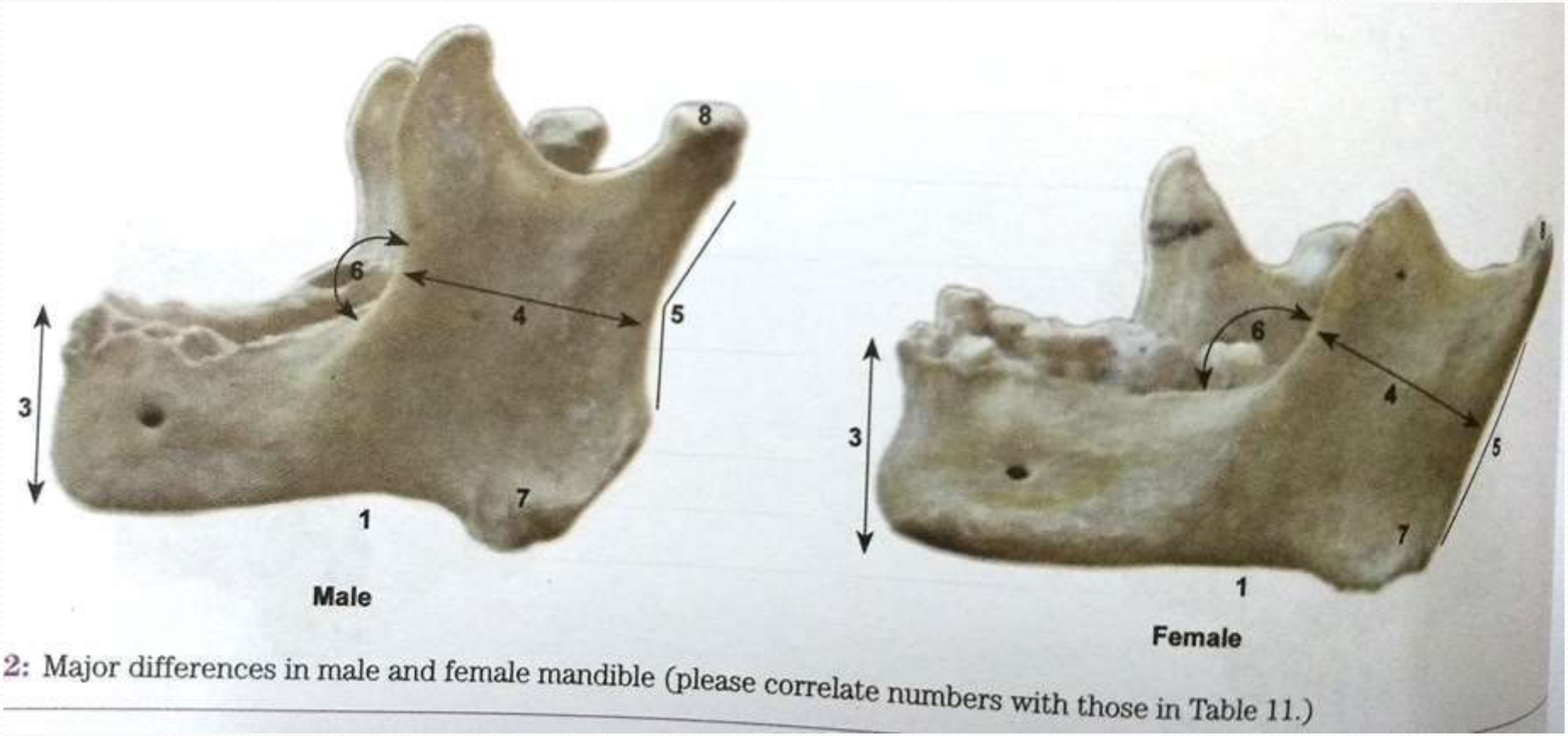


Fig. 3.11: Mastoid types. Males have an "M" type mastoid [apex directed vertically; concavity immediately above the base]. Females have an "F" type mastoid [medially directed apex; no concavity above]. N type is inconclusive [intermediate type. Apex vertically directed; no concavity] (please correlate with Table 10)

