Walls of Pelvis

Walls of Pelvis

Introduction

The **pelvic walls** are formed by **bones, muscles, and fascia** that create a strong yet flexible basin supporting the **pelvic viscera** and transmitting **neurovascular structures** between the trunk and lower limb.

They are divided into:

- **Posterior wall** – formed mainly by the **sacrum** and **piriformis muscle**.
- **Lateral walls** – formed by the **hip bone** (ischium and part of ilium), **obturator internus muscle**, and **obturator membrane**.
- **Anterior wall** – formed by the **bodies of the pubic bones**, **pubic symphysis**, and associated fascia.
- **Inferior wall (pelvic floor)** – formed by the **levator ani** and **coccygeus muscles**, collectively known as the **pelvic diaphragm**.

These walls not only **support pelvic organs** like the bladder, uterus, and rectum, but also provide **passage for important vessels and nerves** that enter or leave the pelvis.

Vessels of the Pelvis

The main blood supply of the pelvis is derived from the **internal iliac artery**, a terminal branch of the **common iliac artery**, which arises from the **abdominal aorta** at the level of the **L4 vertebra**.
The **pelvic veins**, lymphatics, and nerves accompany these arteries in close relation to the

pelvic viscera and muscles.

Internal Iliac Artery

The **internal iliac artery** is the **principal artery of the pelvis**, supplying the **pelvic walls, pelvic viscera, perineum, and parts of the gluteal and medial thigh regions**.
It represents the major branch that ensures both **somatic** and **visceral circulation** in the pelvis.

Course

- The internal iliac artery arises from the **common iliac artery** opposite the **lumbosacral disc (between L5 and S1)**.
- It descends **posteromedially** into the **pelvic cavity** in front of the **sacroiliac joint**.
- It usually measures **3–4 cm in length**.
- At the **upper margin of the greater sciatic foramen**, it divides into:
    - **Anterior division** ? supplies **viscera** and **muscles of the perineum and medial thigh**.
    - **Posterior division** ? supplies **parietal branches** to the **pelvic wall and gluteal region**.

Relations

Anteriorly:

- In males ? **Ureter, vas deferens, and peritoneum of rectovesical pouch**.
- In females ? **Ureter and peritoneum of rectouterine pouch**.

Posteriorly:

- **Internal iliac vein**, **lumbosacral trunk**, and **piriformis muscle**.

Medially:

- **Pelvic viscera** (rectum, bladder, uterus, vagina).

Laterally:

- **Obturator internus muscle** and **parietal pelvic fascia**.

Branches of Internal Iliac Artery

Branches of Anterior Division

In males – six branches:

1. **Superior vesical artery** – supplies upper part of urinary bladder; gives artery to ductus deferens.
2. **Obturator artery** – runs along obturator fascia, passes through obturator foramen; gives iliac, vesical, and pubic branches (anastomoses with inferior epigastric).
3. **Middle rectal artery** – small; supplies mainly prostate and seminal vesicles, little to rectum.
4. **Inferior vesical artery** – to trigone of bladder, prostate, seminal vesicles, and lower ureter.
5. **Inferior gluteal artery** – largest branch; passes below piriformis to gluteal region; supplies buttock, back of thigh, and gives vesical branches.

6. **Internal pudendal artery** – terminal branch; supplies perineum and external genitalia, giving inferior rectal, perineal, bulb, urethral, deep and dorsal arteries

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In females – seven branches:

- **Inferior vesical artery** is replaced by **vaginal artery**, which supplies vagina, bulb of vestibule, base of bladder, and nearby rectum.

- An additional **uterine artery** supplies cervix, uterus, vagina, and uterine tube; crosses ureter 2 cm lateral to cervix

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Branches of Posterior Division

1. **Iliolumbar artery** – ascends in front of sacroiliac joint, divides into:

   - **Lumbar branch** – to psoas, quadratus lumborum, erector spinae, and cauda equina.

