Female pelvis and fetal skull

Female pelvis:

Pelvic Girdle (Hip)
The female pelvis is formed by a pair of hip bones (innominate) bones, the sacrum and the coccyx.
The pelvis attaches the lower limbs to the axial skeleton with the strongest ligaments of the body and transmits weight of the upper body to the lower limbs, also it supports the visceral organs of the pelvis.

* Each hip bone compose of pubic bone in front with its upper and lower rami, the ischium below, and the ilium above. They meet together at a cup shape fossa that articulate with the head of the femur called the acetabulum.
* The two hip bones join with each at the pubic symphysis anteriorly and with sacrum via the sacral alae at the sacroiliac joint.

Each hip bones consist of:
1- Ilium: It consists of a body and a superior wing like portion called the ala, the broad postero-lateral surface is called the gluteal surface, the auricular surface articulates with the sacrum (sacroiliac joint) and the major markings include the iliac crests, four spines, greater sciatic notch, iliac fossa, arcuate line, and the pelvic brim.

2- Ischium: The ischium forms the posteroinferior part of the hip bone and consist of a body and a ramus. The thick body form 2/5 of the acetabulum articulates with the ilium, and the thinner ramus articulates with the pubis. Major markings include the *ischial spine (the sacrospinal ligament binds to it), lesser sciatic notch, and the *ischial tuberosity (the sacrotuberous ligament bind to it) are two important landmarks in obstetrics.

3- Pubis: The pubic bone forms the anterior portion of the hip bone. It articulates with the ischium and the ilium. Has a body, superior and inferior rami that unite with ishial ramus to bound the obturator foramen. The superior ramus fuses with the ilium at the iliopubic eminence and form about 1/5 of the acetabulum. Major markings include superior and inferior rami, the pubic crest, pubic tubercle, pubic arch, pubic symphysis, and obturator foramen (along with ilium and ischium)

Sacrum: Compose of 5 fused vertebrae. It is triangular in shape with anterior projection called sacral promontory and paired rows of foramina on the dorsal and pelvic surfaces. The sacral hiatus is used to introduce anesthetic solutions to sacral canal to block the sacral nerves (it represents the lower sacral canal that is deficient posteriorly but covered with fibrous tissue only).
Coccyx:
Is small triangular structure, formed by fusion of four coccygeal vertebrae and articulate with the sacrum, it gives attachment to the sacrotuberous ligament and levator ani muscle.

Joints:
1- Sacroiliac joint; it is synovial joint between the sacrum and the ilium, supported by ventral and dorsal sacroiliac ligaments.
2- Sacrococcygeal joints; secondary cartilaginous joint, has considerable mobility which increased late in pregnancy that the joint may be dislocated.
3- Symphysis pubis; secondary cartilagenous joint between the two pubic bones. The joint is supported by inferior and superior ligaments.

Ligaments:
1- Sacrotuberous ligament; between posterior iliac spines and the postero-lateral aspect of the sacrum and coccyx to the ischial tuberosity.
2- Sacrospinal ligament; from lateral border of sacrum and coccyx to the ishial spine.
* The two ligaments with the ischium form the boundaries of the greater and lesser sciatic foramina.
* Pelvic ligaments loosen during pregnancy and become stretched so help to increase pelvic diameters during labour.

Comparison of Male and Female Pelvic Structure:

**Female pelvis**
- Tilted forward, adapted for childbearing
- True pelvis defines birth canal
- Cavity of the true pelvis is broad, shallow, and has greater capacity

**Male pelvis**
- Tilted less forward
- Adapted for support of heavier male build and stronger muscles
- Cavity of true pelvis is narrow and deep
Comparison of Male and Female Pelvic Structure