Sex differences in human mandibles

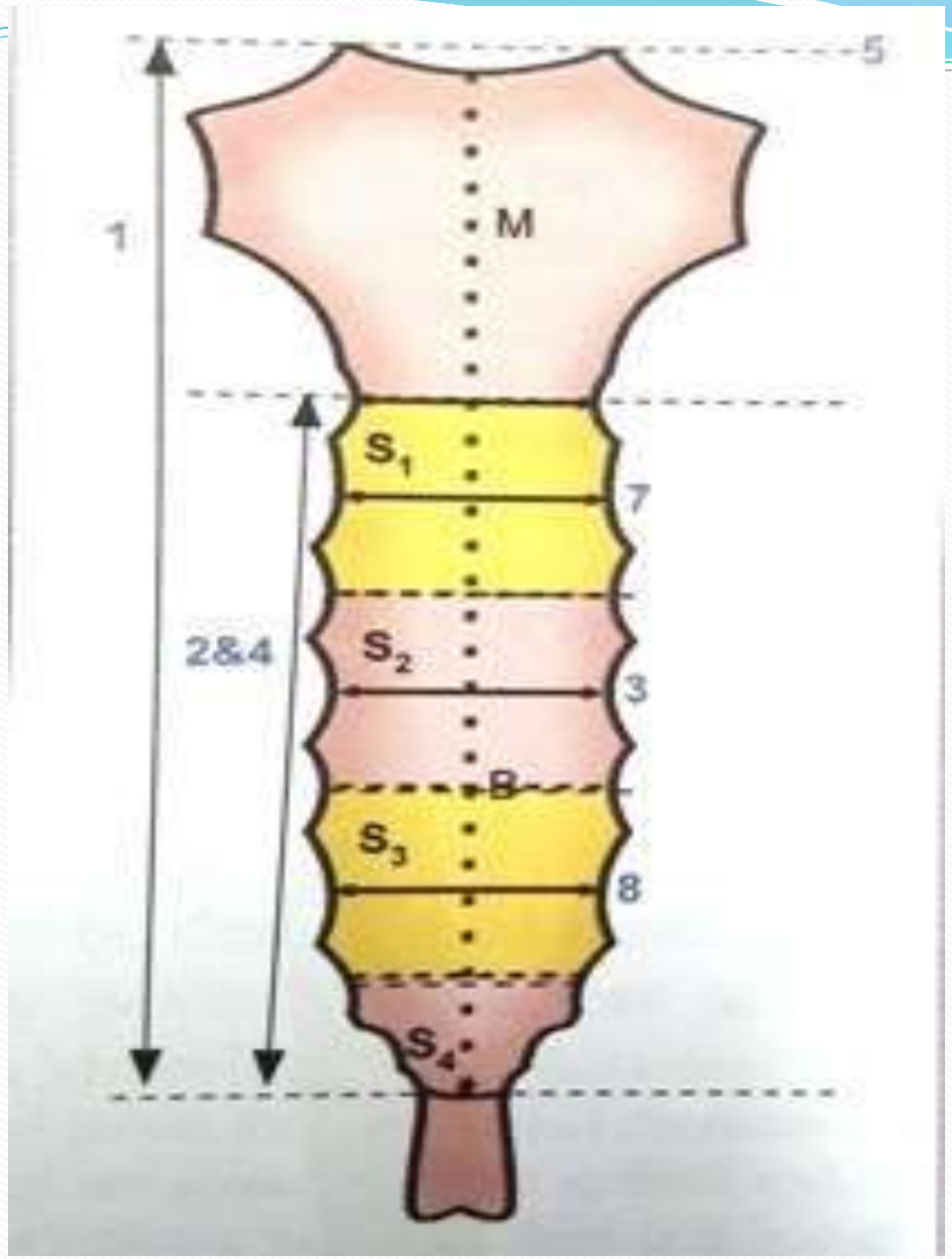
S. No.	Criteria	Male	Female
1	General size	Larger & thicker	Smaller & thinner
2	Chin [Symphysis menti]	Square	Rounded
3	Body height at Symphysis	Greater	Smaller
4	Breadth of ascending ramus	Greater	Lesser
5	Posterior border of ascending ramus	Shows indentation at the level of molars	No indentation
6	Angle of body and ramus	Less obtuse [less than 125]	More obtuse [more than 125]
7	Angles	Everted	Inverted
8	Condyles	Larger	Smaller



2: Major differences in male and female mandible (please correlate numbers with those in Table 11.)

Sex differences in human sternum

S. No.	Criteria	Male	Female
1	Ashley's rule	Total length more than 149 mm	Total length less than 149 mm
2	Breadth	More	Less
3	Body of sternum	95 mm	80 mm
4	Level of upper margin	In level with lower part of body of T2	In level with lower part of body of T3
5	Sternal index	46.2	54.3
6	Width of the 1st sternebra at its waist	27 mm approx.	24 mm approx.
7	Width of the 3rd sternebra at its waist	32 mm approx	29 mm approx


5
1
M
S1
7
2&4
S2
3
B
S3
8
S4

Sex differences of human ribs and thorax

S. No. (Ribs)	Criteria	Male	Female
1	Composition	Thicker	Thinner
2	Curvature	Lesser	Greater
3	Cranio caudal inclination	Less	More
4	Length of ribs in relation to body	Less	More
(Thorax)			
5	Shape	Larger and narrower	Shorter and wider
6	Volume	More	Less
7	Clavicle	Longer, broader, heavier, less curved	Smaller , narrower, lighter, more curved

Sex differences in human pelvis

S. No.	Criteria	Male	Female
1	Bony framework	Massive, more erect, muscular markings more marked, rougher, stand higher	Less massive, less erect, muscular markings less marked, smoother, stand lower
2	Bones	Tough, thick, heavy	More delicate, thin, light
3	General shape	Deep funnel shape	Flat bowl shape
4	Ilium	Curve of iliac crest reaches higher level, more prominent, less vertical, iliac fossa deep	Curve reaches lower level, less prominent, more vertical, iliac fossa shallow

Continue.....