   - **Iliac branch** – to iliacus and iliac fossa; participates in anastomosis around anterior superior iliac spine.

2. **Lateral sacral arteries (two)** – descend on sacral nerves; enter anterior sacral foramina to supply contents of sacral canal; exit posteriorly to supply muscles and skin of back of sacrum.

3. **Superior gluteal artery** – passes above piriformis through greater sciatic foramen; supplies gluteus maximus and nearby muscles; participates in anastomoses around

anterior superior iliac spine and greater trochanter

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Internal Iliac Vein

- Lies **posteromedial to the internal iliac artery**.
- Joins **external iliac vein** to form **common iliac vein** at pelvic brim.
- Tributaries correspond to the arterial branches, except that **iliolumbar vein** drains directly into **common iliac vein**.

Tributaries include:

- **Parietal veins:** superior gluteal (largest), inferior gluteal, internal pudendal, obturator, lateral sacral veins.
- **Visceral veins:** from **rectal**, **prostatic**, **vesical**, **uterine**, and **vaginal venous plexuses**

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Lymph Nodes of the Pelvis

Pelvic lymphatics drain into three main groups of nodes located along the corresponding vessels:

1. **Common iliac nodes (4–6)** – receive lymph from internal and external iliac nodes; efferents go to **lateral aortic nodes**.
2. **External iliac nodes (8–10)** – receive lymph from inguinal nodes, infraumbilical abdominal wall, prostate, bladder base, cervix, and vagina.

- **Inferior epigastric** and **circumflex iliac nodes** are part of this group.

3. **Internal iliac nodes** – receive lymph from all **pelvic viscera**, deep perineum, and gluteal region; efferents drain to **common iliac nodes**.

    - **Sacral** and **obturator nodes** are outlying members of this group

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Dissection

To study the pelvic vessels:

- Remove the **pelvic viscera** carefully from the cavity.
- Trace the **internal iliac artery** and its **anterior and posterior divisions**, following each branch to its destination in the viscera or pelvic walls.
- Remove the **venous plexuses** (rectal, vesical, prostatic, uterine, and vaginal) to visualize the arteries clearly.
- Identify and clean the **hypogastric plexus** lying near the bifurcation of the common iliac artery

Nerves of the Pelvis

Overview

The **pelvic nerves** include:

1. **Lumbosacral plexus**

2. **Coccygeal plexus**

3. **Pelvic autonomic nerves**

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Lumbosacral Plexus

Formation:

- Formed by the **lumbosacral trunk** (L4–L5) and **ventral rami of S1–S3** with part of **S4**.

- The **lumbosacral trunk** is made by the **descending branch of L4** and **entire ventral ramus of L5**, crossing the **pelvic brim** in front of the **sacroiliac joint** to join S1

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Relations:

- Lies in front of **piriformis** and behind **internal iliac vessels** and **ureter**.

- **Superior gluteal vessels** separate L4–L5 and S1; **inferior gluteal vessels** separate S1 and S2

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Layout of Branches

Before forming the plexus, ventral rami give off:

- **Nerves to piriformis (S1, S2)**

- **Nerves to levator ani, coccygeus, and sphincter ani externus (S4)**
- **Pelvic splanchnic nerves (S2, S3, S4)**

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The plexus gives rise mainly to:

- **Sciatic nerve** – for locomotion
- **Pudendal nerve** – for perineal and reproductive functions

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Branches from Dorsal Divisions

1. **Superior gluteal nerve (L4, L5, S1):** To **gluteus medius, minimus, and tensor fasciae latae**.
2. **Inferior gluteal nerve (L5, S1, S2):** To **gluteus maximus**.
3. **Nerve to piriformis (S1, S2).**
4. **Perforating cutaneous nerve (S2, S3).**

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Branches from Ventral Divisions

1. **Nerve to quadratus femoris (L4, L5, S1).**
2. **Nerve to obturator internus (L5, S1, S2).**

