

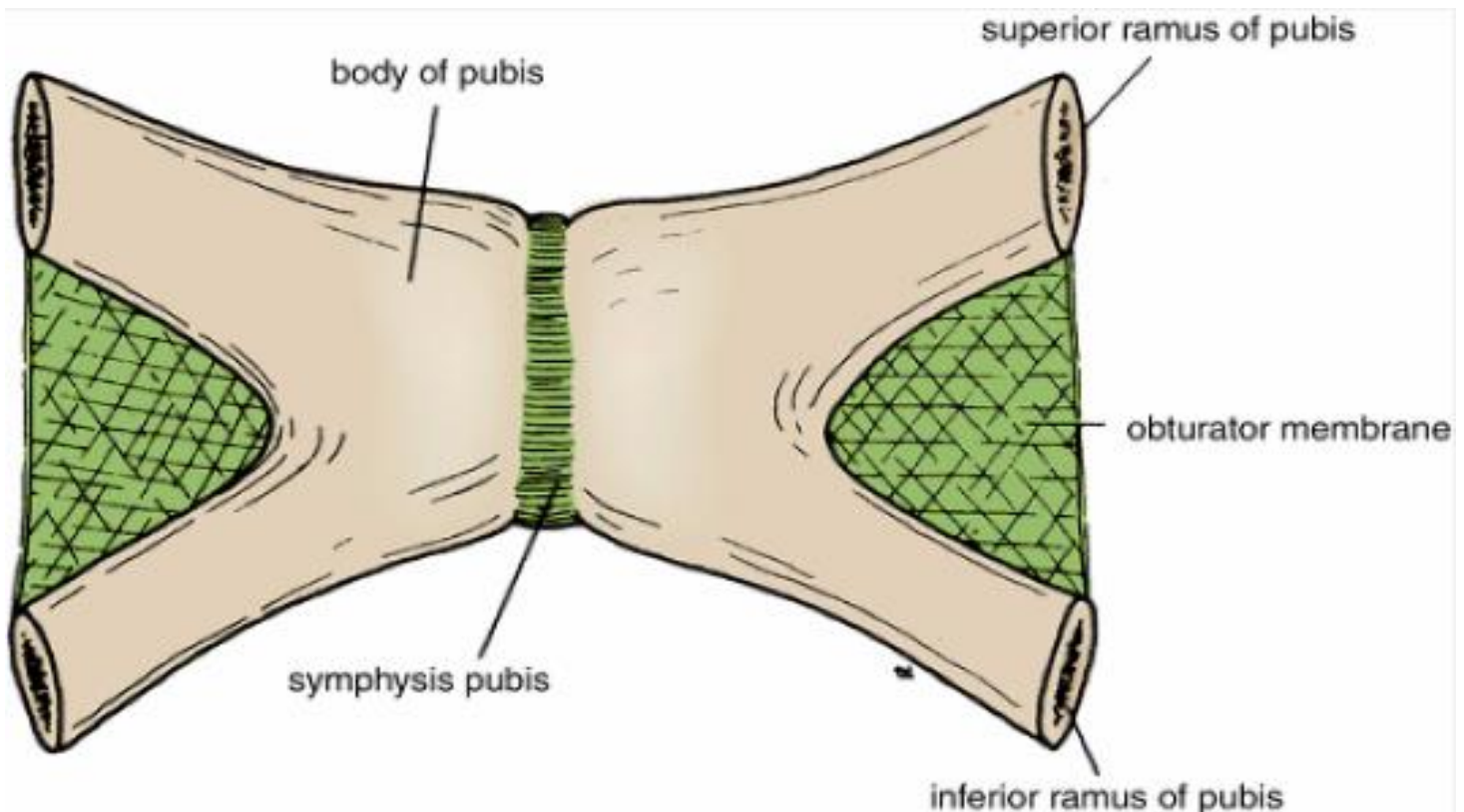
Pelvic Wall

*The walls of the pelvis are formed by **bones , joints** and **ligaments** that partly lined with **muscles** covered with **fascia** and **parietal peritoneum**

*The lesser pelvis has :

1)The anterior pelvic wall :

- It is formed by the bodies of the pubic bones, the pubic rami, the symphysis pubis , medial part of obturator membrane and obturator internus muscle .



2) Lateral Pelvic Wall :

-The lateral pelvic wall is formed by part of the hip bone below the pelvic inlet , the obturator membrane, the sacrotuberous and sacrospinous ligaments, and the obturator internus muscle and its covering fascia .

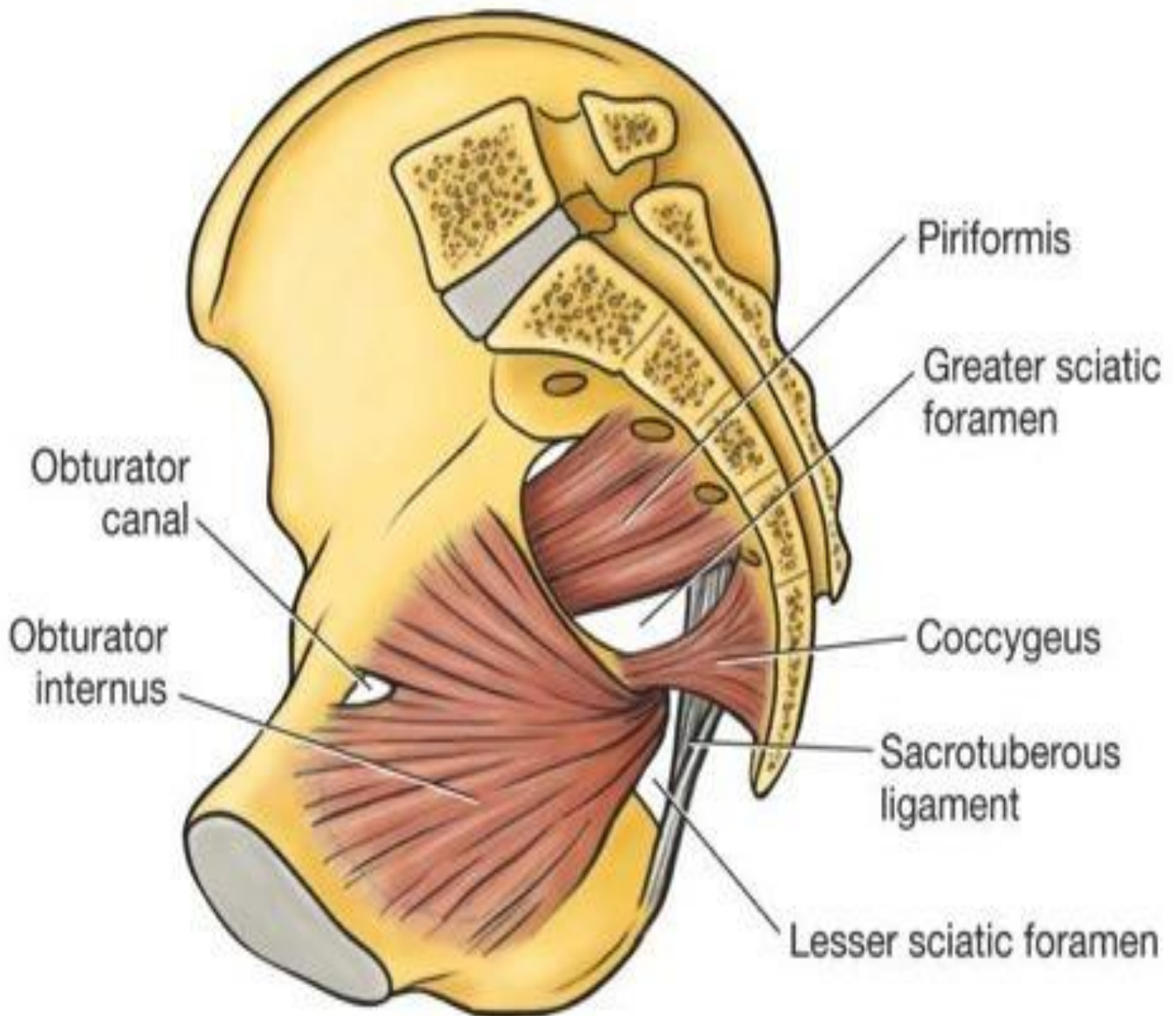
-Postero-laterally the sacrotuberous and sacrospinous form the greater & lesser sciatic foramenae .

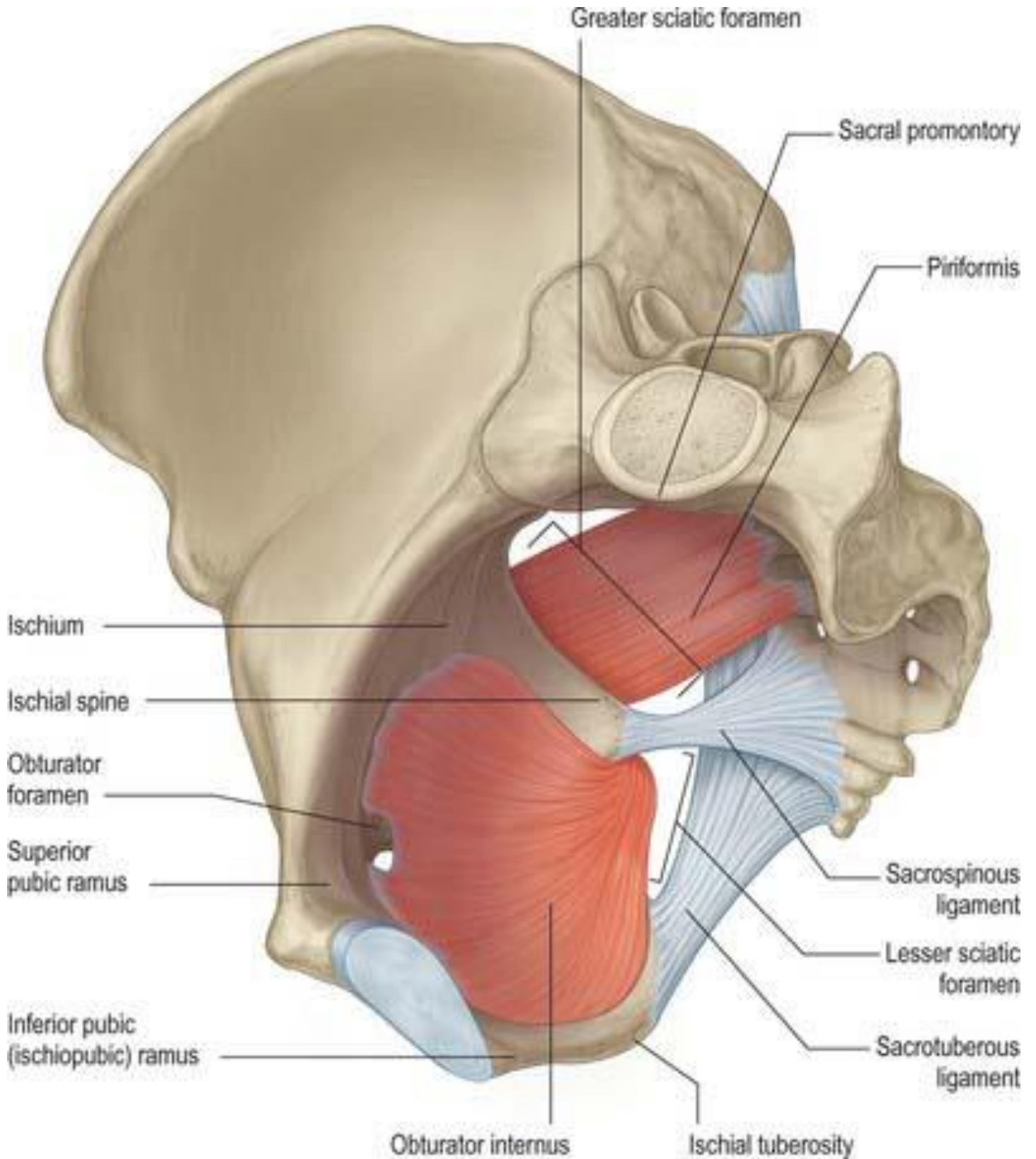
3) Posterior Pelvic Wall :

- It is formed by the sacrum , coccyx , piriformis & coccygeus muscles and their covering of parietal pelvic fascia.

4) Inferior Pelvic Wall, or Pelvic Floor :

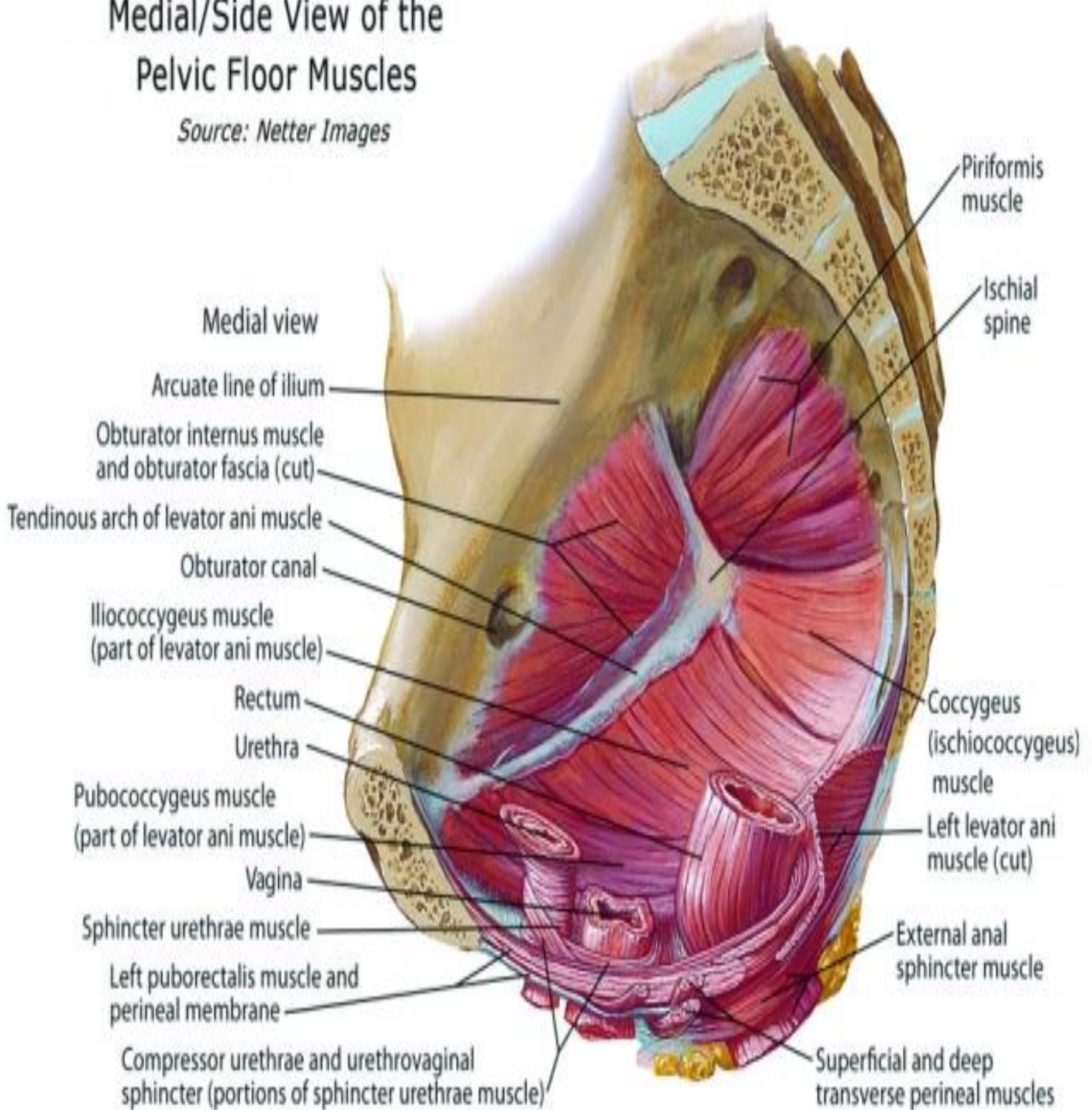
- The floor of the pelvis is formed by the pelvic diaphragm (levator ani and coccygeus).