S. No.	Criteria	Male	Female
5	Preauricular sulcus [attachment of anterior sacroiliac ligament]	Not prominent, narrow, shallow	More frequent, broad and deep
6	Acetabulum	Large, directed laterally	Small, directed anterolaterally
7	Obturator foramen	Larger , oval with base upward	Small, triangular with apex forwards
8	Greater Sciatic Notch	Smaller, narrower , deeper	Larger, wider, shallower
9	Average width of greater sciatic notch	46.5	51.5

Continue.....

S. No.	Criteria	Male	Female
10	Average depth of greater sciatic notch	32 mm	31 mm
11	Sciatic notch index	145	166
12	Iliopectineal line [linea terminales], divides pelvis into greater (false) and lesser (true) pelvis	Rough, well marked. Less vertical	Smooth, rounded. More vertical
13	Ischial spines	Closer together, inverted	More separated, everted
14	Ischial tuberosity	Inverted	Everted, more widely separated

Continue.....

S. No.	Criteria	Male	Female
15	Chilotic line [line extending backwards from Iliopectineal eminence to the nearest point on the anterior margin of the auricular surface and then to iliac crest. The auricular point divides it into anterior (pelvic) and posterior (sacral) segment.	Sacral part prominence	Pelvic part prominence

Continue.....

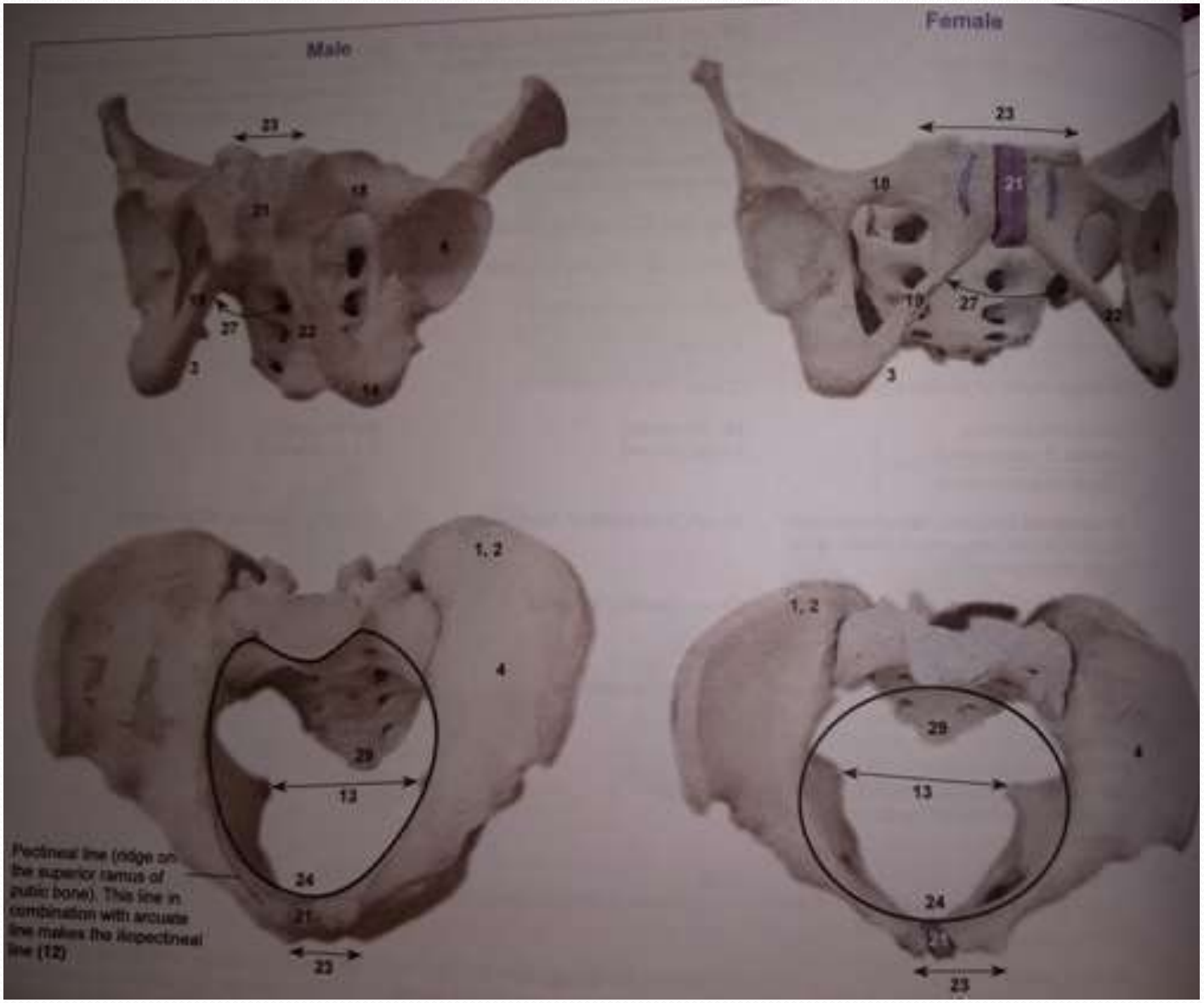
S. No.	Criteria	Male	Female
16	Chilotic line index	More than 100	Less than 100
17	Body of pubis	Narrow, triangular, no parturition pits	Broad, square, parturition pits
18	Superior ramus of pubis	It is like continuation of body of pubis	Short and thick. Constricted or narrow appearance
19	Ischiopubic rami	Distinctly roughness, heavier, everted	Smoother, lighter, less everted