3. **Pudendal nerve (S2, S3, S4):** To **sphincter ani externus** and **muscles of urogenital triangle**.
4. **Muscular branches (S4):** To **levator ani**, **coccygeus**, and **sphincter ani externus**.
5. **Pelvic splanchnic nerves (S2–S4):** Parasympathetic fibers to **pelvic viscera**

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Coccygeal Plexus

1. Formed by **descending branch of S4**, **S5**, and **coccygeal nerve**.
2. Lies on **pelvic surface of coccygeus**.
3. Gives rise to **anococcygeal nerves**, which pierce **sacrotuberous ligament** to supply **skin over coccyx and anus**

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Clinical Anatomy

- **Lumbosacral trunk (L4–L5)** and **S1 nerve** may be compressed or inflamed in **sacroiliac joint disease**, causing **pain radiating below the knee**.
- **L4 root** ? pain in **medial leg and sole**; **S1 root** ? pain in **lateral foot**.
- Injury to **pudendal nerve** causes **perineal sensory loss** and **sphincter weakness** (fecal or urinary incontinence)

Pelvic Sympathetic System

The **pelvic part of the sympathetic chain** runs downward and slightly medially over the **sacral bodies**, along the **medial margins of the anterior sacral foramina**.
Both chains unite in front of the coccyx to form a small **ganglion impar**.
Each chain contains **four sacral ganglia** on either side and one **median ganglion impar**.

Branches of the pelvic sympathetic chain include:

- **Grey rami communicantes** to all sacral and coccygeal ventral rami.
- **Branches to the inferior hypogastric plexus** from the upper ganglia.
- **Branches to the median sacral artery** from the lower ganglia.
- **Branches to the rectum** from the lower ganglia.
- **Filaments to the glomus coccygeum** from the ganglion impar

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The **inferior hypogastric plexus** (pelvic plexus) lies on either side of the rectum and pelvic viscera.
It is formed by:

1. **Hypogastric nerve** from the superior hypogastric plexus.
2. **Branches from the upper sacral sympathetic ganglia.**
3. **Pelvic splanchnic nerves (S2–S4).**

Branches of the inferior hypogastric plexus include:

- **Rectal plexus**
- **Vesical plexus**
- **Prostatic plexus** (in males)
- **Uterovaginal plexus** (in females)

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Pelvic Splanchnic Nerves (Nervi Erigentes)

These nerves represent the **sacral outflow of the parasympathetic system**.
They arise as fine filaments from the **ventral rami of S2, S3, and S4** and join the **inferior hypogastric plexus** to supply the **pelvic viscera**.
Their functions include:

- **Motor to smooth muscles** of bladder and rectum.
- **Vasodilator** to erectile tissue.
- **Secretomotor** to glands of pelvic organs.

Some parasympathetic fibers ascend through the **hypogastric nerve** to the **superior hypogastric plexus** and further to the **inferior mesenteric plexus**, thus reaching parts of the **hindgut**.
Others ascend independently to supply the **descending colon and sigmoid colon**, reflecting their **hindgut derivation**

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Dissection Steps

1. Expose the **lumbosacral trunk** and **ventral rami of sacral nerves (S1–S5)**.
2. Lift the **sacral plexus** forward to identify the **sciatic** and **pudendal nerves**.
3. Locate nerves emerging from the **dorsal surface** of the plexus (e.g., superior and inferior gluteal nerves).
4. Trace branches from the **pelvic surface**—nerves to **quadratus femoris** and **obturator internus**.
5. Identify the **pelvic sympathetic trunks** on the sacrum and trace them to the **ganglion impar** on the coccyx.
6. Follow the **grey rami communicantes** from the sacral ganglia to sacral nerves.
7. Finally, locate the **inferior hypogastric plexus** around the **internal iliac vessels**

Pelvic Fascia

Parietal Fascia of the Lateral Pelvic Wall

- The **pelvic fascia** covers the **muscles of the lateral pelvic wall** and is **thick and strong**.
- It is **closely adherent** to the pelvic cavity walls and is attached along a line from the **iliopectineal line to the inferior border of the pubic bone**.
- The fascia over the **obturator internus** forms the **obturator fascia**, which shows a **linear thickening (tendinous arch)** for the **origin of the levator ani**.
- Below this arch, it relates to the **pudendal canal**.

