

Anatomy of the Female Pelvic Organs

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References: 436 doctor's slides and notes , 435 teamwork

Color code: Notes | Important | Extra | Kaplan

Editing file: <https://docs.google.com/presentation/d/1-BVEbLfTvdm-wTAEGyqY9476Nr6VPVwpwSZWq6bfeMo/edit - slide=id.p>

Objectives:

1. Explain the relationship between pelvic organs.
2. Comprehend the normal organs.
3. Understand the relationship between the female pelvis (Bones & Soft Tissue) and fetal skull, in order to understand the mechanism of labour.
4. Understand the major variant in the fetal circulation than that of the adult.
5. Know the significance of ductus venosus ductus arteriosus and the first breath.
6. Explain the changes that occur after birth.
7. Familiarize yourself with the placental structure.
8. Know the significance of placental and umbilical cord inspection after birth.
9. Differentiate between the different types of placental abnormalities and their significance.

Female Genitalia

Female External Genitalia (vulva):

*Doctor only mention the Bartholin gland

- Mons veneris¹
- Labia majora²
- Labia minora
- The clitoris³
- The vestibule⁴ → has six openings: Urethral meatus, opening of two Skene's ducts, Vaginal orifice, and opening of two Bartholin ducts.

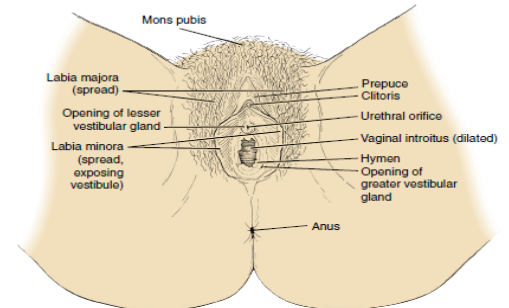


FIGURE 2.12 The female external genitalia, or vulva.

Bartholin glands "greater vestibular glands"

- lies on each side of the vagina, in the posterior lower third 1/3 of the introitus.
- Secrete mucus –alkaline

- **Bartholin cyst:** when the orifice of the Bartholin duct becomes obstructed, mucous produced by the gland accumulates, leading to cystic dilation proximal to the obstruction. Obstruction is often caused by local or diffuse vulvar edema. Bartholin cysts are usually sterile. **Management** : is conservative unless pressure symptoms occur due to size. **Then we treated by "marsupialization"**
- **Bartholin abscess:** it may occur due to infection (mostly caused by E. coli and anaerobic Bacteroides species, and seldom due to gonococcus). **Management:** Outpatient treatment is I&D with placement of a Word catheter under local anesthesia. The balloon is inflated and left in place for a month to allow a drainage tract to form. Antibiotic treatment is usually not needed.

Procedures of the vulva during labor:

- Catheterization
- Episiotomy
- Anaesthetic infiltration

¹cushion of fatty tissue, covered by skin and pubic hair, lies over the pubic symphysis

²male homologous = scrotum

³male homologous = glans of penis

⁴The cavity between the labia minora

Internal reproductive Organs

1/ Vagina

- A Canal/tube extends from the vulva to the uterus.
- Runs upwards and backwards
- Walls lie in close contact, easily separated.
- The posterior vaginal wall “11.5 cm (4.5 in)” is longer than the anterior wall “7.5 cm”
- Cervix enters the vagina at a right angle.
- Four fornices: Anterior, posterior, and 2 lateral
- In vagina only know the epithelium and acidity.
 - The covering epithelium of vagina is **non-keratinized squamous epithelium**, it's tough which lead to the acidity
 - The vagina is **acidic**. It has low PH= 4.5, so it's very difficult to get bacterial infections. This acidity is buffered by **menstrual cycle** so vagina becomes alkaline which makes it prone to infections.

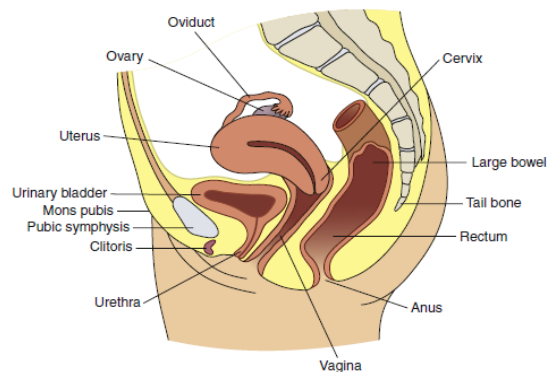
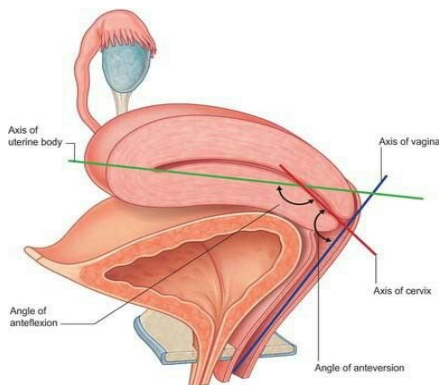