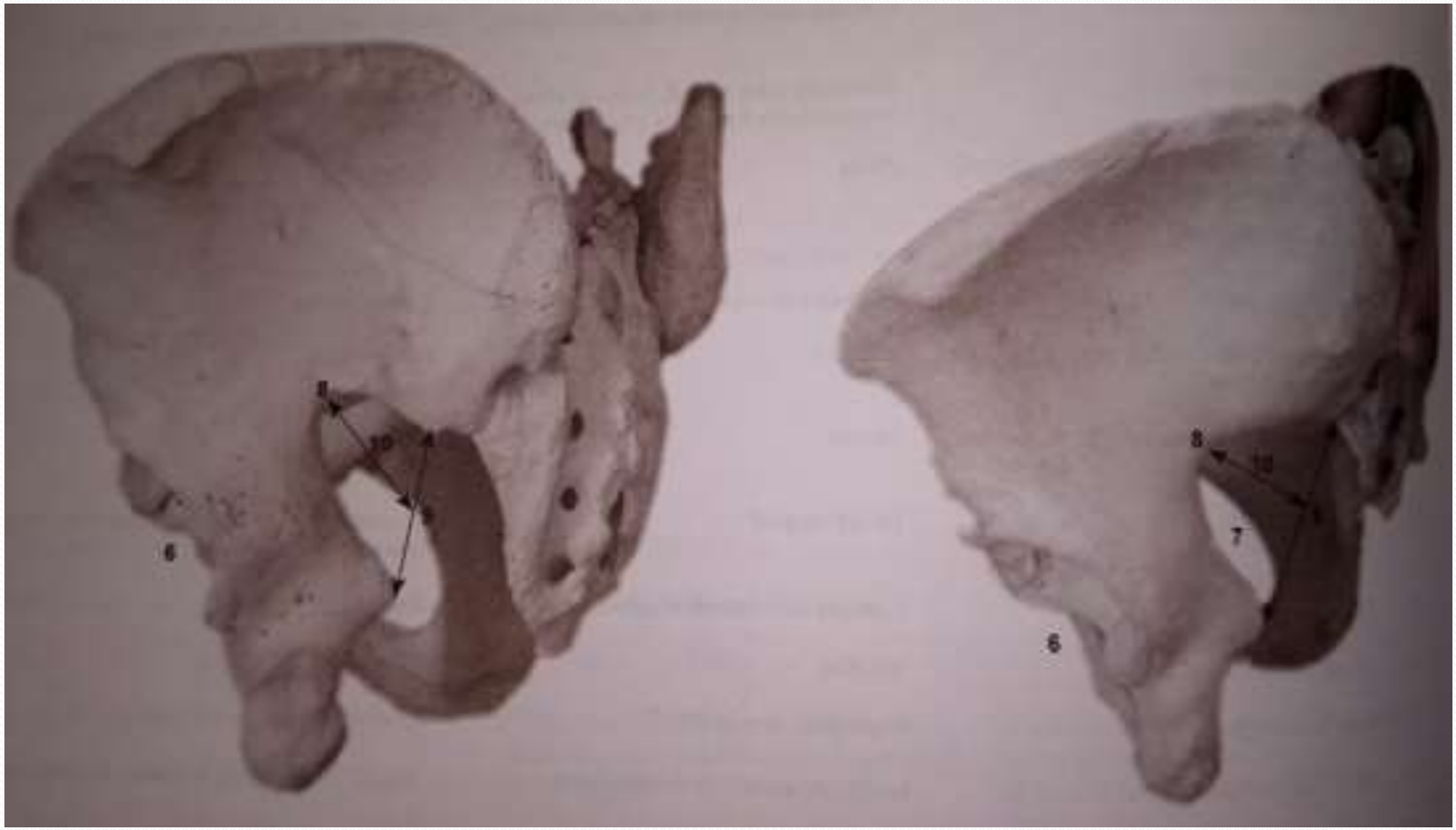
Continue.....