Medial/Side View of the Pelvic Floor Muscles

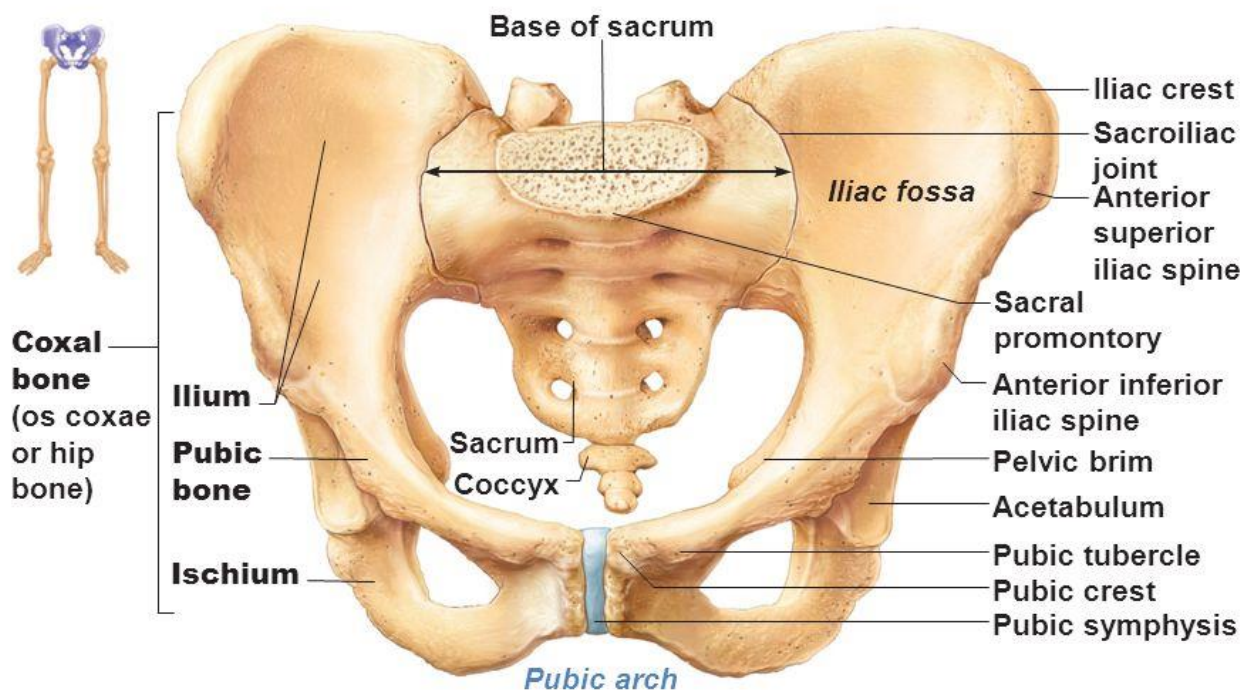
Source: Netter Images



BONY PELVIS

*Formation:

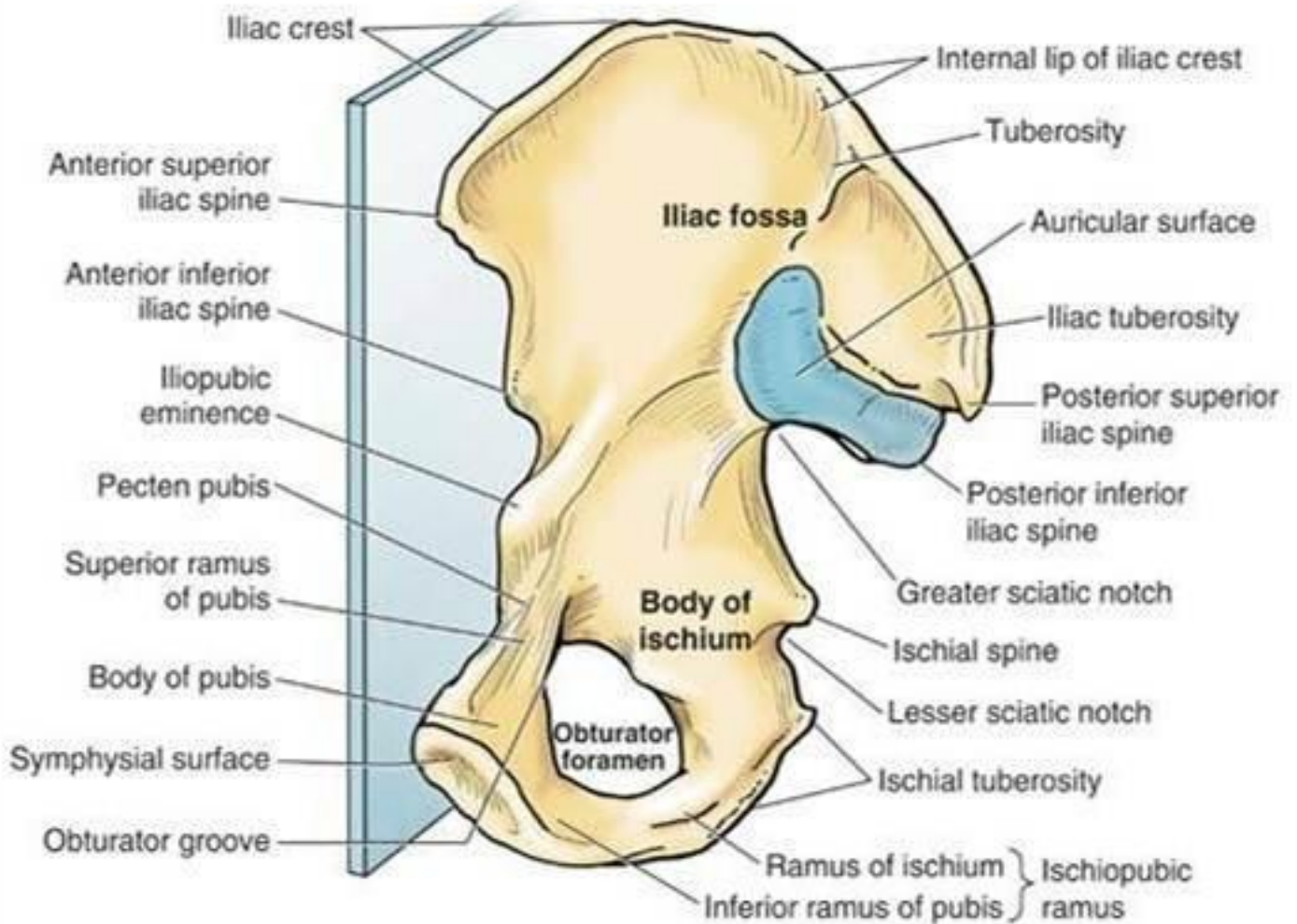
- The bony pelvis consists of **4 bones** , (right and left) hip bones, sacrum and coccyx. All are bounded together by **4 joints** and strong ligaments.
- **In front:** the 2 hip bones articulate with each other at the ***symphysis pubis***.
- **Behind:** each hip bone articulates with the sacrum at ***the sacroiliac joint***.
- **Behind and below:** the sacrum articulates with the coccyx at the ***sacrococcygeal joint***.



Bony pelvis

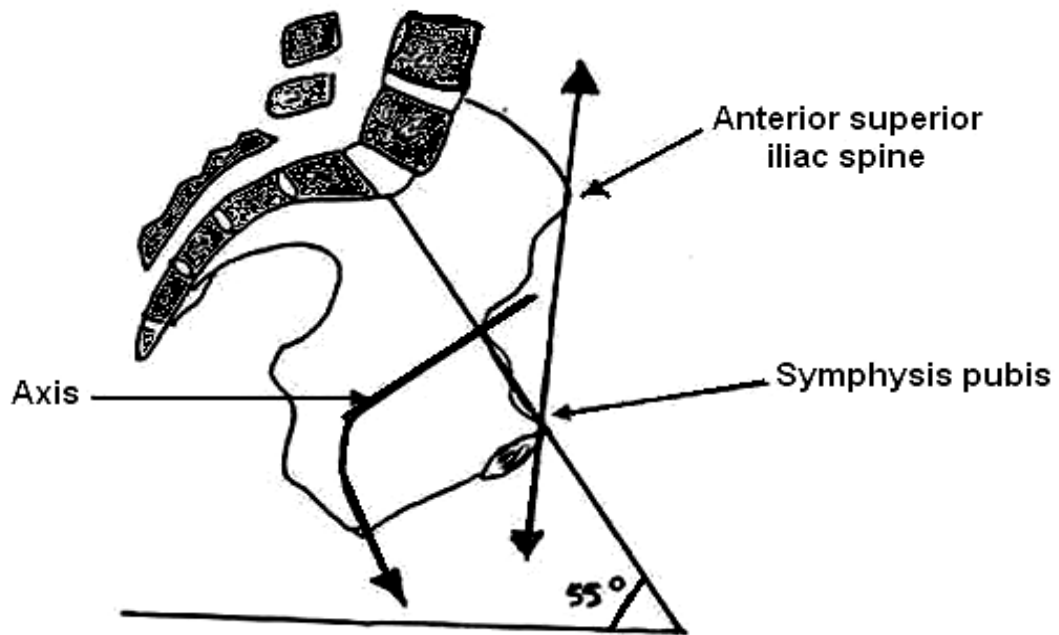
***Anatomical position:**

- During *standing ASIS* and the upper border of the symphysis pubis lie in **the same vertical plane**.
- Also the plane of the pelvic inlet makes an **angle 50-60°** with the horizontal plane. This position helps the pubic bones to sustain the downward pressure of the abdominal viscera.



C Medial aspect

ns & Wilkins.



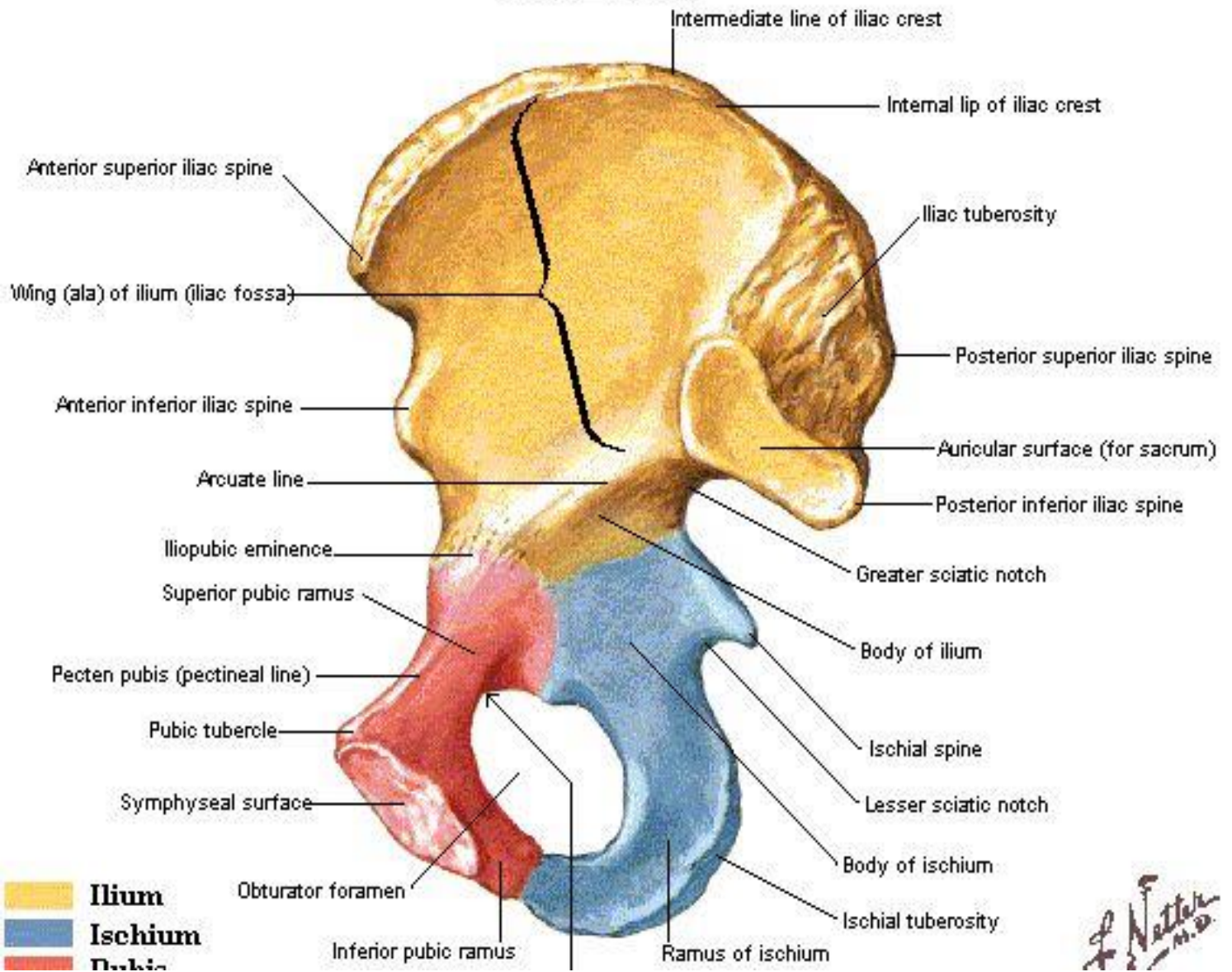
***Boundaries of the pelvic inlet:**

- In front: upper border of symphysis pubis and pubic crest & tubercle .
- Laterally: pectineal line , iliopubic eminence & arcuate line.
- Behind: upper border of sacroiliac joint , ala and promontory of sacrum .