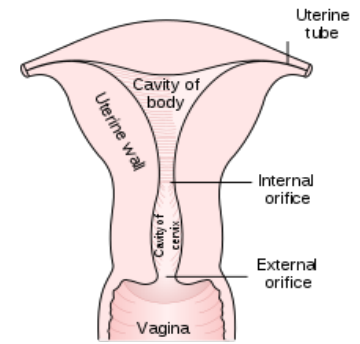
FIGURE 2.1 Side view of the female pelvic region showing some major components of the reproductive system.

Relations:

Anterior	Posterior	Lateral
<ul style="list-style-type: none"> • Upper ½ of vagina: base of the bladder • Lower ½ of vagina: Urethra 	<ul style="list-style-type: none"> • Pouch of Douglas in the lower ½ • Rectum centrally • Perineal body inferiorly 	<ul style="list-style-type: none"> • Ureters • Uterine arteries


2/ Cervix

- Forms the lower 1/3 of the uterus.
- Enters the vagina at a right angle.
- Barrel shape.
- 2.5 cm (1 in) long
- Two parts: Supra vagina & Intra vaginal.
- Cervical os: Internal os & External os.
- Cervical canal between the internal and external os.
- cervix is closed during pregnancy, if it opens abortion could happen
- STD in female genital tract could ascend to the cervix so pap smear screening test is done
- Transformation zone vs squamous-columnar junction. transformation zone is the common site of cervical malignancy so when taking pap smear you have to include it



*doctor focused in the explanation

The cervix:

In pregnancy:	Late in pregnancy	In labor:
<ul style="list-style-type: none"> • Rich blood supply – bluish coloration • Soft • Cervical glands – mucus plug “operculum⁵” 	<ul style="list-style-type: none"> • softer and starts to dilate 	<ul style="list-style-type: none"> • The longitudinal fibres of the uterus contract and retract pulling upward thus reducing the length of the cervix. • The cervix is made up of fibrous and elastic tissue • Full dilatation marks the end of the first stage of labour.

3/ Uterus *doctor skip it

- The uterus lies in the true pelvis.
- Mostly Anteverted⁶ (A/V) and anteflexed⁷ (A/F) in position.
- The body of the uterus lies above the bladder.
- Size:

Length	Width	Thickness	Weight
7.5 cm	5 cm	2.5 cm	50 - 70 gm

- Layers: Endometrium - Myometrium - Perimetrium - peritoneum
- Gross structures: The cervix lower 1/3 - The isthmus - The cavity - The corpus - The cornua. - The fundus
- **The relationship between the ureter and uterine artery:** Uterine artery runs behind the peritoneum, cross transverse cervical ligament (Cardinal ligament) then it pass

⁵ a plug that fills and seals the cervical canal during pregnancy

⁶ angle between vagina and cervical canal

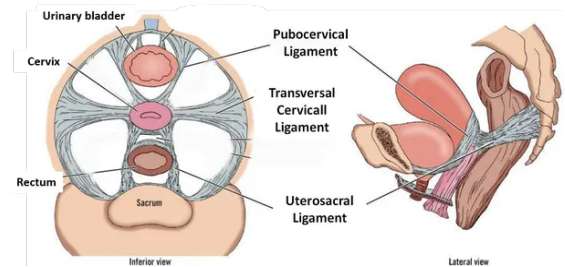
⁷ angle b/w junction of cervix and body of uterus

anterior to and above the ureter 1.5cm from lateral vaginal wall fornix. During surgeries (hysterectomy for example) the surgeon while ligation of uterine artery damages the ureter without knowing and that leads to hydronephrosis, progress to renal failure

Supports of cervix and uterus:

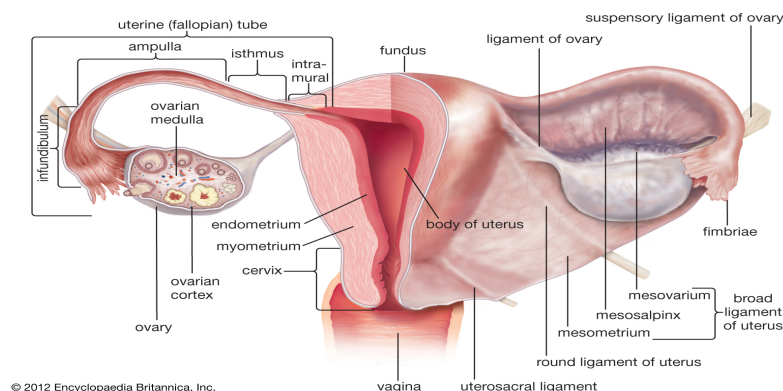
1. Cardinal ligaments: if this ligament is effected then it will lead to uterine prolapse
2. Pubocervical ligaments
3. Uterosacral ligaments

Only these 3 ligaments which support the uterus



4/ Fallopian Tube fallopian tumors are rare but tubal ligation has shown decrease in the incidence of ovarian tumors

- Extend from the cornua of the uterus, travels towards the sidewalls of the pelvis → then turns downwards and backwards.
- The tube lies in the upper margin of the broad ligaments
- Length 10 cm (4 in): 3 mm thick
- Communicate: superiorly with the uterine cavity and inferiorly with the perineal cavity
- 4 Parts: ✓ Isthmus ✓ Ampulla ✓ Infundibulum ✓ Fimbriae



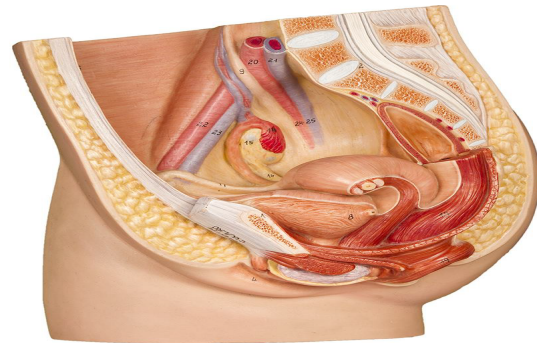
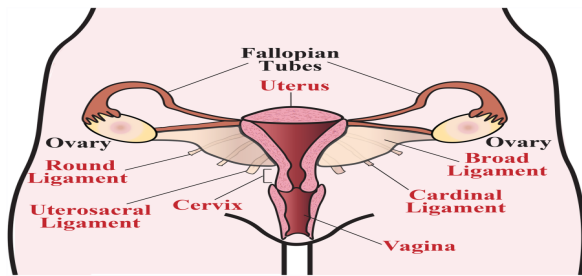
5/ Ovaies not mentioned by the doctor

- Lie in the posterior wall of the broad ligament at the fimbrial end of the fallopian tubes at the level of the pelvic brim.
- Size: almond like = 3 x 2 x 1 cm
- Dull white colour, Corrugated surface
- Structure varies with woman's age.
- They lie in a fossa.

Support of ovaries:

- Attached to the **broad ligament**⁸ (mesovarium)
- The mesosalpinx is the broad ligament that extend between the fallopian tube and the ovary.
- The Fallopian tubes, ovaries and broad ligaments are called Adnexa

Ligaments



1. **Round ligaments:**
 - a. Maintain uterus in Anteverted A/V + anteflexed A/F position
 - b. From the cornua of the uterus – pass downwards and insert in the tissue of the labia majora.
 2. **Broad ligaments:**
 - a. Not true ligament but folds of peritoneum extend laterally from the uterus to the pelvic side walls.
 3. **Cardinal ligaments (transverse cervical ligament)**
 4. **Pubocervical ligament:** Inserted into the lateral portion of the cervix and vagina.
 5. **Uterosacral ligament:** from posterior surface of pubis → cervix of uterus
- Round and broad ligaments don't support the uterus

	⁹ Blood Supply	Venous drainage	Lymphatic Drainage	Nerves
Vulva	Pudendal artery from the femoral artery	Corresponding vein	- Inguinal glands - External iliac glands	Branches of the pudendal nerve, perineal nerve (T12, L1-2, S2-4)
Vagina	- Vaginal artery, - uterine artery, - middle hemorrhoidal, - inferior vesical, - pudendal branch of the	Corresponding veins	- Inguinal, - Internal iliac, - Sacral glands	Sympathetic (hypogastric plexus) and parasympathetic (S2-S4)

⁸ The broad ligament may be divided into 3 subcomponents: mesometrium, mesosalpinx, and mesovarium