- The fascia covering the **piriformis** is thin; **sacral nerves** lie outside the fascia, while **gluteal vessels** lie inside it and pierce it when exiting the pelvis

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Parietal Fascia of the Pelvic Floor

- The fascia covers both **surfaces of the pelvic diaphragm**, forming **superior and inferior layers** (the latter called **anal fascia**).

- It is **loosely arranged** between the **peritoneum and pelvic floor**, forming potential spaces for the **distension of bladder, rectum, uterus, and vagina**.

- Because of its **loose areolar nature**, infections may **spread rapidly** within it.

- At certain places, the fascia **condenses to form fibromuscular ligaments** that support pelvic viscera — e.g., **puboprostatic, pubovesical, uterosacral, and rectovesical ligaments**

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Visceral Pelvic Fascia

- Surrounds the **extraperitoneal parts of the pelvic viscera**.

- **Loose and cellular** around distensible organs (bladder, rectum, vagina) but **dense** around non-distensible ones (prostate).

- Attached along a **line from the back of the pubis to the ischial spine**, forming a **continuity between parietal and visceral fascia**

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Pelvic Muscles

Pelvic muscles are divided into two groups:

1. **Piriformis and Obturator Internus** – short lateral rotators of the hip joint.
2. **Levator Ani and Coccygeus** – form the **pelvic diaphragm**, separating the **pelvic cavity from the perineum**

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Levator Ani

The **levator ani** is a broad, thin, sheet-like muscle forming the **greater part of the pelvic diaphragm**. It consists of three main parts:

1. Pubococcygeus Part

- **Origin:** Medial part of the pelvic surface of the pubic body.
- **Insertion:**
  - *Anterior fibers* surround the **prostate (levator prostatae)** in males or **vagina (sphincter urethrovaginalis)** in females and insert into the **perineal body**.
  - *Middle fibers* form the **puborectalis**, looping around the **anorectal junction**, maintaining fecal continence.
  - *Posterior fibers* arise from the anterior half of the **white line** and insert into the **anococcygeal ligament** and **tip of coccyx**

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2. Iliococcygeus Part

- **Origin:** Posterior half of the **tendinous arch (white line)** on obturator fascia and **ischial spine**.
- **Insertion:** Into the **anococcygeal ligament** and **last two pieces of the coccyx**.
- Thinner than the pubococcygeus, it forms the **posterolateral part of the pelvic diaphragm**

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3. Ischiococcygeus (Coccygeus) Part

- Triangular muscle forming the **posterior part of the pelvic diaphragm**.
- **Origin:** Pelvic surface of **ischial spine** and **sacrospinous ligament**.
- **Insertion:** Side of **coccyx** and **fifth sacral vertebra**.

Nerve Supply

- **Levator ani:**
  - Branch from **fourth sacral nerve (S4)**.
  - Branch from **inferior rectal nerve**.

- **Coccygeus:** Branch from **fourth and fifth sacral nerves**

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Actions

1. **Support pelvic viscera** and **fix perineal body**.
2. **Close posterior pelvic outlet** with coccygeus.
3. **Resist intra-abdominal pressure** during coughing, sneezing, defecation, and parturition.
4. **Puborectalis** maintains the **anorectal angle**, preventing premature fecal descent.
5. **Coccygeus** draws coccyx forward after defecation or childbirth

Levator Ani

The **levator ani** is a broad, sheet-like muscle forming the major portion of the **pelvic diaphragm**, which supports the pelvic viscera and maintains continence. It is divided into three parts — **pubococcygeus**, **iliococcygeus**, and **ischiococcygeus (coccygeus)**

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Pubococcygeus Part

- **Origin:** Medial part of the pelvic surface of the pubic body.