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Female</th>
<th>Male</th>
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</thead>
<tbody>
<tr>
<td>Bone thickness</td>
<td>Lighter, thinner, and smoother</td>
<td>Heavier, thicker, and more prominent markings</td>
</tr>
<tr>
<td>Pubic arch/angle</td>
<td>80°–90°</td>
<td>50°–60°</td>
</tr>
<tr>
<td>Acetabula</td>
<td>Small; farther apart</td>
<td>Large; closer together</td>
</tr>
<tr>
<td>Sacrum</td>
<td>Wider, shorter; sacral curvature is accentuated</td>
<td>Narrow, longer; sacral promontory more ventral</td>
</tr>
<tr>
<td>Coccyx</td>
<td>More movable; straighter</td>
<td>Less movable; curves ventrally</td>
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Anatomic Landmarks
Components of pelvimetry
- Forepelvis
- Sidewalls
- Ischial spines
- Sacrosciatic ligament/notch
- Coccyx
- Sacrum
- Diagonal conjugate
- Pubic arch
- Bituberous diameter

The Bony Pelvis
- Functions to support and protect the pelvic contents and to form the relatively fixed axis of the birth passage.
- Made up of hip bones, the sacrum and the coccyx. Ischial spines serve as a reference point during labor to evaluate descent of the fetal head into the birth canal.
- The true pelvis is divided into three sections: inlet, midpelvis and outlet. Represents the bony limits of the birth canal.

*Pelvic inlet (brim)*:
*The pelvis is divided by an imaginary line through the pelvic brim into false pelvis (above) and true pelvis (below).
*It is represented by the line that runs from the upper border of symphysis pubis anteriorly and the upper margin of the superior pubic ramus, the ilipectineal line on each side and the ala of the sacrum and sacral promontory posteriorly.
* The inlet forms a plane that makes 60 degree with the horizontal in erect position called (pelvic inclination). But in Afro-Caribbean women this angle may as much as 90 degree, this increased angle may delay the head entering the pelvis in labour.

* In a gynecoid pelvis: the transverse diameter of the inlet is about 13.5 (largest diameter), which is the widest distance between selected points on the two iliopectineal lines.

  The anterior-posterior diameter is about 11cm, it is the distance between the upper border of the symphysis pubis to the tip of the sacral promontory.

**Mid cavity:**
* It it’s the area that bounded by the middle of the symphysis pubis in front, pubic bones on each side, obturator fascia and the inner aspect of the ischial bone and posteriorly by the junction of the 2nd and 3rd piece of the sacrum.
  * It is rounded with equal transverse, A-P, and oblique diameters, they are about 12 cm.
  * The ischial spine are palpable vaginally and are used as:
    - Landmark to assess the degree of descent of the head on vaginal examination (station).
    - Also landmark for providing anesthetic block to the pudendal nerve which passes below and behind the spine on each sides.
    - Also the interischial spine space is use for assessment of the adequacy of the pelvis.

**Pelvic outlet:**
* It is bounded in front by the lower margin of the symphysis pubis and on each side by the lower pubic rami, ischial tuberosity and sacrotuberous ligament and posteriorly by the last piece of sacrum.
  * The A-P diameter of the pelvic outlet is largest diameter 13.5 cm and the transverse diameter is around 11.

**Pelvic axis:**
An imaginary curved line that shows the path by which the center of the fetal head takes during its passage through the pelvis.

**Pelvic floor**
* It compose of two levator ani muscles and their fascia forming a gutter like structure, which has important role in the mechanism of labour.

* Levator ani muscle:
  * It’s a broad thin muscle; compose of pair of symmetrical striated muscle sheet. It’s the major component of the pelvic floor (pelvic diaphragm) and each muscle compose of three pieces; the most anterior is the pubococcygous then ischiococcygous and the coccygous muscle is the most posterior. The muscle fibers of each pass backwards, downwards and medially forming a gutter like structure which is deficient in the midline to allow passage of the rectum, vagina and urethra.
  * Its inserted to the line that runs from back of the pubis anteriorly to the ischial spine and the fascia covering the obturator internus muscle between them. The muscle fibers
descend to meet the fibers of the opposite site in the midline raphe (anococcygeal raphe) and the coccyx. They blind with anal sphincter and urethral sphincter.

* Levator ani muscle provides support to the pelvic viscera particularly when the intraabdominal pressure is raised and it reinforces the anal and the urethral sphincters.

* The gutter like arrangement of the muscle rotates the fetal head into the anteroposterior planes as it’s descends into the pelvis during labour.