S. No.	Criteria	Male	Female
20	Ischiopubic or Washburn's index	73-94	91-115
21	Symphysis pubis	Higher, narrower	Lower, wider
22	Margins of pubic arches [formed by both Ischiopubic rami]	Everted	Not everted
23	Distance between two pubic spines	Lesser	Greater

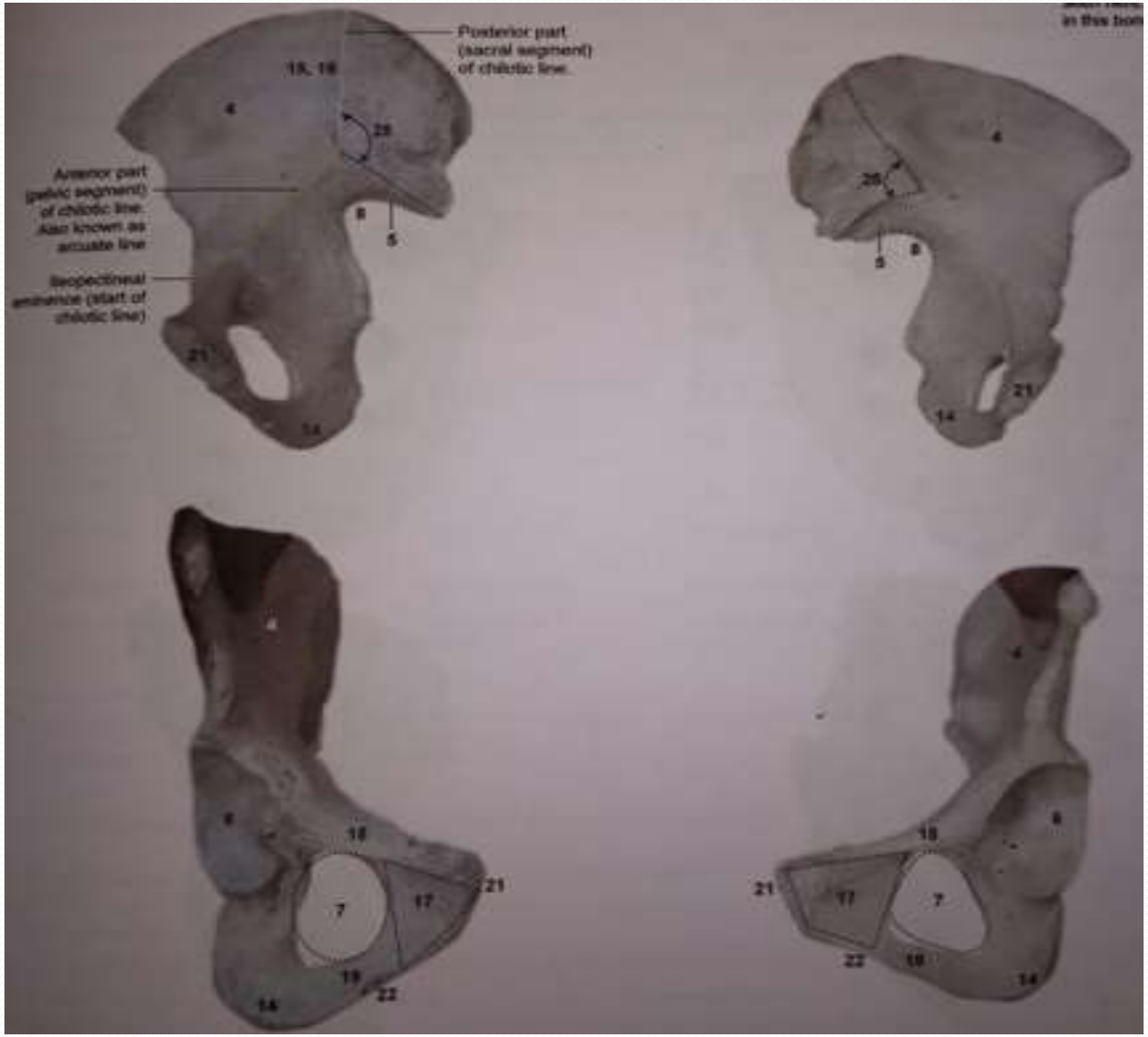
Continue.....

S. No.	Criteria	Male	Female
24	Pelvic brim (inlet)	Heart shaped	Circular or elliptical
25	Pelvic cavity	Conical or funnel shaped	Broad and round
26	Pelvic outlet	Smaller	Larger
27	Sub pubic angle	V shaped, angle 70-75	U shaped, angle 90-100
28	Sacroiliac joint surface	Large, Angulations less sharp	Small, Angulations sharp
29	Coccyx	Less movable	More movable


Male
Female
23
21
27
22
3
10
1, 2
4
29
13
24
23
Pectineal line (ridge on the superior ramus of pubic bone). This line in combination with arcuate line makes the iliopectineal line (12)