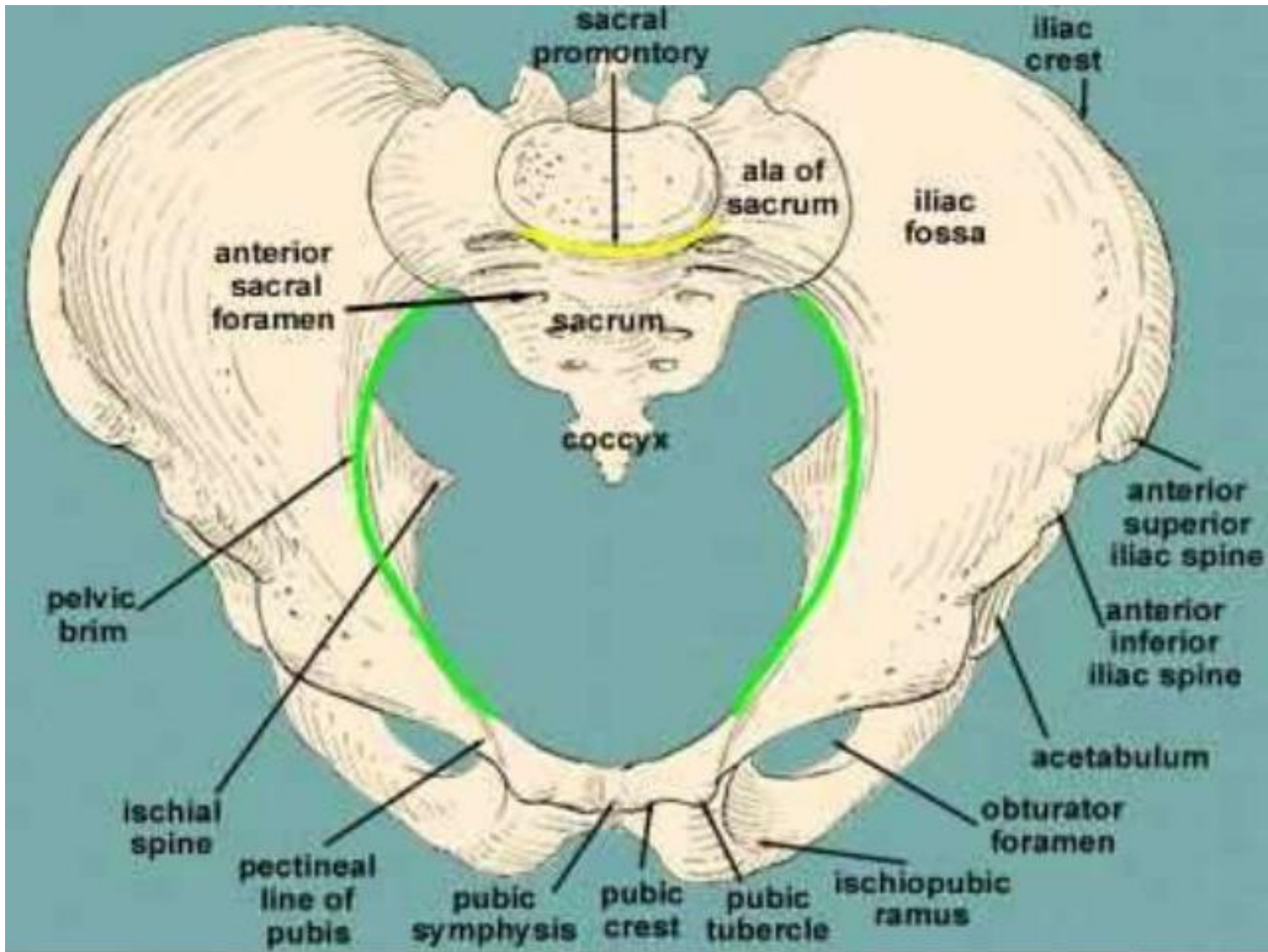
***Division of the pelvic cavity:**

- The plane of the inlet divides the pelvic cavity into:
 1. ***False or greater pelvis:***
 - ***Above*** the pelvic inlet and contains ***abdominal viscera***.
 - It is bounded on each side by the ***iliac fossa***.
 2. ***True or lesser pelvis:***
 - ***Below*** the pelvic inlet and contains the ***pelvic viscera***.
 - The cavity of the lesser pelvis has a an ***upper opening (the pelvic inlet) and a lower opening (the pelvic outlet)***

Coxal Bone Medial View

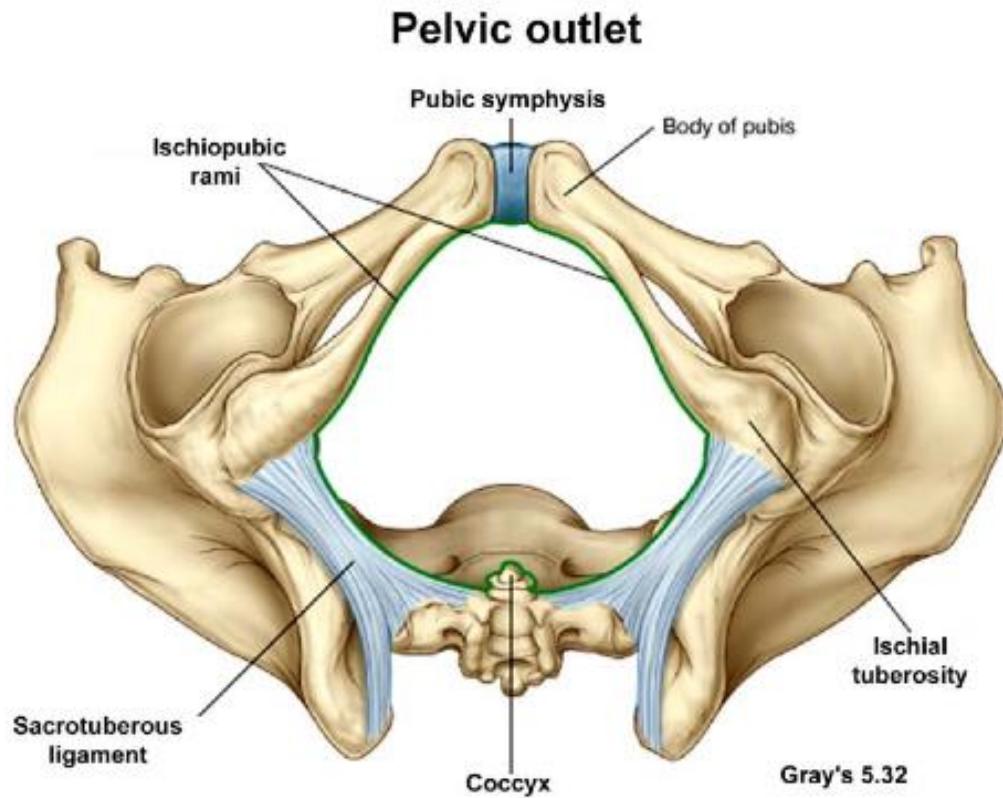


Pelvis



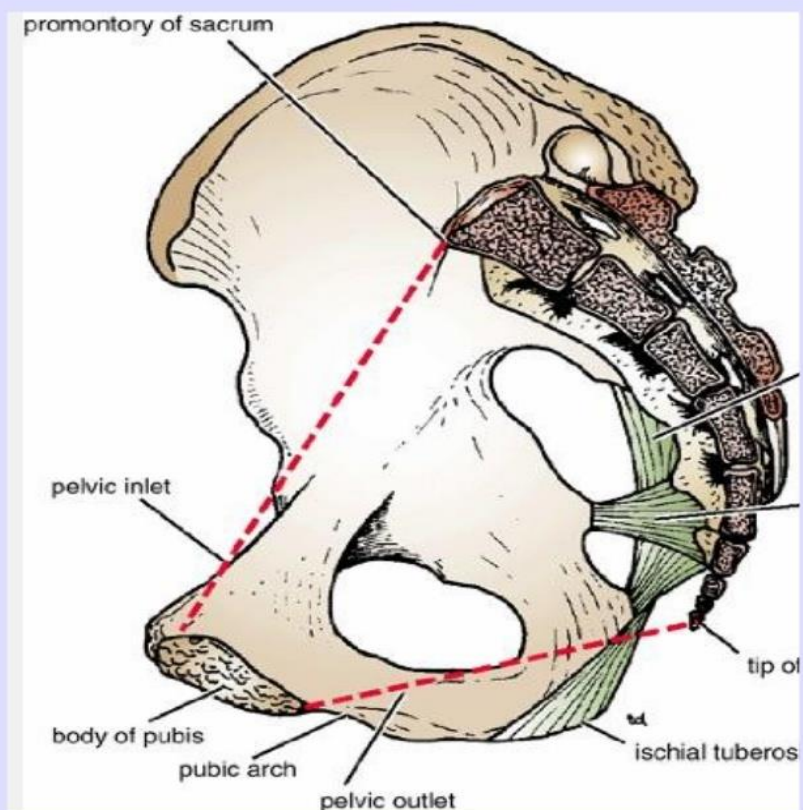
*Boundaries of the pelvic outlet:

- The pelvic outlet corresponds to the region of the perineum which is the lower end of the trunk. It is diamond shaped and bounded by:
- **Anteriorly** : lower border of symphysis pubis.
- **On each side**: the ischiopubic rami , ischial tuberosity and sacrotuberous ligaments.
- **Posteriorly**: tip of the coccyx.



***Boundaries of the cavity of the lesser pelvis.**

- ***Antero-inferiorly:*** the symphysis pubis , body of pubic bone and pubic rami.
- ***Posteriorly:*** the concave anterior surface of sacrum and coccyx.
- ***Laterally:*** the pelvic aspect of the fused ilium and ischium below pelvic inlet .



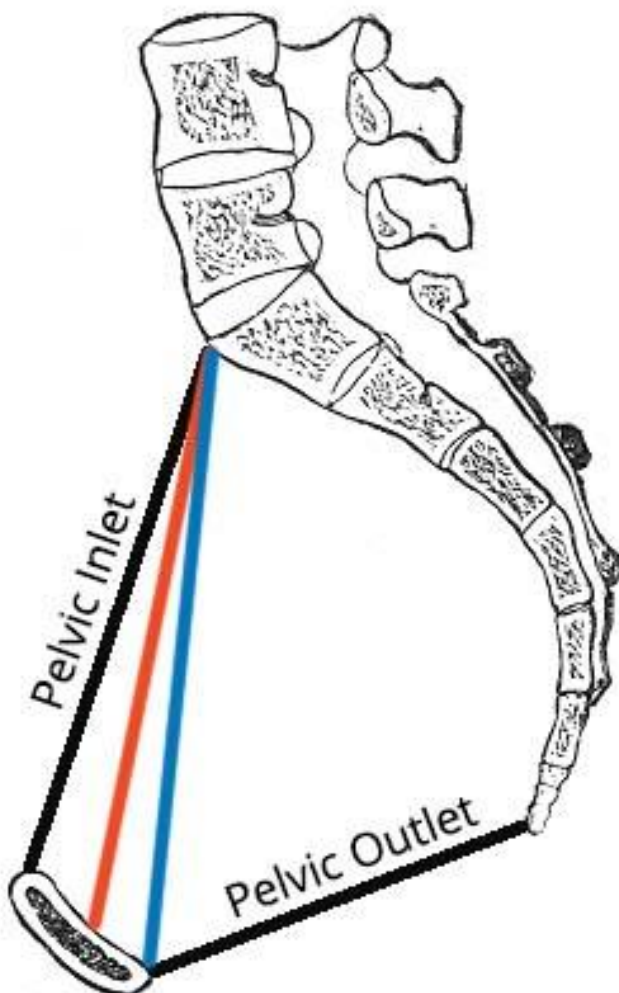
* **Diameters of the pelvis** :To determine the capacity of the female pelvis for childbirth the diameters of the lesser pelvis are estimated radiologically or manually during PV exam.

A) The antero-posterior diameters :

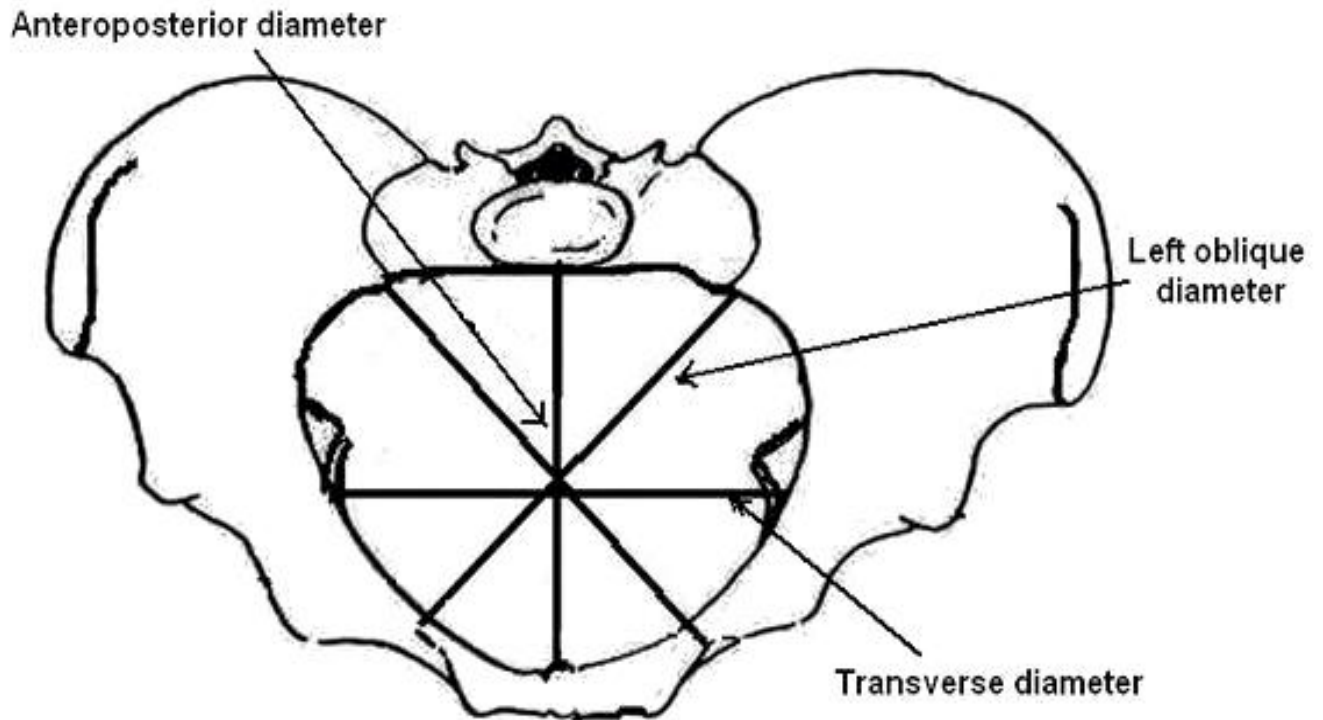
1) *Of the inlet (true conjugate)*: between the midpoints of sacral promontory and the upper border of symphysis pubis. Normally 11cm or more in females .The *diagonal conjugate* is the same but measured to the lower border of symphysis pubis (13 cm) .

2) *Of the cavity*: between the midpoints of S₃ vertebra and midpoint of posterior surface of symphysis pubis.

3) *Of the outlet*: between the apex of coccyx to the midpoint of the lower border of the symphysis pubis.



 **Obstetric Conjugate**
 **Diagonal Conjugate**



Diameters of the pelvic inlet

***The transverse diameter:**

- 1) *Of the inlet:*** it is the maximum transverse distance between the 2 iliopectineal lines .
- 2) *Of the cavity:*** is the widest transverse distance between the side walls of the cavity.
- 3) *Of the outlet:*** is measured between the medial borders of the 2 ischial tuberosities.
- 4) *The interspinous distance*** (between the ischeal spines) is the narrowest part of pelvic (birth) canal .