⁹ Doctor skip the whole table except the ovaries

	internal iliac a.			
Cervix	Uterine artery	-	- Internal iliac, - sacral glands	-
Uterus	Fundus: ovarian artery Body: uterine artery, directly from internal iliac artery	- Right ovarian vein → inferior vena cava - Left ovarian vein → renal vein	- Internal and - external iliac gland - Inguinal /Sacral gland	
Fallopian Tubes	- Ovarian artery - Uterine artery	corresponding veins	-	-
Ovaries	Ovarian artery	Right ovarian vein drains to IVC Left ovarian vein drains to left renal	Lumbar glands	Ovarian plexus

Female Pelvis

Normal Female Pelvis

- The pelvis articulates with the fifth lumbar vertebra above and with the head of each femur in the right and left acetabulum.
- The weight of the trunk is transmitted through the pelvis into the legs.
- Gives protection to the pelvic organs
- The pelvis is the largest bone in the body.
- **Gross structure: Consists of:**
 - 5 fused sacral vertebrae and coccyx
 - left & right innominate bones “hip bones”.
 - 4 pairs of holes (for passage of nerves, blood vessels/lymph)

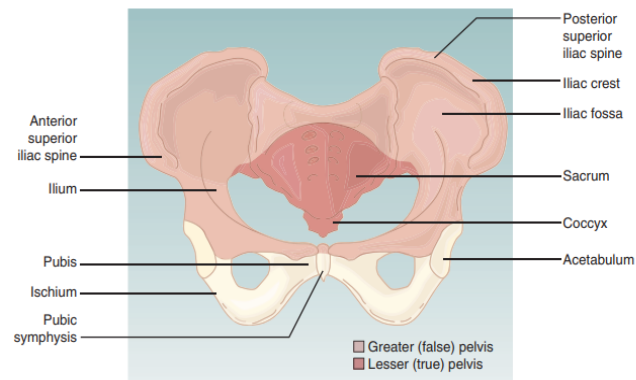


FIGURE 3-12 The bony pelvis.

Pelvic bones		
The Sacrum	The Coccyx	Right & Left Innominate Bones
<ul style="list-style-type: none"> • Triangular shape • The hollow of the sacrum is 	<ul style="list-style-type: none"> • 4 Fused coccygeal vertebrae 	<ul style="list-style-type: none"> • Each made of 3 separate parts meet in the acetabulum.

- smooth and concave
- **The ala of the sacrum:** give the appearance of wings
 - **The sacral promontory:** is the centre point of the upper border of the first sacral vertebrae.
 - The sacral canal opens at the level of 5th sacral vertebra, a passage for spinal cord.
 - At the level of the 2nd and 3rd sacral vertebrae, the nerves spread out to form the cauda equina.
 - Anaesthesia in labour¹⁰.

- Triangular shape
- Articulate with the sacrum
- Muscles are attached to its tip.

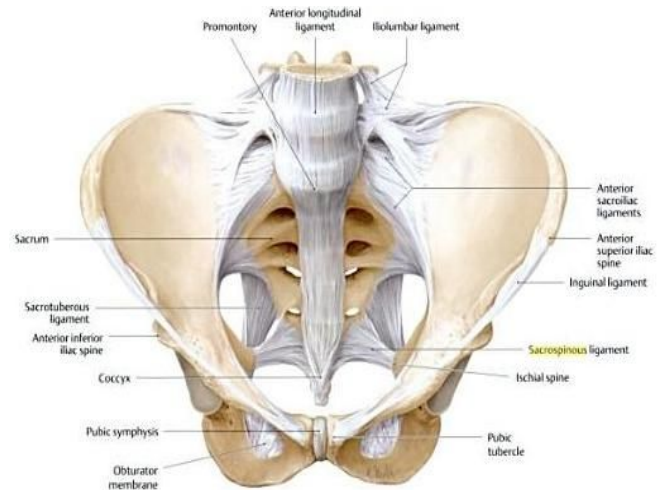
- **Ilium:** upper part is iliac crest (anterior and posterior, superior iliac crest)
- **Ischium:** ischial tuberosity, 2 cm above is the ischial spines.
- **Pubis:** both meet the pubic body fused by cartilage “symphysis pubis”

Pelvic Joints:

1. The two sacroiliac joints
2. The symphysis pubis
3. The sacrococcygeal joint

Pelvic Ligaments:

1. **Sacroiliac ligament = strongest in the body**
2. **Sacrotuberous ligament**
3. **Sacrospinous ligament**
4. **Inguinal ligament**



Division of Pelvis

- The pelvis has a brim (inlet), cavity, outlet, and forms the curved canal through which the fetus pass during labour.
- The brim divides the pelvis into the parts:

False	lies above the pelvic brim “not important in obstetrics”
True	what lies below the pelvic brim

¹⁰ Pain relief from perineal distention in stage 2 of labor, involves sacral roots, S2 to S4

1/ Pelvic Inlet:

- The inlet is Round in shape.
- Bounded: *anteriorly* by the pubis, *Laterally* by iliopectineal lines, *Posteriorly* by ala and sacral promontory.