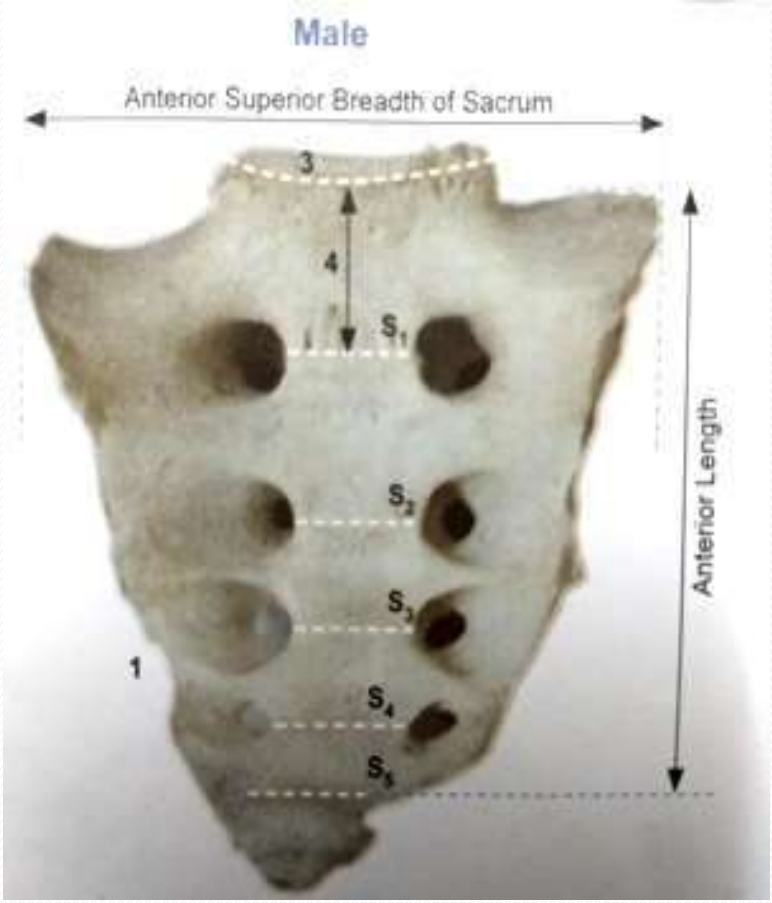

8
10
6
8
10
7
6

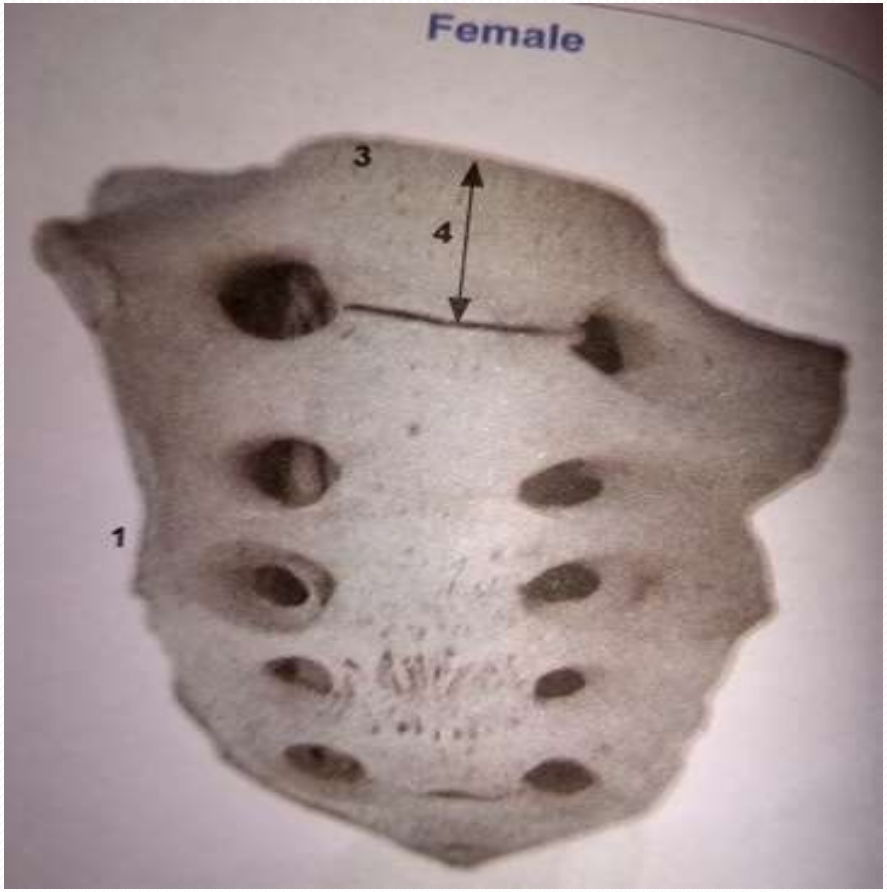

Male
Female
25
13
26
14
18
19
25
13
26
18
7
14
17
19
Parturition pits are seen here. Not seen in this bone