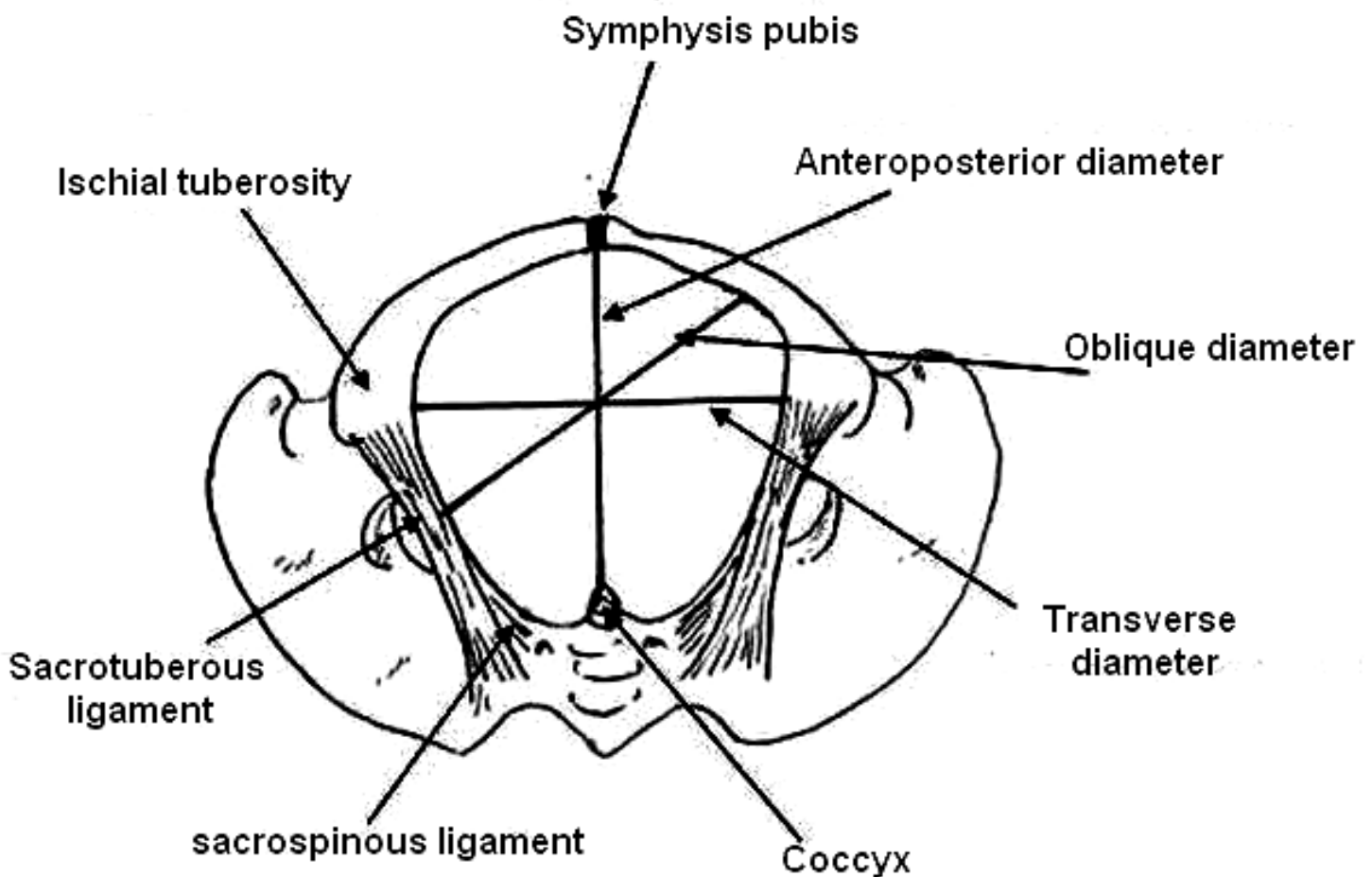
***The oblique diameter:**

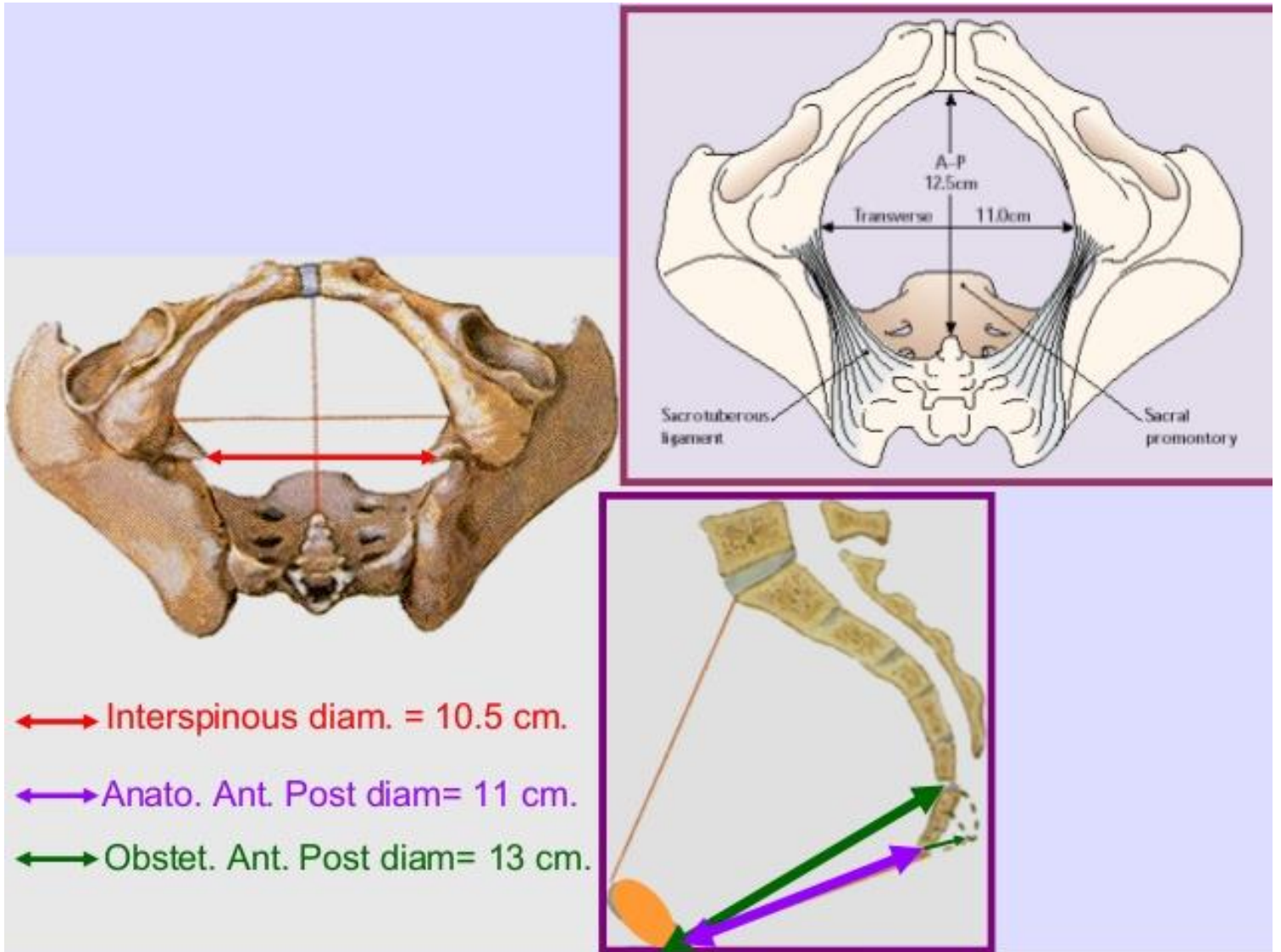
1) Of the inlet: from the iliopubic (iliopectineal) eminence to the upper border of opposite sacroiliac joint.

2) Of the cavity: from the lowest point of one sacroiliac joint to the midpoint of the contralateral obturator membrane.

3) Of the outlet: from the midpoint of the sacrotuberous ligament on one side to the contralateral ischiopubic junction.

*** Boundaries and diameters of the pelvic outlet ***





***Dimensions of the lesser pelvis:**

	<i>Anteroposterior</i>	<i>Transverse diameter</i>	<i>Oblique diameter</i>
Inlet	10 cm ♂	12.5 cm ♂	12 cm ♂
	11.2 cm ♀	13.1 cm ♀	12.5 cm ♀
Cavity	10.5 cm ♂	12 cm ♂	11 cm ♂
	13 cm ♀	12.5 cm ♀	13.1 cm ♀
Outlet	8 cm ♂	8.5 cm ♂	10 cm ♂
	12.5 cm ♀	11.8 cm ♀	11.8 cm ♀

HIP BONE

*It is formed of three parts: **ilium, pubis and ischium** which articulate together by Y - shaped triradiate cartilage in the acetabulum in young age. They join each other at puberty and become one complete bone.

***The acetabulum:** is a deep socket on the lateral surface of the hip bone. Its upper 2/5 are formed by the ilium; its lower posterior 2/5 are formed by the ischium and its lower anterior 1/5 is formed by the pubis. It articulates with the head of femur to form the hip joint.

ILIUM

* Is formed of: **body and ala.**

*The body forms the upper 2/5 of the acetabulum.

* The ala shows: 3 borders & 2 surfaces

1) Upper border: called **iliac crest** which is convex outwards in the anterior 2/3 and concave in its posterior 1/3 to the outside. It has an outer and inner lips and an intermediate area. It starts anteriorly at the **anterior superior iliac spine** and ends posteriorly at the **posterior superior iliac spine**. The iliac tubercle: lies about 5 cm behind the anterior superior iliac spine.

2) **Anterior border:** extends between the anterior superior iliac spine above to the **anterior inferior iliac spine below**

3) **Posterior border:** extends from the posterior superior iliac spine above to the posterior inferior iliac spine below.

4) **Outer gluteal surface:** it has three gluteal lines: posterior, middle and inferior

5) **Inner pelvic surface:** in front it forms **the iliac fossa** till the **arcuate line**. Behind, it shows the **auricular surface** for the articulation with the sacrum. **The iliac tuberosity** lies above the auricular surface.

PUBIC BONE

* It has a **body and two rami (superior and inferior):**

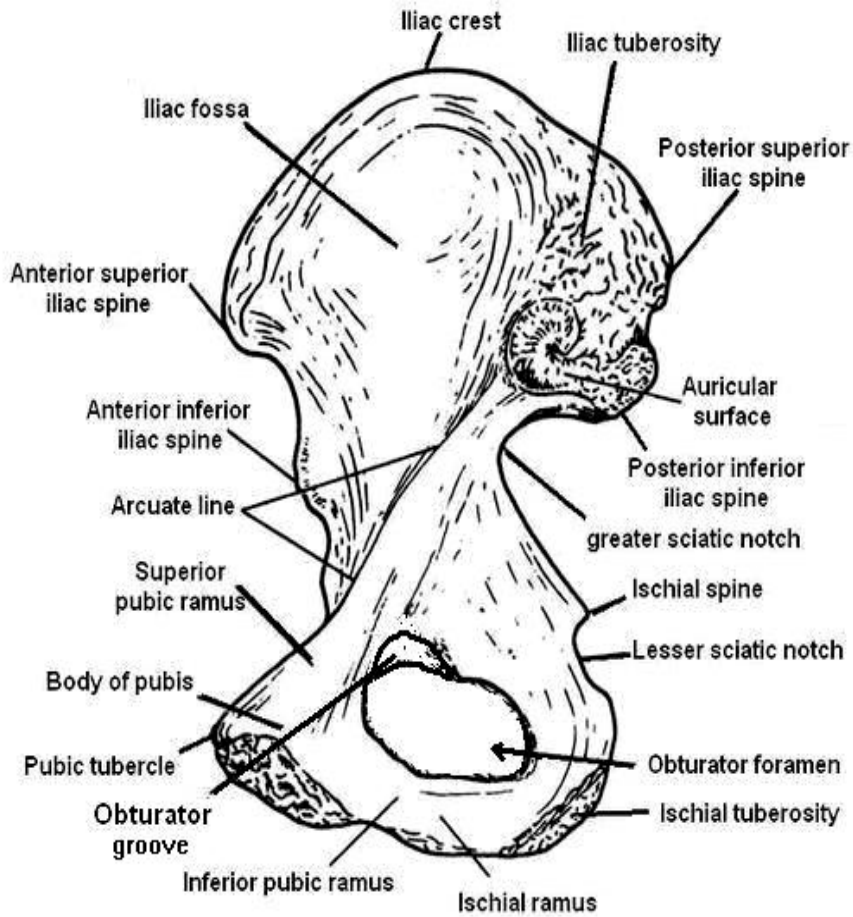
1) **Body:**

- It articulates medially with the other hip bone at the **symphysis pubis**. Its upper border is called **pubic crest** which ends laterally as the **pubic tubercle**.

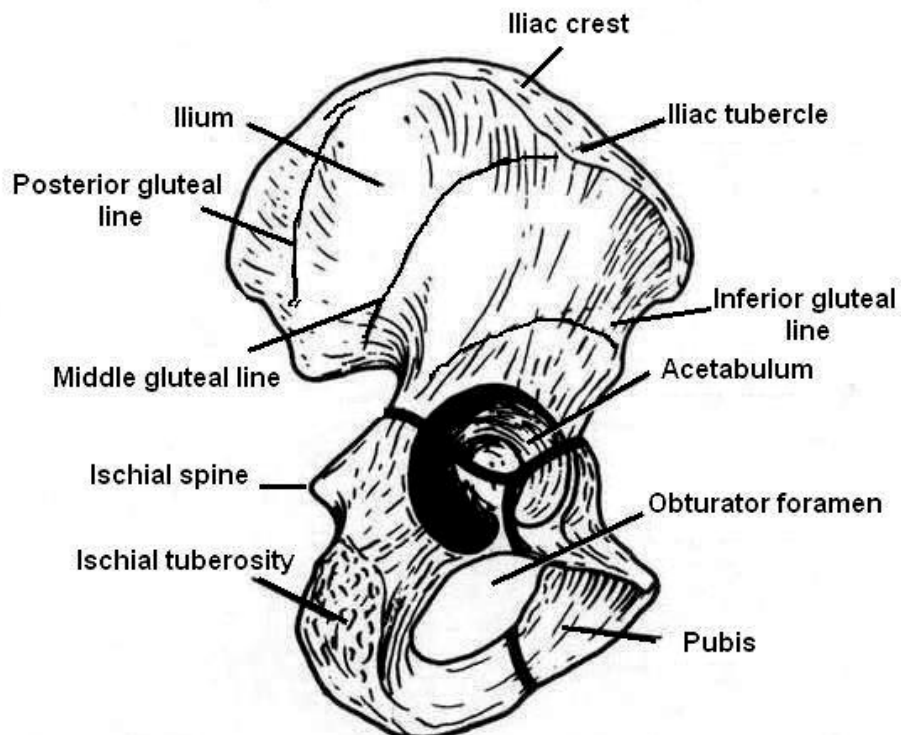
2) **Superior ramus:** has 3 surfaces:

- Upper pectineal surface between the pubic tubercle medially and the **iliopubic eminence** laterally. This surface has a sharp upper border called **pectineal line**.
- Pelvic surface
- Obturator surface

3) **Inferior ramus:** it joins the ischial ramus to form the **ischiopubic ramus**.