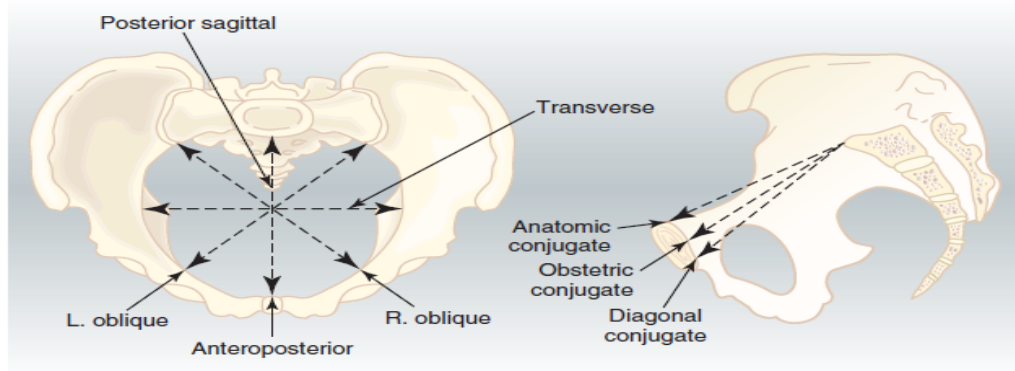


FIGURE 8-3 Pelvic inlet and its diameters.

- Pelvic Inlet has eight points, as demonstrated “figure 8-3”, formed by 5 important diameters:
 1. The **anteroposterior diameter** is described by one of two measurements:
 - a. The true conjugate (**anatomic conjugate**) is the anatomic diameter and extends from the middle of the sacral promontory to the upper inner border of the pubic symphysis “11.5 cm”.
 - b. The **obstetric conjugate** represents the **actual space available** to the fetus and extends from the **middle of the sacral promontory** to the closest point on the convex **posterior surface of the symphysis pubis** “11 cm”.
 - c. The Diagonal Conjugate¹¹
 2. The **transverse diameter** is the **widest diameter**. Measured by the widest distance **between the iliopectineal lines**.
 3. Two **oblique diameters** (right or left) that extends from the sacroiliac joint to the opposite iliopectineal eminence.
 4. The **posterior sagittal diameter** extends from the anteroposterior and transverse intersection to the middle of the sacral promontory.

2/ Pelvic Cavity (True Pelvis):

- Extends from the brim above to the pelvic outlet below .
- The **posterior wall** (11 cm): formed by hollow of the sacrum
- The **anterior wall** (3.8 cm): is formed by the symphysis pubis and obturator foramen
- The **lateral walls**: sacrosclatic ligament and ischial spines

¹¹ the anteroposterior dimension of the inlet that measures the clinical distance from the promontory of the sacrum to the inferior margin of the pubic symphysis, **measured manually per vagina or by ultrasonography**

- Interspinous Diameter is the diameter between the two ischial spines, considered the shortest diameter in the true pelvis.

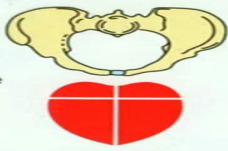
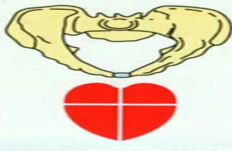
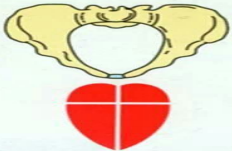
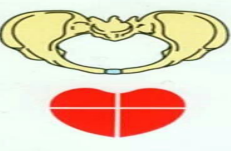
3/ Pelvic Outlet:

Anatomical Outlet	Obstetrical Outlet
<p>The anatomical outlet is formed by fixed points useful landmarks for taking pelvic measurement.</p> <p>Bounded:</p> <ul style="list-style-type: none"> • Anteriorly by pubic Arch • Laterally by sacrosiatic ligaments & Ischial tuberosities • Posteriorly by tip of Coccyx 	<p>The landmarks are:</p> <ul style="list-style-type: none"> • The lower border of the symphysis pubis • The ischial spines: this bony structure is used to determine whether the Fetal head is engaged during vaginal Examination • The sacrospinous ligament • The lower border of the sacrum.