Posterior part (sacral segment) of chilotic line.
15, 16
4
23
Anterior part (pelvic segment) of chilotic line. Also known as arcuate line
8
5
Iliopectineal eminence (start of chilotic line)
21
14
4
20
5
8
21
14
4
8
18
7
17
21
19
22
14
4
8
18
21
17
7
22
19
14

Sex differences in human sacrum

S. No.	Criteria	Male	Female
1	Size and shape	Longer, narrower	Shorter, wider
2	Curvature	Evenly distributed	Only lower half curved suddenly
3	Sacral promontory	Well marked	Less marked
4	First sacral vertebra	Larger	Smaller
5	Sacroiliac articulation	Larger	Smaller
6	Sacral index	105	115
7	Alar Index	65	80
8	Corporabasal Index	45	40

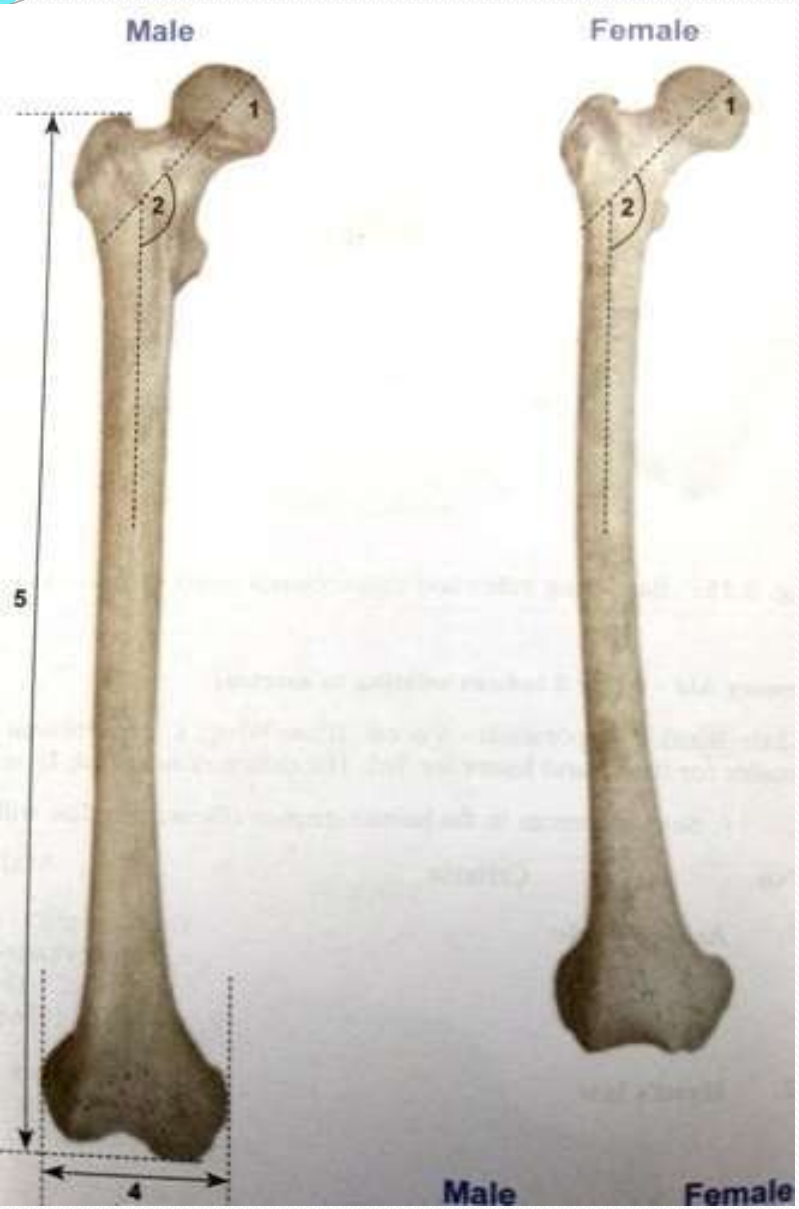

Male
Anterior Superior Breadth of Sacrum
3
4
S1
S2
S3
S4
S5
1
Anterior Length

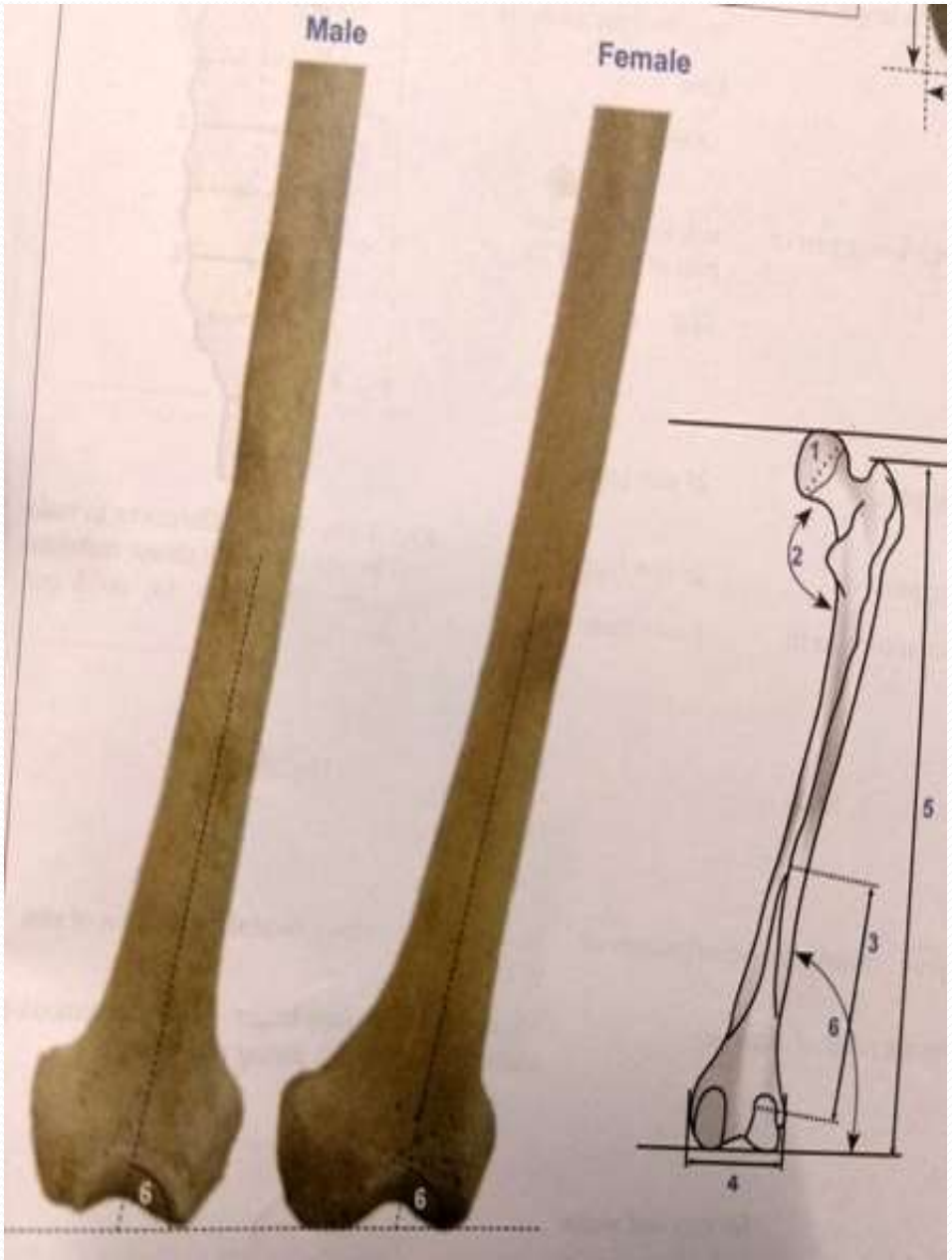

Female
3
4
1

- Sacral Index = $\frac{Anterior\ Superior\ Breadth\ of\ Sacrum}{Anteror\ Length} \times 100$
- Alar Index = $\frac{Width\ of\ wings}{Breadth\ of\ 1st\ Sacral\ Vertebra} \times 100$
- Corporabasal Index = $\frac{Breadth\ of\ 1st\ Sacral\ Vertebra}{Anterior\ Superior\ Breadth\ of\ \ Sacram} \times 100$

Sex differences in human femur