*** Hip bone: inner pelvic surface ***



Hip bone: outer gluteal surface

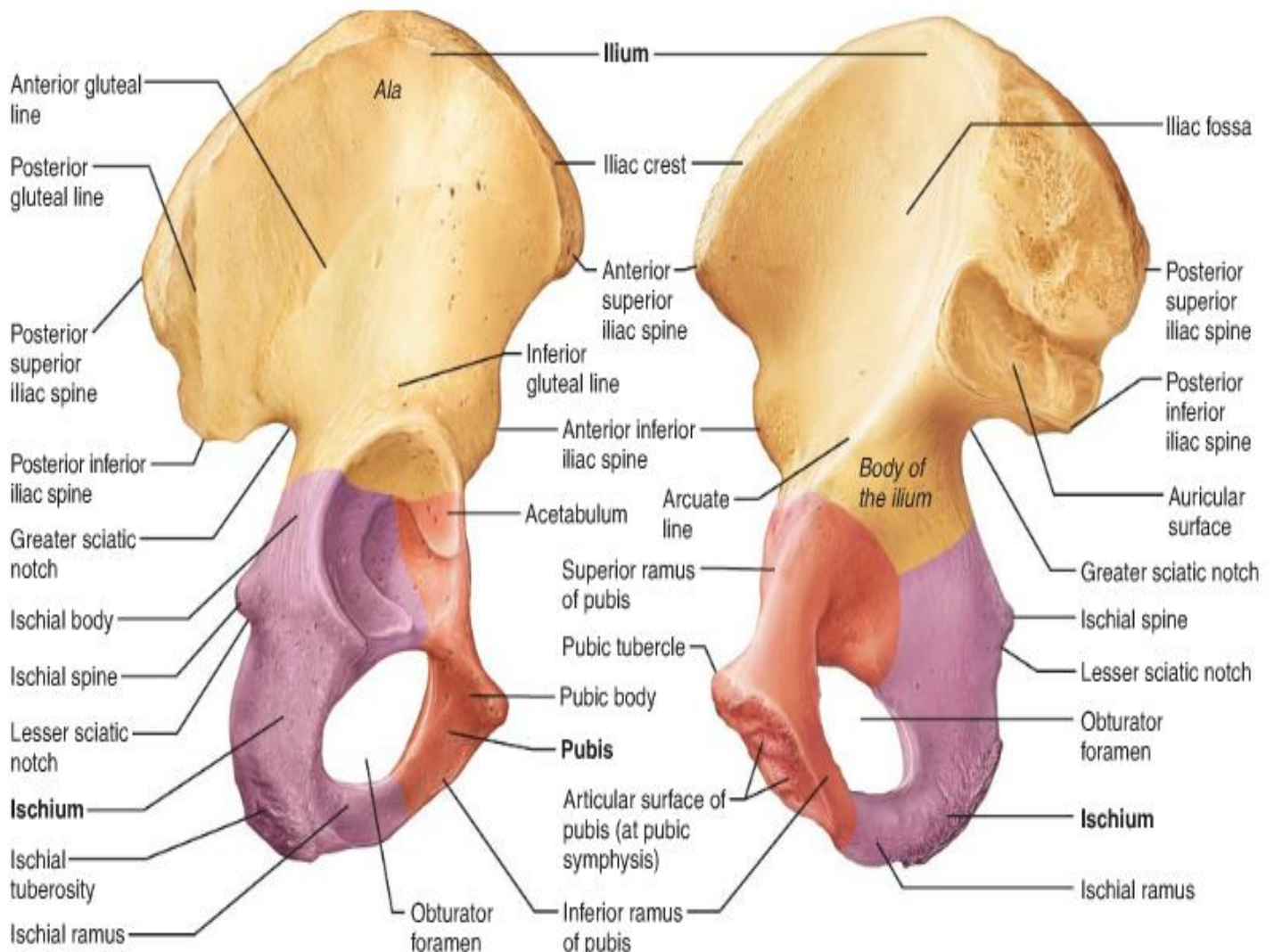
ISCHIUM

* It has **body, ischial ramus and ischial tuberosity.**

* The posterior border of the body has **ischial spine** between the **lesser and greater sciatic notches.**

***Articulations of the hip bone :**

1. With its fellow anteriorly to form the symphysis pubis.
2. With the sacrum posteriorly to form the sacroiliac joint.
3. With the femur laterally to form the hip joint.



(a) Lateral view, right hip bone

(b) Medial view, right hip bone

SACRUM

* It is a triangular bone formed by fusion of 5 sacral vertebrae.

*It has a **base** (above), an **apex** (below), **anterior (pelvic)** , **posterior** and **2 lateral surfaces**.

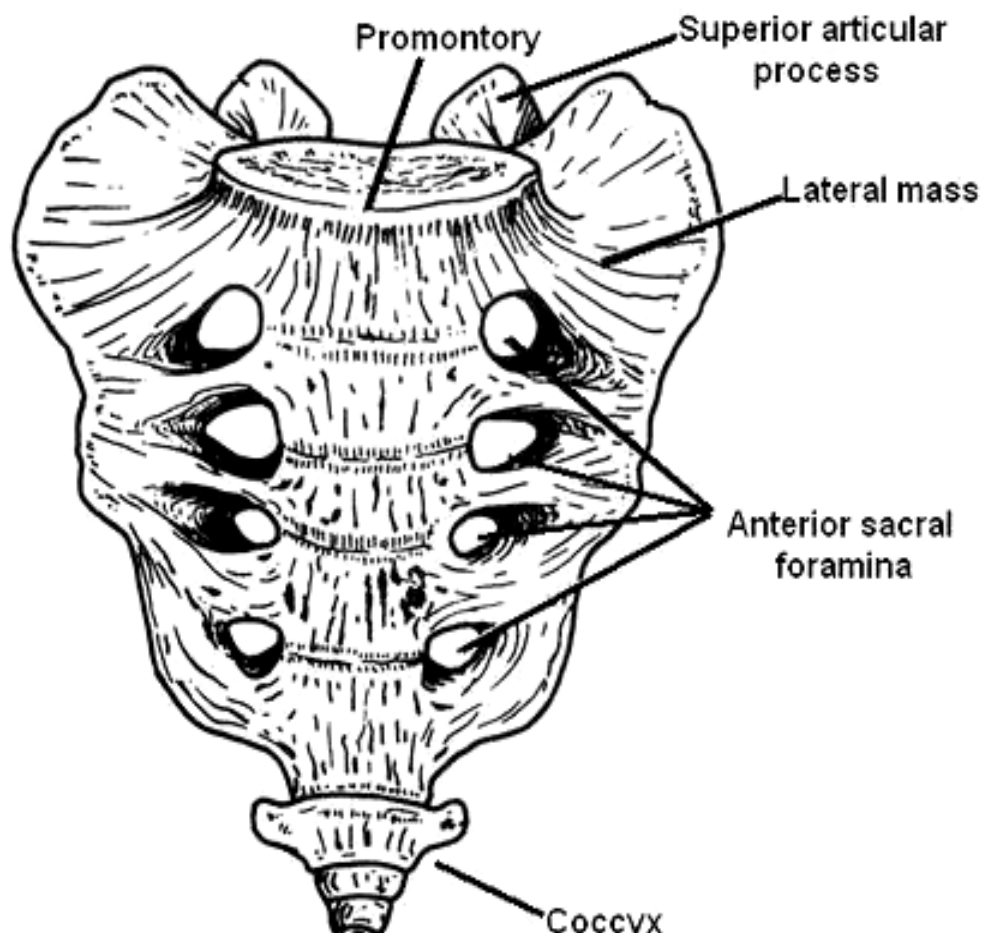
***Base:**

- It is formed of the **body** of S₁ vertebra and 2 **alae** (wings) of the sacrum.
- It articulates with the L₅ vertebra to form lumbosacral joint .
- **Promontory of the sacrum** is the anterior projecting border of the S₁ vertebra.

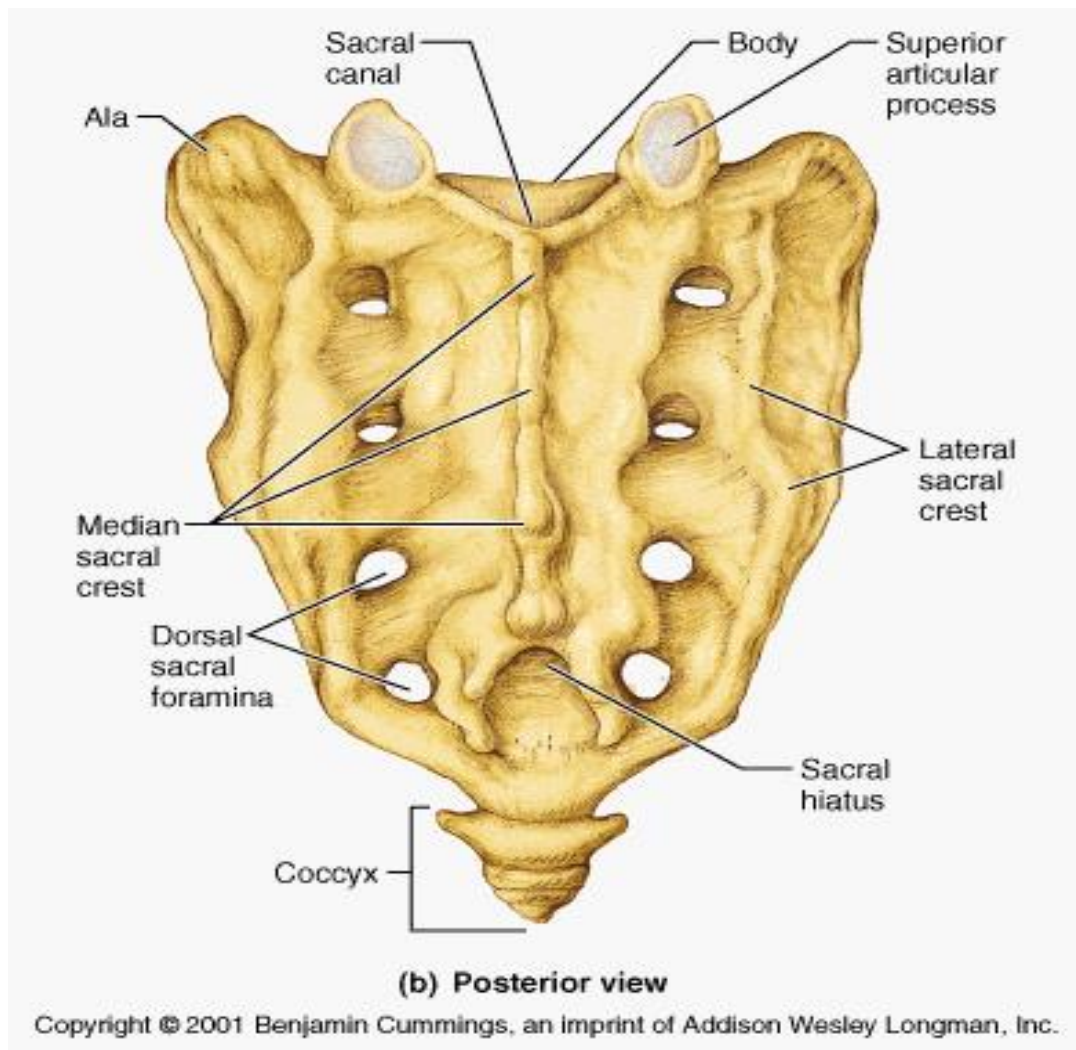
***Apex:** is the lower surface of the S₅ vertebra. It articulates with the coccyx to form sacrococcygeal joint .

***Anterior (pelvic) surface:** smooth and concave. It has 4 pairs of **anterior sacral foramina** for the passage of the ventral rami of the upper 4 sacral nerves and the lateral sacral vessels.

Sacrum: anterior (pelvic) surface



Sacrum: posterior surface



***Posterior surface:** irregular and convex. It has 4 pairs of **posterior sacral foramina** for the passage of the dorsal rami of the upper 4 sacral nerves.

- **Median sacral crest:** is made by fusion of the spines of the upper 4 sacral vertebrae.
- **Lateral sacral crest:** is made by fusion of the transverse processes of the sacral vertebrae.
- **Intermediate sacral crests:** made by fusion of the articular facets of sacral vertebrae.

Pelvis

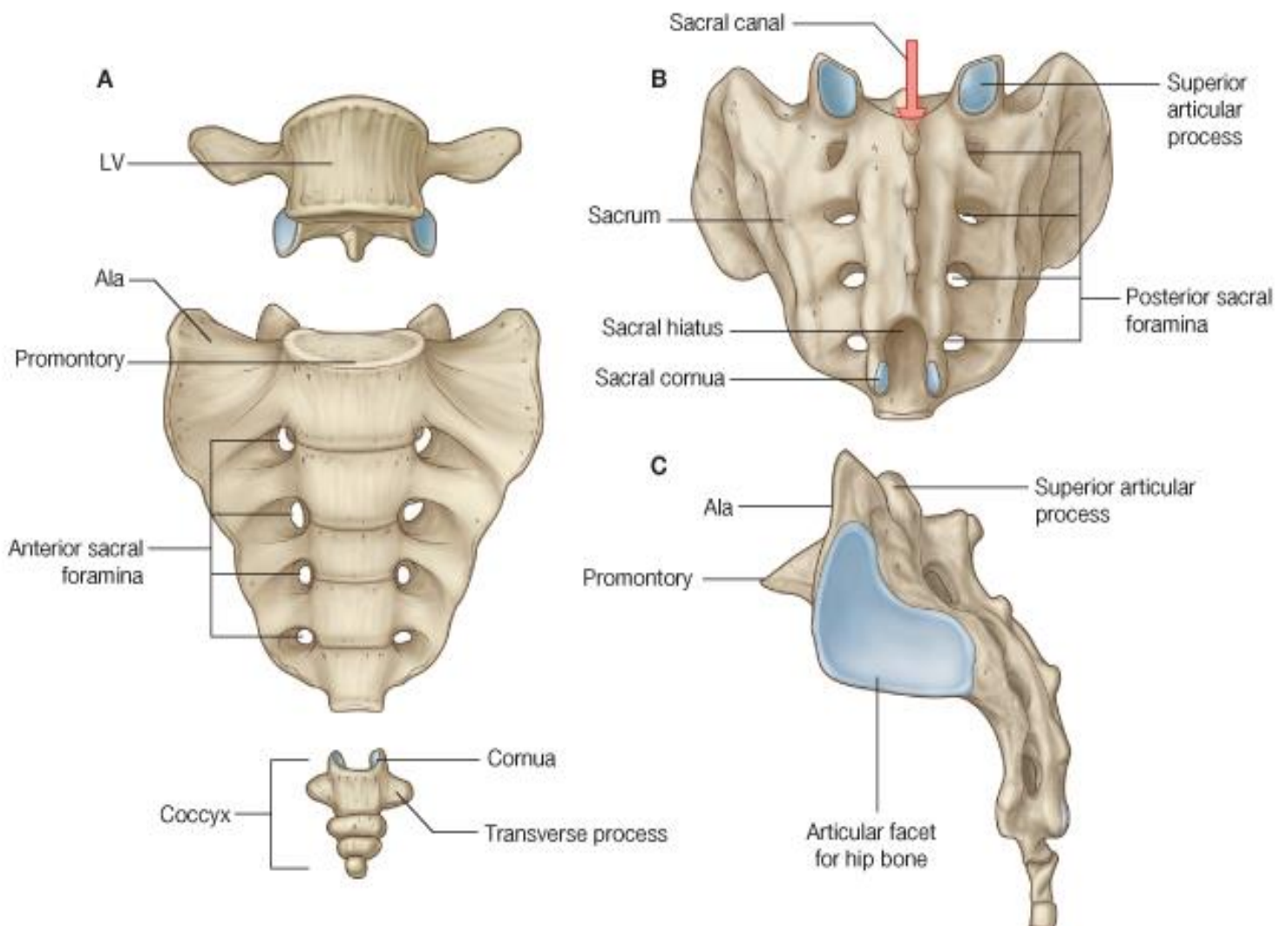
***Lateral surface:** its upper part bears an ear-shaped surface (the **auricular surface**) which articulates with the auricular surface of the ilium.