Average measurements of pelvis:

	Brim	Cavity	Outlet
Anteroposterior	11.5 cm	12.0 cm	12.5 cm
Transverse	13.0 cm	10.5 cm	11.0 cm

Pelvis Shapes:

Shape	Gynecoid	Android	Anthropoid	Platypelloid
				
	Gynecoid	Anthropoid	Android	Platypelloid (flat)
	50%	25%	20%	5%

Pelvic Floor:

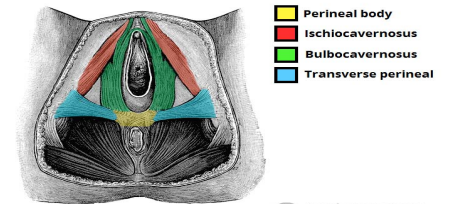
- The outlet of the pelvis is filled with a soft tissue that **supports** the pelvic and abdominal organs.
- It forms as a gutter-shaped structure highest anteriorly than posteriorly.
- Three canals with external orifices run through the tissue:
 1. The urethra
 2. The vagina
 3. The rectum

Perineum

- There are six layers of tissue:
 1. An outer covering of skin
 2. Subcutaneous fat
 3. Superficial muscles enclosed in fascia:
 - I. Transverse perinei
 - II. Bulbocavernosus (bulbospongiosus)
 - III. Ischiocavernosus
 4. Deep muscles enclosed in fascia:
 - Three pairs of muscles all have their insertion around the coccyx.
 - Their anatomical name is levator ani muscles (5 mm thick):
 - 1) Ilio-coccygeus
 - 2) ischiococcygeus
 - 3) pubo-coccygeus
 5. Pelvic fascia, thickened to form pelvic ligaments:
 6. Peritoneum

Perineal Body:

- Lies between the vaginal and rectal canals
- Triangular, the base is the skin and the apex pointing upward each side is 3.8 cm in length
- Perineal body attaches three layers of tissue:
 1. outer covering of skin
 2. superficial pelvic floor: a- bulbo-cavernous. b- transverse perinei
 3. deep pelvic floor muscle



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Episiotomy (types + indications):

	Midline episiotomy	Mediolateral episiotomy
Procedure	incision is made in the middle of the vaginal opening, straight down toward the anus	incision begins in the middle of the vaginal opening and extends down toward the buttocks at a 45-degree angle
Advantage	easy repair and improved healing	risk for anal muscle tears is much lower
Disadvantages	increased risk for tears that extend through the anal muscles	more severe pain and difficult repair

Indications:

- ★ fetal weight greater than 4kg
- ★ operative delivery
- ★ shoulder dystocia
- ★ **Crowning of fetal head** (this will be explained in later lectures)

Fetal Skull

- Skull is divided into regions
 - The **vault**: formed from membrane and not cartilage.
 - The **face**
 - The **base**
- There are 5 points – ossification centres. Calcification begins as early as 5 weeks after conception. If a premature baby is born, there is a risk of intracranial damage!!!!
- Bones:
 - Two frontal bones,
 - Two parietal bones,
 - **One occipital bone.**
- Bones are separated by? Sutures
- Suture, an area of membrane which has not ossified:
 - **Lambdoidal suture**
 - **Sagittal suture**
 - **Coronal suture**
 - **Frontal suture.**
- Fontanelles very important landmarks where two or more sutures meet.
 - Anterior fontanelle: diamond in shape where sagittal, frontal and coronal sutures meet. It looks like Mercedes logo
 - Posterior fontanelle: Y or T shaped where lambdoidal and sagittal sutures meet.

When the baby is delivered the posterior fontanelle is already closed, while the anterior fontanelle will close later

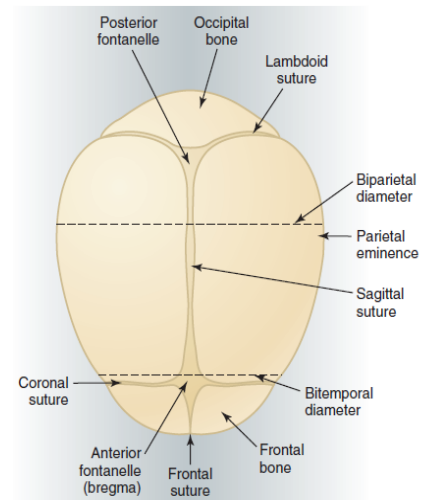
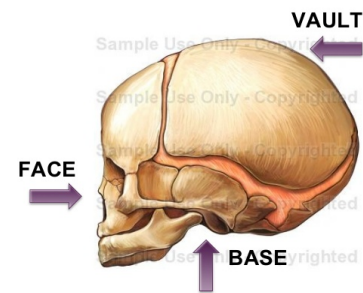


FIGURE 8-1 Superior view of the fetal skull showing the sutures, fontanelles, and transverse diameters.