S, No.	Criteria	Male	Female
1	Head	Larger, forms two-third of sphere, vertical diameter more than 46 mm	Smaller, forms less than two-third of sphere, vertical diameter less than 42
2	Angle of neck with shaft	125	Less than 125
3	Poplitial length	145	106
4	Bicondylar width	78 mm	72 mm
5	Trochanteric length	450 mm	390 mm
6	Angle of shaft with condyl	80	75


Male
Female
1
2
5
4
Male
Female


Male
Female
6
6
1
2
3
6
5
4

ACCURACY OF SEXING….KROGMAN

- ENTIRE SKELETON… 100%
- PELVIS & SKULL…….98%
- PELVIS……95%
- SKULL……90%
- LONG BONES……80%

Medico Legal Importance of sex:

- Marriage
- Divorce
- Rape
- Paternity
- Inheritance
- Employment
- Contesting in election
- Other civil rights etc.

Sources and suggested reading:

- Textbook of Forensic Medicine and Toxicology, Anil Aggrawal, APC publication
- Review of Forensic Medicine and Toxicology, Gautam Biswas, JAYPEE publication
- The Essentials of Forensic Medicine and Toxicology, Dr. K S Narayan Reddy and Dr. O P Murthy, The Health Science Publisher
- Textbook of Forensic Medicine and Toxicology, P C Dikshit, PEEPEE publications
- Research papers

THANK U….!!!!