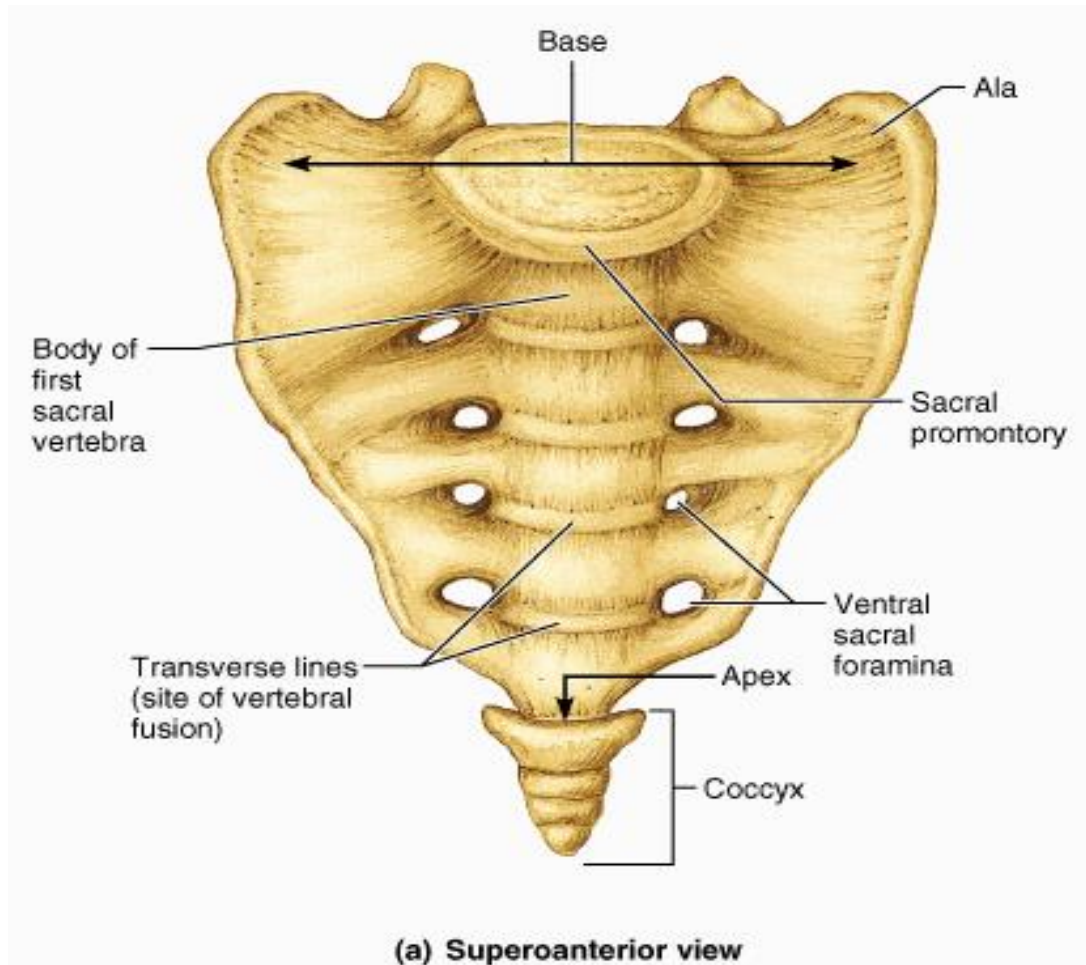
***Sacral hiatus:** is the lower end of the sacral canal through which passes:

1. The roots of the 5th pair of sacral nerves.
2. The roots of the coccygeal nerve.
3. The filum terminale (pia mater).

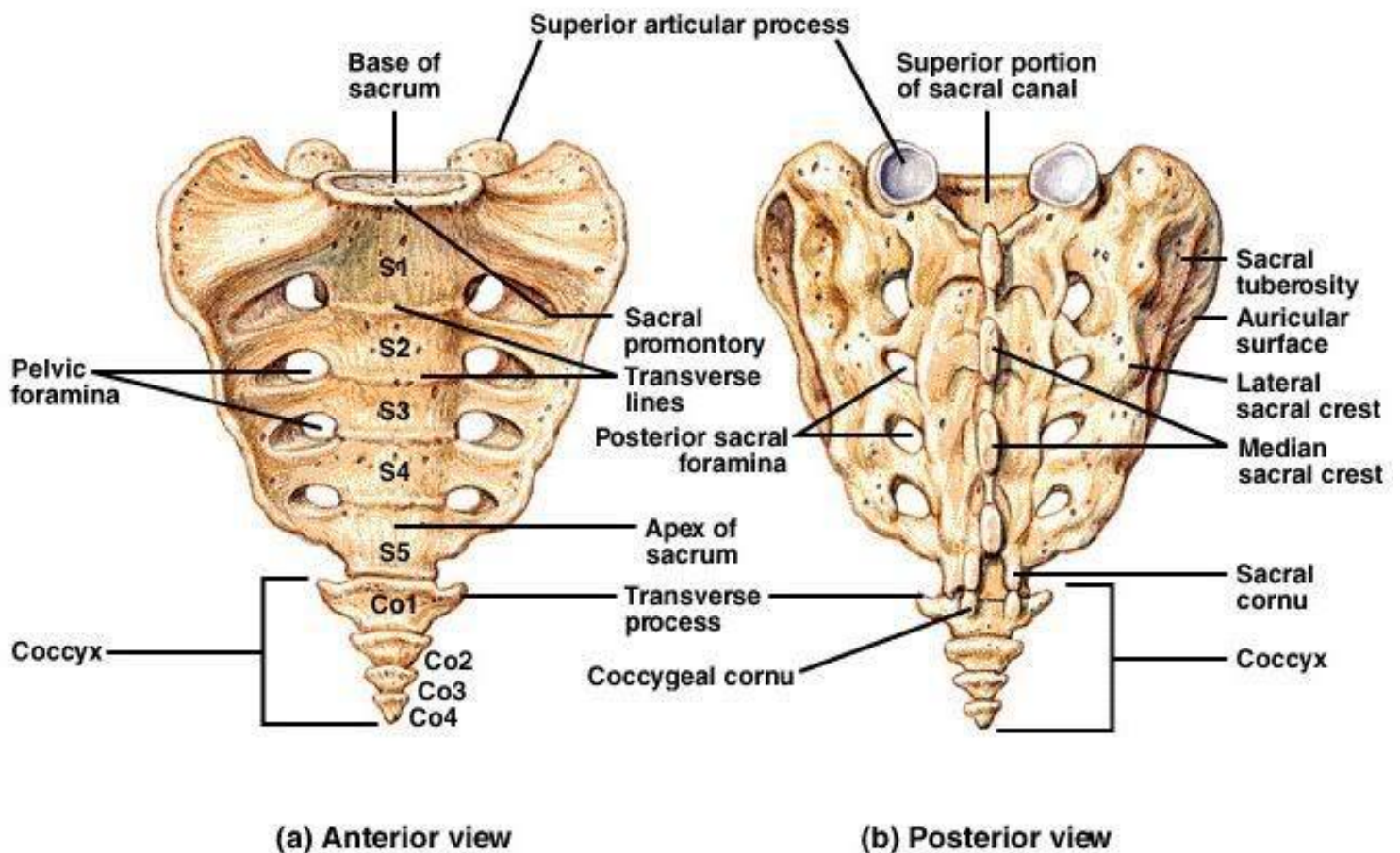
***Contents of the sacral canal:**

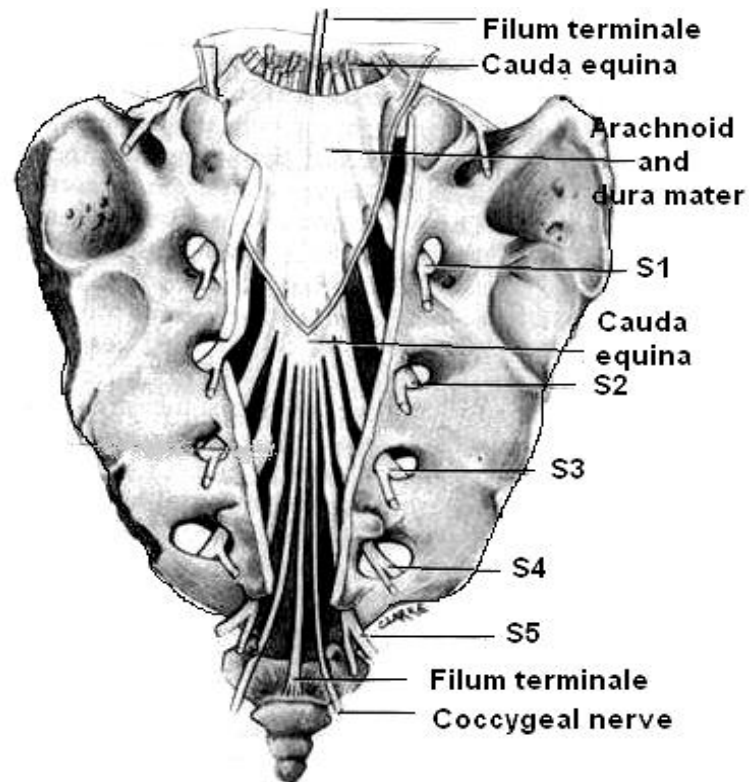
1. **Cauda equina:** the collection of sacral and coccygeal nerve roots, below the end of the spinal cord (lower border of L1).
2. **Filum terminale:** is a prolongation of the pia mater which passes through the sacral hiatus and is fixed to the back of coccyx.
3. **Dura and arachnoid mater:** both end at the lower border of S2 vertebra.
4. **Vertebral venous plexus & Areolar tissues.**





Sacrum and Coccyx





Contents of the sacral canal

***Ligaments attached to the sacrum:**

1. Sacrotuberous ligament
2. Sacrospinous ligament
3. Sacroiliac ligament (anterior, posterior and interosseous)

***N.B: Sacralisation:** means fusion of the 5th. lumbar vertebra with the sacrum .

TYPES OF FEMALE PELVIS

1. Gynaecoid (typical female)pelvis:

It represents 50% of female pelvises. It has a rounded inlet.

2. Android (male like) pelvis: it has narrow pubic arch & heart shaped inlet .

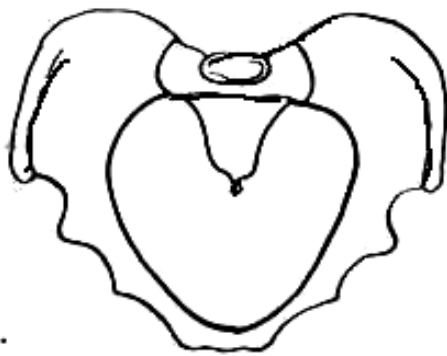
3. Anthropoid pelvis: it has long anteroposterior diameter and *narrow transverse* diameter.

4. Platypelloid pelvis: it has long transverse diameter and *narrow anteroposterior* diameter.

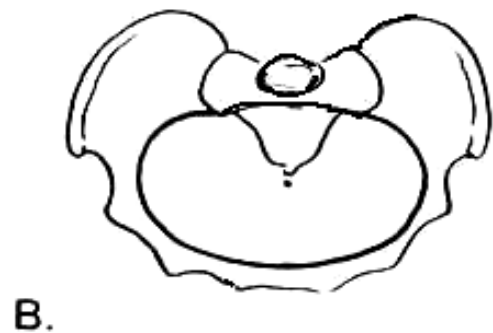
5. Contracted pelvis: small female pelvis. It shows *decrease in all diameters* of the pelvis.

6. Rachitic pelvis: the sacral *promontory projects forwards* and the *coccyx projects backwards* so that the anteroposterior diameter of the inlet is reduced and that of the outlet is increased.

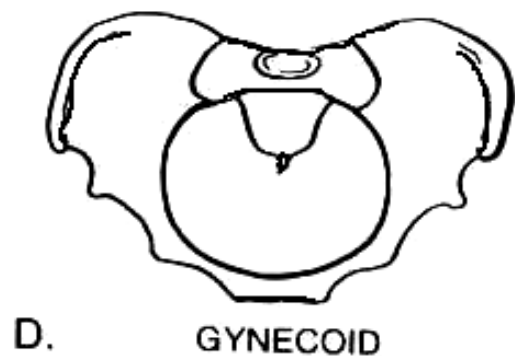
ANTHROPOID



PLATYPELLOID



ANDROID



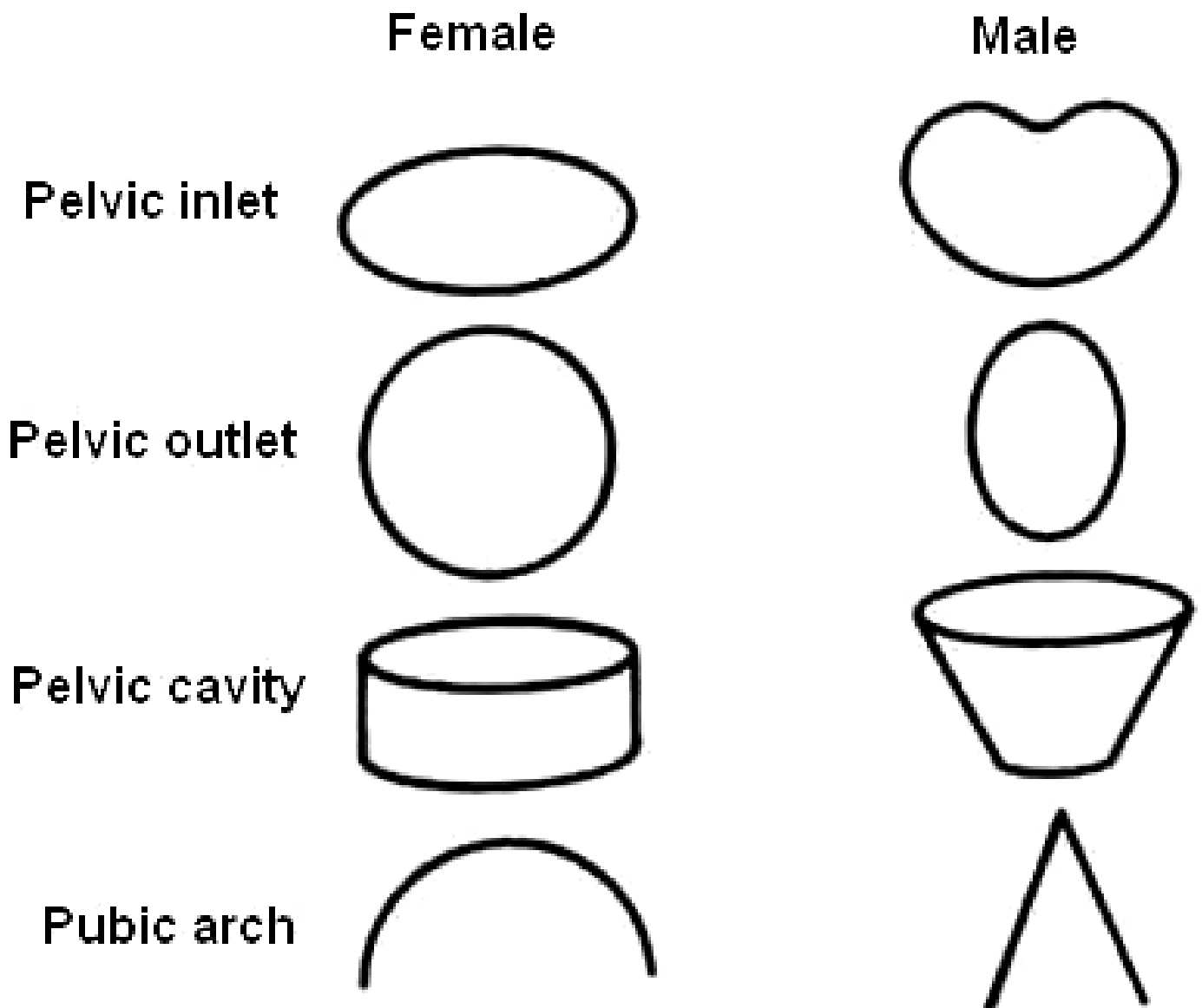
GYNECOID

Types of female pelvis

Differences between male and female pelvis

Male	Female
I. Articulated pelvis	
Heavy and thick	Light and thin
Well defined surface markings	Ill defined surface markings
Pelvic inlet is heart shaped	Pelvic inlet is oval or rounded
Sub-pubic angle is acute	Sub-pubic angle is obtuse
Pelvic cavity is narrow and long	Pelvic cavity is wider and short
Symphysis pubis is relatively long	Symphysis pubis is relatively short
The auricular surface of both ilium and sacrum: is large and extends down to the middle of the 3rd sacral piece.	The auricular surface of both ilium and sacrum: is small and extends down to the 2nd sacral piece.
II. Hip bone	
Greater sciatic notch is deep and narrow	Greater sciatic notch is wide and shallow
The edge of inferior pubic ramus is everted	The edge of inferior pubic ramus is not everted.
Pre-auricular groove is not obvious	Pre-auricular groove is obvious
Ischial spine is inverted	Ischial spine is everted
Distance from the symphysis pubis to the anterior margin of acetabulum is relatively short.	Distance from the symphysis pubis to the anterior margin of acetabulum is relatively long
Acetabulum is relatively large	Acetabulum is relatively small
Obturator foramen is oval	Obturator foramen is triangular
Iliac fossa is shallow	Iliac fossa is more concave
III. Sacrum	
Long and more curved	Short and less curved
Width of the body of 1st sacral vertebra equals that of both alae.	Width of the 1st sacral vertebra equals that of one ala.