Areas of the Skull:

1. Glabella: the bridge of the nose
2. Sinciput: the forehead
3. Bregma: the anterior fontanelle
4. Vertex
5. Lambda: the posterior fontanelle
6. Occiput
7. Suboccipital area
8. Mentum: the chin

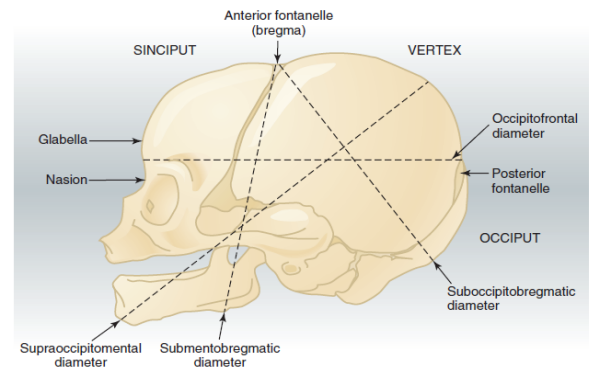
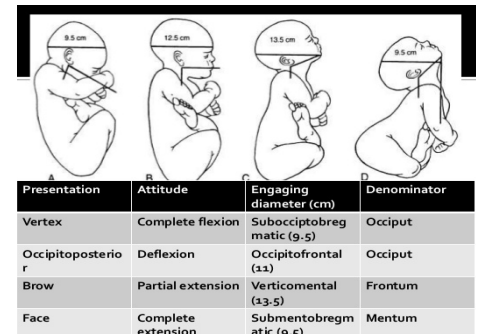


FIGURE 8-2 Lateral view of the fetal skull showing the prominent landmarks and the anteroposterior diameters.

Circumferences of the Fetal Skull:

- The engaging diameter in a **well flexed head**:
 - Suboccipito-bregmatic + Biparietal
 - In Vertex presentation
- The engaging diameter in a **deflexed head** (partly extended)
 - OccipitoFrontal + Biparietal
 - In Occipito posterior Position



Definitions

Malposition: Abnormal position of fetal head in relation to maternal pelvis

Malpresentation: Any presentation other than vertex

Diameters of Fetal Skull:

- Suboccipital-bregmatic
 - Occipito frontal
 - Mentoverical or Supraoccipitomeatal
 - Submento-bregmatic
 - Biparietal
- **The normal position at delivery is occipito-anterior .**
 - **What's the landmark in vertex ? Occipital bone**
 - **What's the engaging diameter in vertex ? Suboccipito-bregmatic. How long is it? 9.5 cm**
 - **What's the landmark in face presentation? Mentum**
 - **What's the engaging diameter in face presentation? Submento-bregmatic. How long is it? 9.5 cm.**
 - **What's the engaging diameter in brow presentation? Mento-vertical. How long? 13.5 cm**

Effect of Labour and Delivery:

- Molding
- Caput succedaneum
- Cephalhematoma

Placenta and Fetal Circulation

Structure of the Mature Placenta

- Flat, Roughly circular
- 22 cm in Diameter
- 2cm thick in the centre
- Weight: 1/6 of the baby's weight



Maternal Surface	Fetal Surface
<ul style="list-style-type: none"> • Lies next to the uterus on inspection • Chorionic villi are arranged in lobes/cotyledons, they are 20 in number – 200 lobules. • The groove separating the lobes are sulci • Dark – red color, rough surface 	<ul style="list-style-type: none"> • Faces the baby. • Bluish gray colour, smooth, shiny surface. • Umbilical cord inserted in the fetal surface usually in the centre. Blood vessels seen radiating from the cord • The amniotic membranes covers the fetal surface.