**Pelvic Types:**

**Gynecoid:** Most common female pelvis. Inlet is transversely oval, with AP diameter shorter than transverse, roomy midcavity and wide sub pubic angle (>90) and relatively big sciatic notch. The most favorable for labour. 40% of female has this type.

**Android:** funnel-shaped, male type pelvis, heart shaped inlet and the widest diameter is the transverse diameter but its more to the back, the sacral promontory pushed more forward decreasing the A-P diameter, mid cavity not roomy because of flattening of the sacrum, the outlet with narrow sub pubic angle( <90). Not favorable usually.

**Anthropoid:** Deep pelvis because of sacralization of the fifth lumber vertebra (sacrum composes of 6 pieces) Outlet capacity is adequate. Encourage occiput posterior presentation because the A-P diameter is the widest diameter at all planes of the pelvis

**Platypelloid:** Flat female pelvis. Outlet capacity maybe inadequate. Wide transverse oval inlet and wide subpubic angle.
Fetal Skull:
It’s made up of vault, face and the base
- At birth, the face bones and base bones are firmly united at their sutures. But the vault bones joined by unossified membranous sutures that allow movement between the vault bones.
- **Vault bones**: The parietal, frontal, occipital and temporal bones joined with each other by four membranous sutures which are the sagittal, frontal, coronal, and lambdoid sutures (Membranous spaces between the cranial bones of the fetal skull. Allow for moulding of the head and identification of fetal position (on vaginal exam).
- **Fontanelles**: Unossified remnants of fibrous membranes between fetal skull bones. The four fontanelles are anterior, Posterior, mastoid, and sphenoid
- **Molding**: Shaping of the fetal head by overlapping of the cranial bones to facilitate movement through the birth canal during labour. By this process fetal skull diameters get smaller, but severe moulding is a signs of cephalopelvic disproportion; it’s harmful to the fetus.

**Skull bones such as the mandible and maxilla are unfused**
**Bones of vault: parietal, part of occipital, frontal, and temporal bones.**
**Lamboidal suture**

**Important Landmarks**
- **Chin**
- **Brow**
- **Anterior fontanelle**: (bregma) its diamond shaped lie at the junction of sagittal, frontal and coronal sutures, larger than posterior, has 4 sutures running into it, take 20 months to close. Between the two parietal and frontal bones
- **Vertex**: the area of fetal skull bounded by the two parietal eminence, anterior and posterior fontanelles, its part of the head which presents in normal labour.
- **Posterior fontanelle**: at the posterior end of sagittal sutures, between the two parietal and occipital bones, triangular in shape, has three sutures, close soon after birth.
- **The position of two fontanelles on vaginal examination indicating the position of the occiput and the degree of the flexion or extension of the head.**
- **Occiput**

**Diameters of fetal skull:**
- **Longitudinal diameters**: Depend of the degree of flexion of the fetal head:
  - In normal labour the head is well flexed, so have the least diameter of ovoid (suboccipito bregmatic 9.5cm) from the sub occipital region to the center of the anterior fontanelle. Engagement occurs by this diameter in a well flexed head.
• If less well flexed head (suboccipito-frontal diameter 10 cm) from below the occiput to prominence of the forehead, it’s the diam which pass through the valvul orifice at the moment of delivery of the head.

• If extended head (occipito-frontal diameter 11.5) engaged, from the root of the nose to the posterior fontanelle, which meet the pelvis in persistant occiput post. position.

• The greatest diam is (mento-vertical 13 cm) from the chin to the furthest point of the vertex, diam in brow presentation, its too large to pass in a normal pelvis. Seen in brow presentation.

• Submento-bregmatic diam 9.5 cm from below the chin to the anterior fontanelle. The diameter by which the head is engaged in face presentation.

• Transverse diameters: Biparietal diameter; the widest diameter from one parietal eminence to the other, 9.5 cm.

Other diameters of the fetus which are not related to the head:

• Bisacromial diameter, between furthest part of the shoulder 12 cm.

• Bitochanteric diameter diameter 10 cm.