*** Differences between male and female pelvis***



JOINTS OF PELVIS

1. Sacroiliac joint

***Type:** synovial

***Variety:** plane

***Articulating surfaces:**

- Auricular surface of ilium
- Auricular surface of the sacrum
- Both extend down to the middle of the 3rd sacral piece in male and only to the lower border of 2nd sacral piece in female.

***Fibrous capsule:** attached to the margins of the auricular surfaces of the sacrum and ilium

***Ligaments:**

1. Anterior sacroiliac ligament: on the anterior aspect of the joint.

2. Posterior sacroiliac ligament: on the dorsal aspect of the joint.

3. Interosseus sacroiliac ligament: the **strongest ligament in the body**.

It is important in body weight transmission. It fills the space between the iliac tuberosity and sacrum.

4. Iliolumbar ligament: extends from the iliac crest to the transverse process of L5 vertebra.

5. Sacrotuberous ligament and Sacrospinous ligament: are considered secondary ligaments of sacroiliac joint.

Mechanics of the pelvis and sacroiliac joint:

1. The long axis of sacrum lies more horizontal than vertical so the weight of the body tends to move the upper end of sacrum downwards and forwards and the lower end upwards and backwards.

2. This tendency of the sacrum to rotate is prevented by:

A. *The Interosseus and posterior sacroiliac ligaments:* both prevent downward and forward movements of the upper end of sacrum.

B. *The sacrotuberous ligament and sacrospinous ligaments:* both prevent the upward and backward movement of the lower end of sacrum

3. The movements of the sacroiliac joints are very limited because they support and transmit the weight of the body from the vertebral column to the hip joint.

Sacrotubeous and sacrospinous ligaments

1. Scarotuberous ligament:

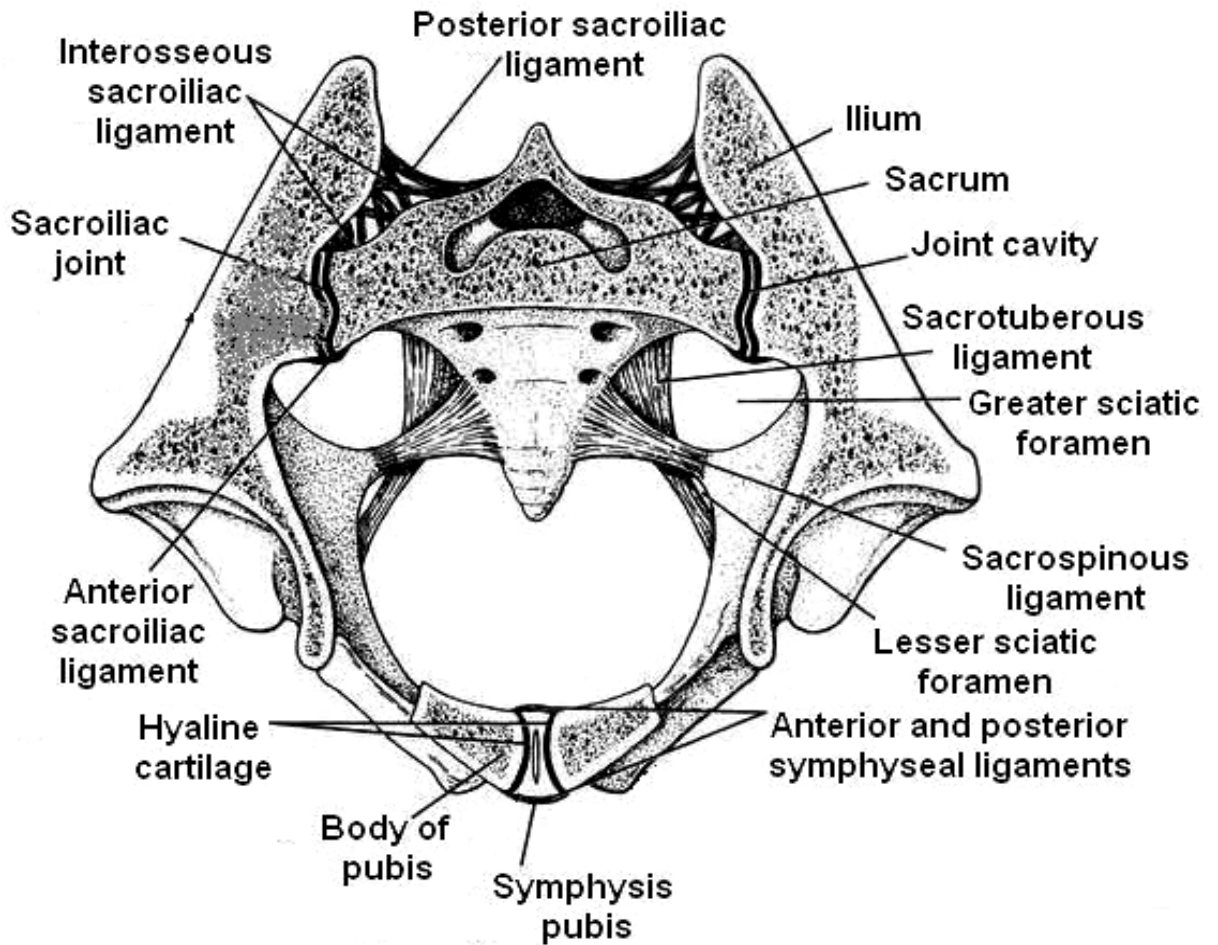
It is long and strong ligament extending from the side of the lower 2 pieces of sacrum and coccyx to the medial border of ischial tuberosity.

2. Sacrospinous ligament:

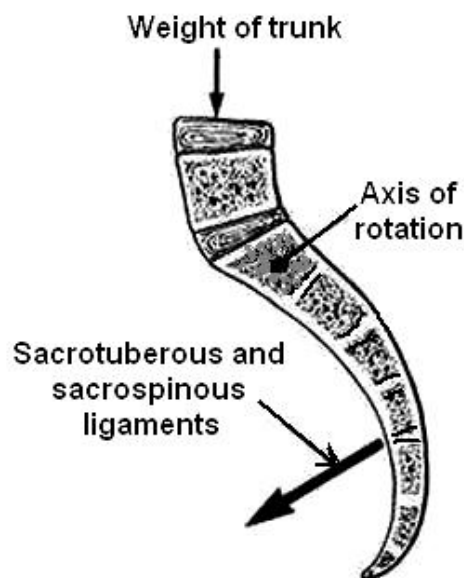
It is short fan shaped ligament extending from the side of the lower 2 pieces of sacrum and coccyx to the ischial spine.

Functions:

1. They prevent the tilt of the pelvis
2. They complete the wall of the pelvis
3. They convert the greater and lesser sciatic notches to foramina.
4. The scarotuberous ligament shares in the formation of the outlet of the pelvis. It gives origin to the gluteus maximus.



Joints and ligaments of the pelvis



**Function of the sacrotuberous and sacrospinous ligaments
in body weight transmission**

Iliolumbar ligament

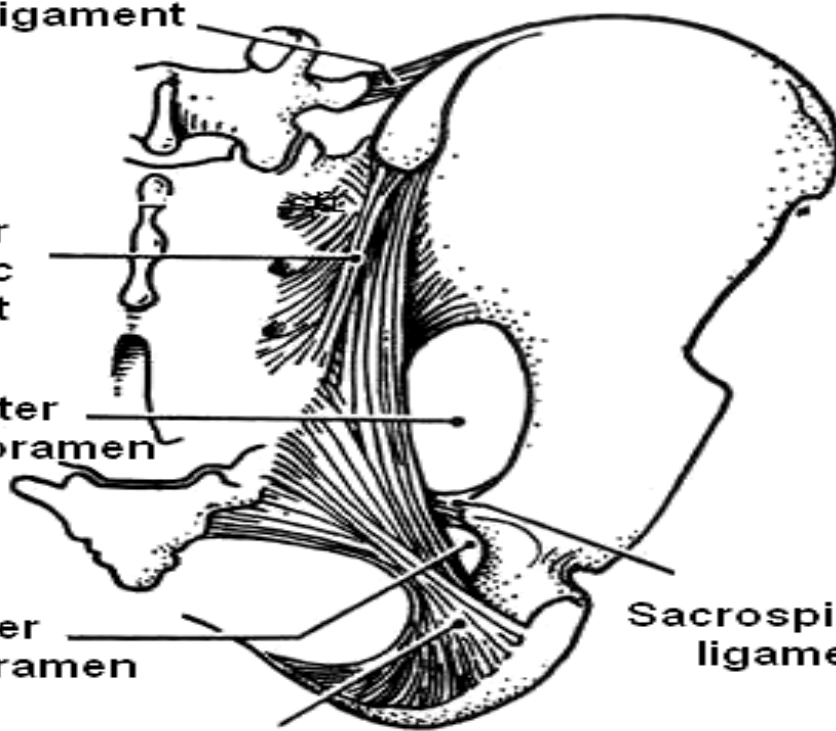
Posterior sacroiliac ligament

Greater sciatic foramen

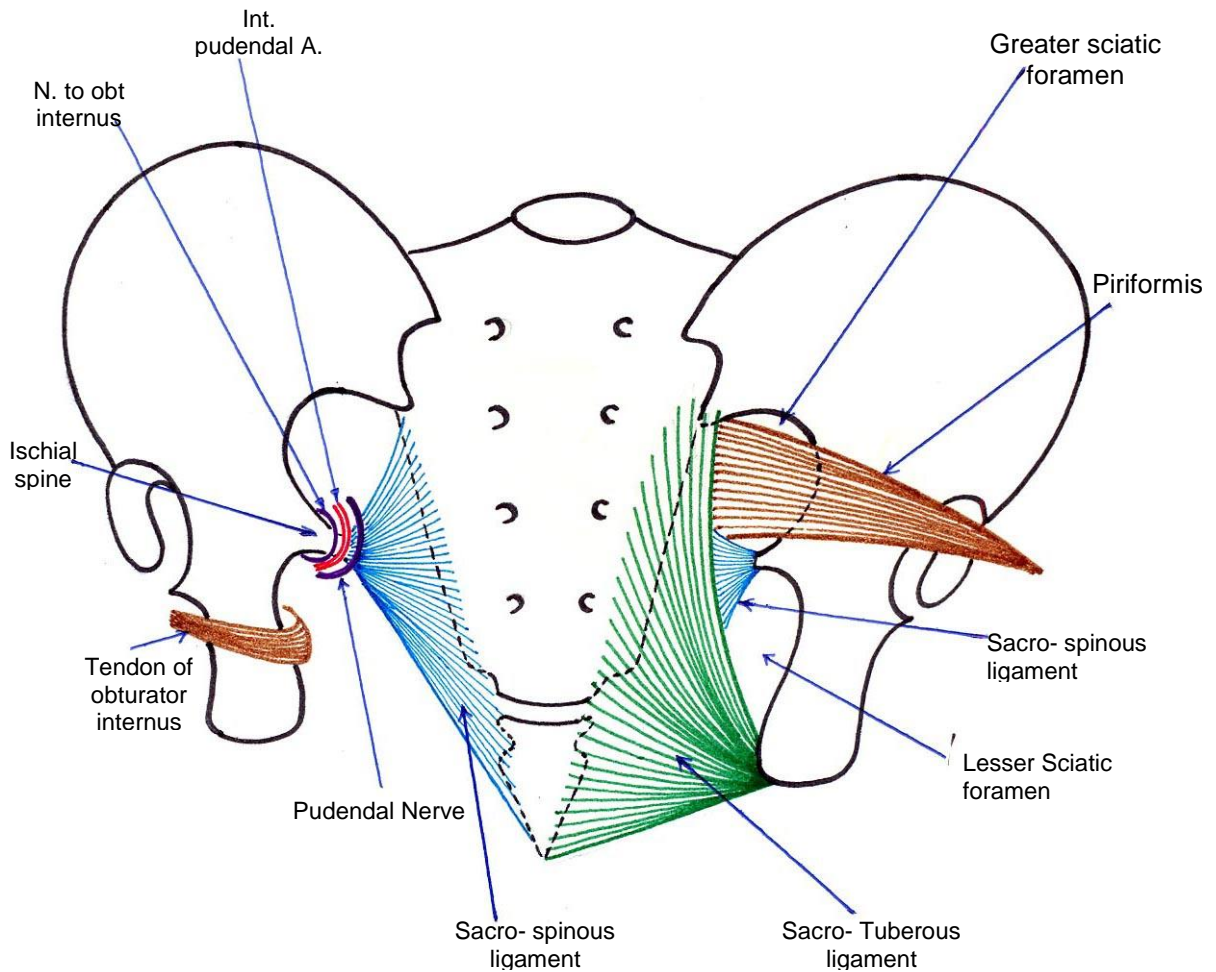
Lesser sciatic foramen

Sacrotuberous ligament

Sacrospinous ligament



Ligaments of the pelvis



Sacro-tuberous & sacro-spinous ligaments

2. Sacrococcygeal joint

*It is the simplest joint in the pelvis

***Type:** 2ry cartilaginous joint.

***Articular surfaces:**

1. The bodies of last sacral and 1st coccygeal vertebrae are united by the intervertebral disc.
2. Their transverse tubercles and horns are united by ligaments.

***Ligaments:**

- Supraspinous and interspinous ligaments (they close the sacral canal from behind).
- Sacrotuberous and sacrospinous ligaments.

3. Lumbosacral joint

Type and surface: the lumbosacral articulation includes three joints:

1. 2ry cartilaginous joint (the intervertebral disc between the bodies of L5 and S1)
2. Two synovial joints between the adjacent articular processes of L5 and S1.

The intervertebral disc between L5 and S1 is much thicker than others to allow much movement. The disc is thicker in front than behind so it contributes to the erect posture.

Ligaments:

1. Typical ligaments:

1. Anterior and posterior longitudinal ligaments: connect the bodies of the vertebrae.
2. Capsular ligaments: connect the articular processes.
3. Ligamenta flava: connect the lamina of the vertebrae.
4. Supraspinous and interspinous ligaments: connect the spines of the vertebrae.