Abnormalities of Placental Development:

- Placenta succenturiata
- Placenta bipartita
- Placenta circumvallata
- Placenta velamentosa
- Placenta succenturiata/ Placenta velamentosa and Vasa previa

Umbilical Cord

- At full term: 40-50 cm long, 1.5 cm in diameter

- Twisted in appearance.
- Two umbilical arteries and One umbilical vein.
- Wharton jelly¹²
- Abnormal insertion of the cord:
 - Battledore insertion
 - Velamentous insertion

Fetal Circulation

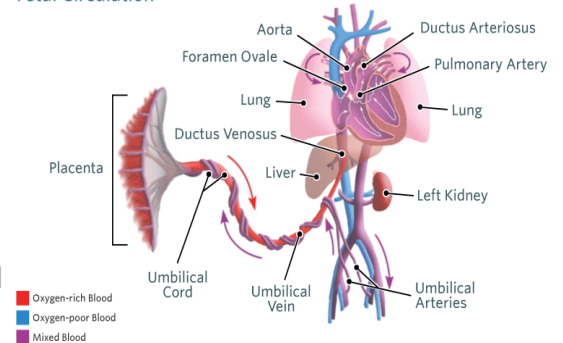
- How does the fetal circulatory system works?
- Two Major Events??

Recommended: [Fetal circulation right before birth](#) / [Baby circulation right after birth](#)

- The respiratory function of the placenta requires that oxygenated blood be returned via the umbilical vein and into the fetal circulation through this journey:
 - 1- The umbilical vein, carrying oxygenated blood from the placenta (O₂ saturation 70-80%) to the fetal body, enters the portal system. A portion of this blood passes through the hepatic microcirculation, but the majority of the blood bypasses the liver through the ductus venosus, which directly enters the inferior vena cava. This mixes with returning non oxygenated blood from the lower limbs and kidney, liver. However, only partial mixing of the two streams.
 - 2- Most of the oxygenated blood is directed to the crista dividens at the upper end of the inferior vena cava into the right atrium through the foramen ovale and thus into the left atrium and hence to the left ventricle and ascending aorta to be directed to the brain, heart and upper extremities. (SUMMARY: IVC → crista dividens → right atrium → foramen ovale → left atrium → left ventricle → ascending aorta → brain, heart and upper limbs)
 - 3- The remainder of the blood from the superior vena cava mixes with that of IVC and passes directly to the right ventricle: 10% of it goes through the pulmonary artery to the lung, while most of this enters the systemic circulation via the ductus arteriosus and into the descending aorta beyond the vessels supplying the head. It supplies the viscera and lower limbs.

It then passes into the umbilical arteries (branches of left and right internal iliac arteries)
(SUMMARY: SVC + IVC → right ventricle → ductus arteriosus → descending aorta → viscera and lower limbs)

Fetal Circulation



¹² A gelatinous substance made up of mucopolysaccharides (hyaluronic acid and chondroitin sulfate) that provides insulation and protection within the umbilical cord. Stem cells are present in Wharton's jelly, as well as in umbilical cord blood.

- The fetal circulatory system uses three shunts:
 1. Ductus arteriosus: shunts mildly oxygenated blood from pulmonary artery to descending aorta
 2. Ductus venosus: shunts highly oxygenated blood from umbilical vein to the IVC , so this structure carries oxygen to fetal organs)
 3. Foramen ovale: shunts highly oxygenated blood from right atrium to left atrium
- Cardiovascular system major variants are explained by:
 - presence of umbilical-placental circulation and
 - absence of significant pulmonary circulation.
- What maintains patency of ductus arteriosus in utero?
High pulmonary vascular resistance maintains the right-left shunt through the ductus arteriosus

At birth:

- Blood circulation after birth:
 - the closure of the shunts (Ductus arteriosus & Foramen ovale) completes the transition of fetal circulation to newborn circulation.
- Umbilical vessels contract:
 - Cessation of umbilical blood flow causes a fall in pressure in the right atrium. The foramen ovale is a valvular opening, the valve functioning from the right to left.
 - The left atrial pressure rises and thus closure of the foramen ovale.
- Breathing:
 - Ventilation of the lung helps to create a negative thoracic pressure, this opens the pulmonary circulation and thus diverts blood from ductus arteriosus then gradually closes.

MCQs

1. What is the landmark in vertex position?
a) Brigma b) mentum c) occipital bone
2. What's the engaging diameter in face presentation?
a) Suboccipital-bregmatic b) Submento-bregmatic c) Supraoccipitomenal
3. which of the following ligaments does not support the uterus?
a) cardinal ligaments b) round ligament c) broad ligaments
4. which of the following is an important landmark in labor?
a) Symphysis pubis b) ischial tuberosity c) ischial spine
5. In average pelvis measurement, which side is larger in pelvic outlet?
a) Anteroposterior b) Transverse
6. Which pelvic shape allow the fetus to pass through easily?
a) Android b) Anthropoid c) Gynecoid

Answers:

1- C. 2- B. 3- B+C. 4- C. 5- A. 6- C.