5. Inter transverse ligaments: connect the transverse processes.

2. Special ligaments:

1. Iliolumbar ligament: it extends from the iliac crest to the transverse process of L5 vertebra. It prevents forward gliding of L5 on the sacrum.
2. lumbosacral ligament: it extends from the transverse process of L5 to the ala of the sacrum.

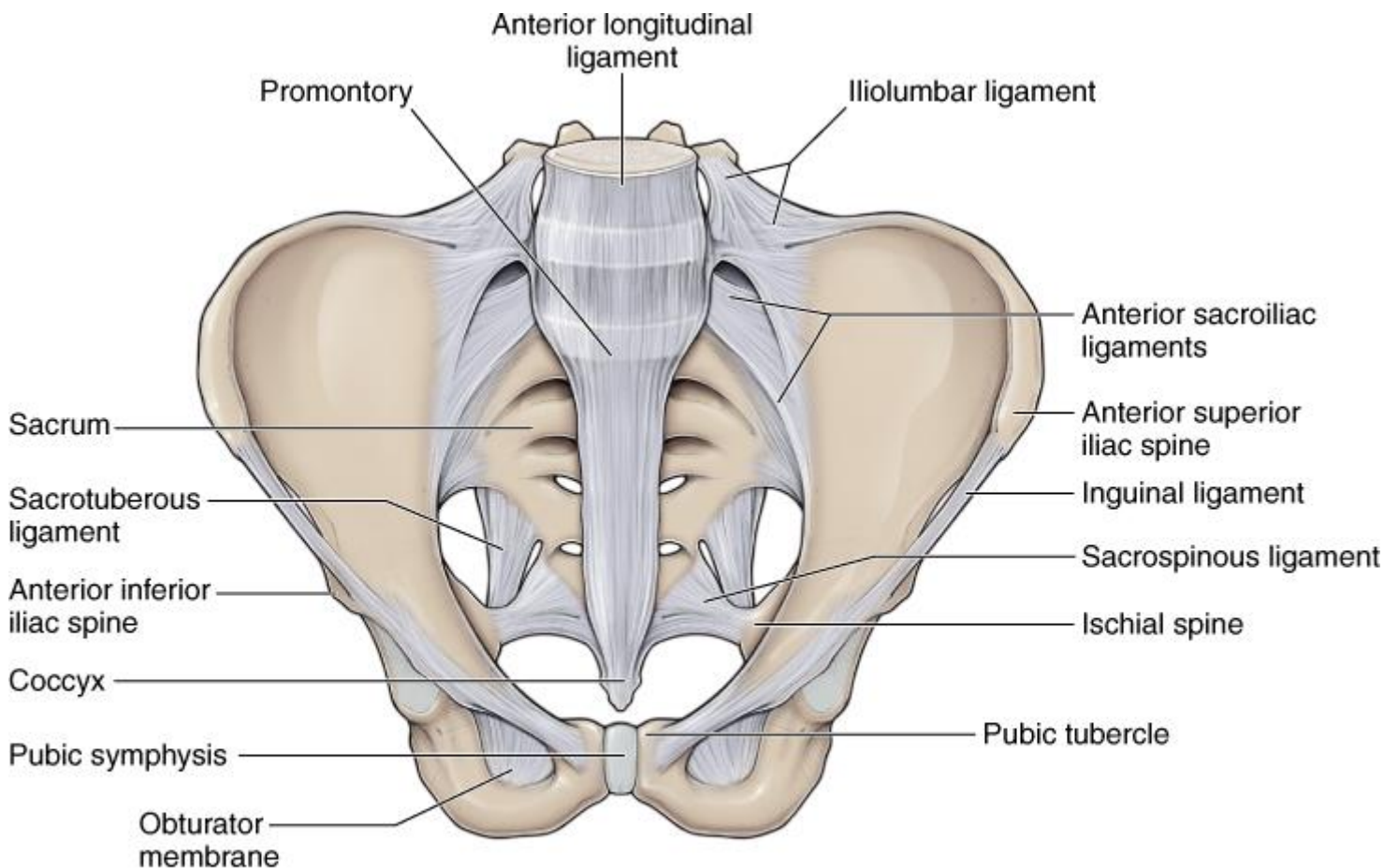
4. Symphysis pubis

Type: 2ry cartilaginous joint

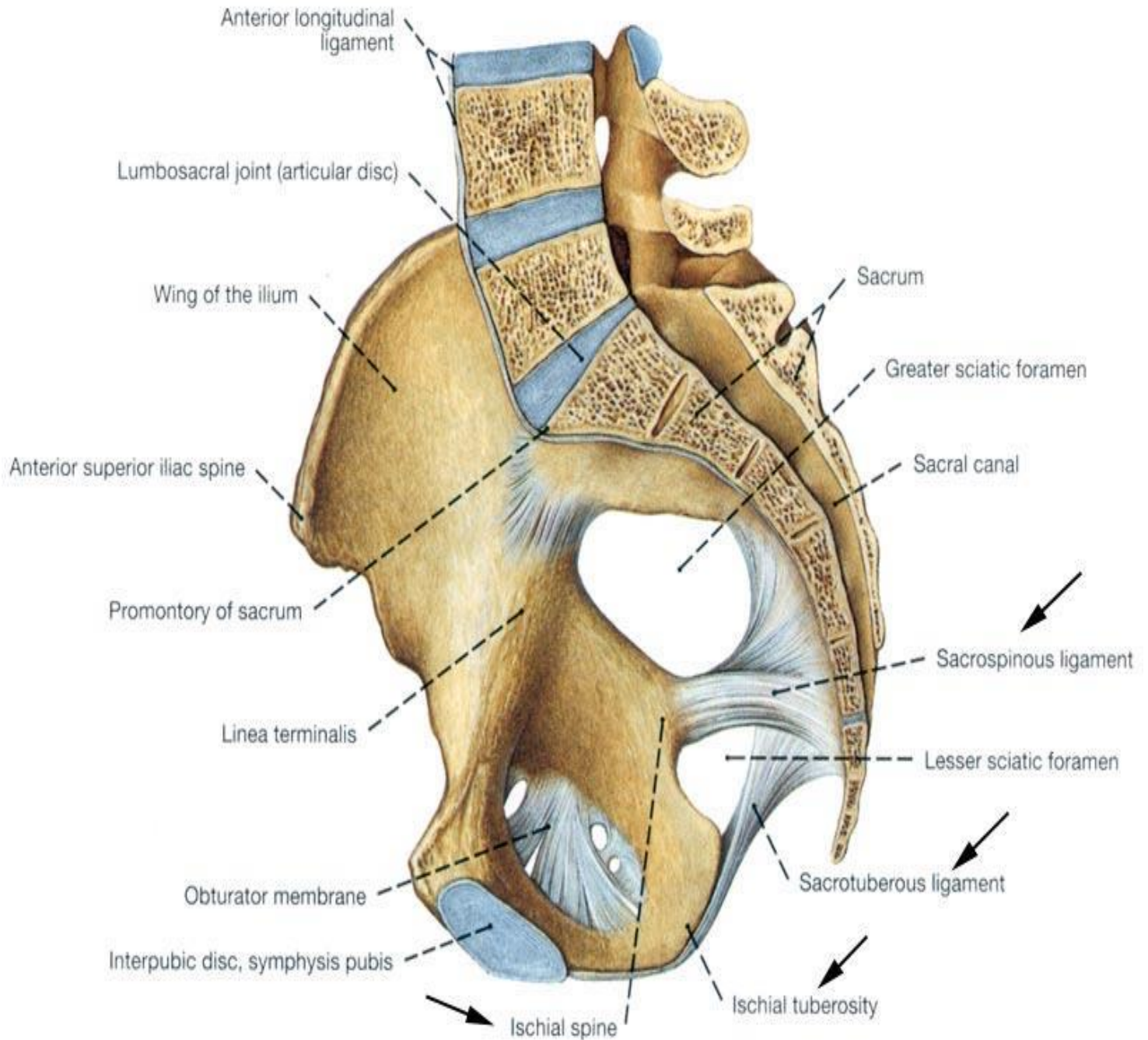
Articular surfaces: the 2 medial surfaces of the bodies of the 2 pubic bones. They are united together by a disc of fibrocartilage.

Ligaments: are weak fibrous ligaments

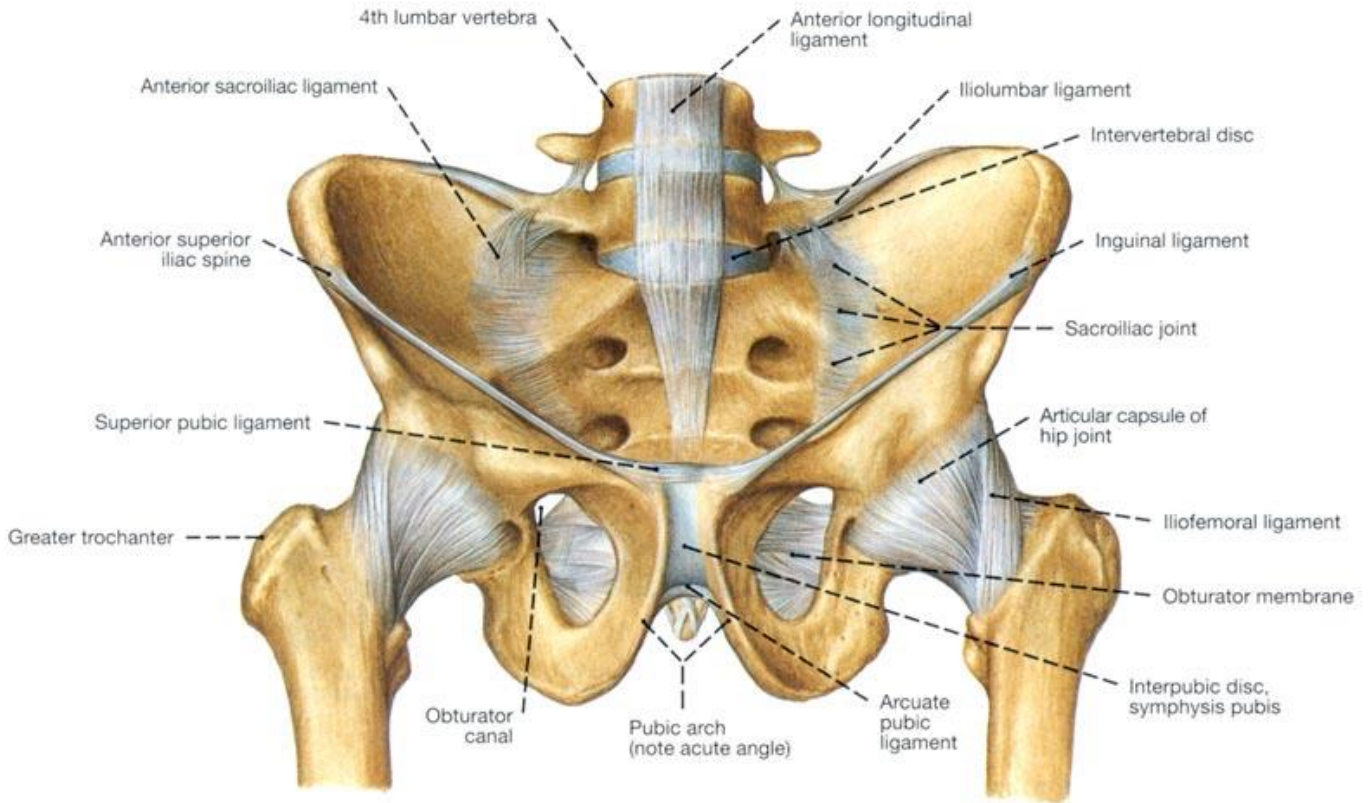
- Anterior and posterior pubic ligaments.
- Superior and inferior pubic ligaments.



Pelvis and Ligaments, Vertical Cross Section, Female

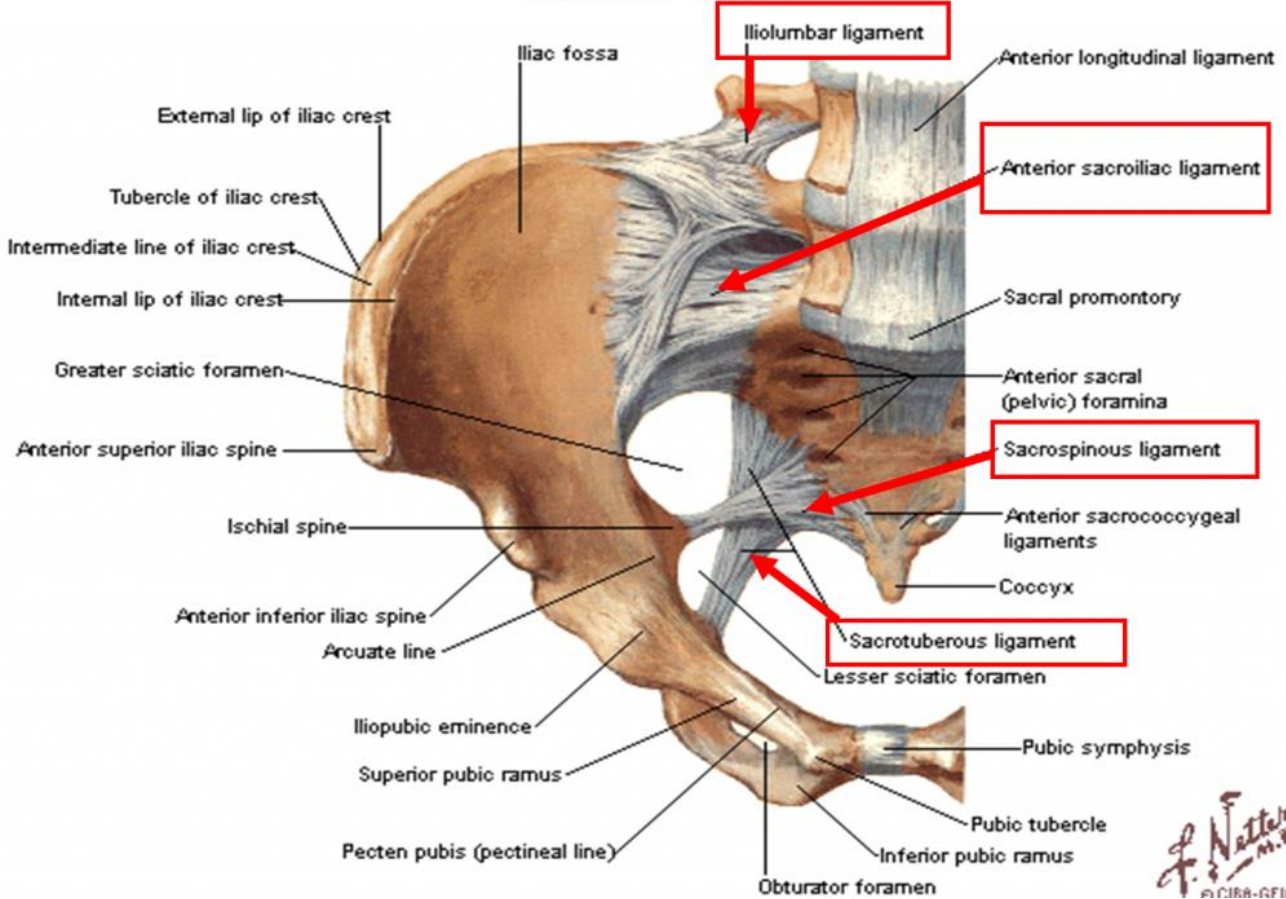


Pelvis and Ligaments, Front View, Male



Bones and Ligaments of Pelvis

Anterior View



F. Netter M.D.
© CIBA-GEIGY