- **Insertion:**
    - *Anterior fibers* form **levator prostatae** (in males) or **sphincter urethrovaginalis** (in females), inserting into the **perineal body**.
    - *Middle fibers* form the **puborectalis**, looping around the **anorectal junction** to maintain fecal continence.
    - *Posterior fibers* arise from the anterior half of the **tendinous arch (white line)** and attach to the **anococcygeal ligament** and **tip of coccyx**

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Iliococcygeus Part

- **Origin:** Posterior half of the tendinous arch and the **ischial spine**.
- **Insertion: Anococcygeal ligament** and **sides of the last two coccygeal vertebrae**.
- This part is thinner and forms the **posterolateral portion** of the pelvic diaphragm

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Ischiococcygeus (Coccygeus) Part

- **Shape:** Triangular; partly muscular, partly tendinous.
- **Origin:** Pelvic surface of **ischial spine** and **sacrospinous ligament**.
- **Insertion:** Side of **coccyx** and **fifth sacral vertebra**

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Nerve Supply

- **Levator ani:**
  - Branch from **fourth sacral nerve (S4)**.
  - Branch from **inferior rectal nerve**.
- **Coccygeus:** Branch from **fourth and fifth sacral nerves**

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Actions of Levator Ani and Coccygeus

1. Close the **posterior part of the pelvic outlet**.
2. **Support and elevate pelvic viscera**; fix the **perineal body**.
3. **Resist intra-abdominal pressure** during coughing, sneezing, and defecation, maintaining urinary and fecal continence.
4. **Puborectalis sling** pulls the **anorectal junction** forward to prevent premature fecal passage.
5. **Coccygeus** draws the **coccyx forward** after it is displaced backward in defecation or childbirth

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Relations of the Levator Ani

1. **Superior (pelvic) surface:** Covered with **pelvic fascia**; related to **bladder, prostate, rectum, and peritoneum**.
2. **Inferior (perineal) surface:** Covered with **anal fascia**; forms the **medial boundary of ischioanal fossa**.
3. **Anterior borders:** Separated by a **triangular space** for **urethra and vagina**.
4. **Posterior border:** Free; lies against the **anterior margin of coccygeus**

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Dissection

- Identify **piriformis** on the sacrum and trace it to the **greater sciatic foramen**.
- Expose the **ischial spine**, tracing origins of **coccygeus** and **levator ani**.
- Follow the **tendinous arch** over **obturator internus** to the **pubic body**.
- Note **union of right and left levator ani** at **perineal body**, **anal canal**, and **anococcygeal ligament**.
- Detach **levator ani** from **obturator fascia** to visualize **pudendal canal** and its contents

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Clinical Anatomy

- Weakness or damage to **levator ani** (especially **pubococcygeus**) during **childbirth** causes **pelvic organ prolapse**.
- **Pudendal nerve injury** leads to **incontinence**.
- Chronic strain may cause **levator ani syndrome**, presenting as dull pelvic or rectal pain.
- **Puborectalis dysfunction** can cause **anorectal angle abnormalities**, resulting in **constipation**.

Joints of the Pelvis

The pelvis contains several key articulations that contribute to stability, weight transmission, and limited movement during locomotion and childbirth. The principal joints include the **lumbosacral**, **sacroiliac**, and **sacrococcygeal** joints

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Lumbosacral Joints

- The **joint between L5 and the sacrum** is similar to other intervertebral joints, having a **thick intervertebral disc** (the thickest in the vertebral column), which is slightly wedge-shaped—thicker anteriorly.
- Stability is reinforced by:
    - **Widely spaced articular processes**.
    - **Iliolumbar ligament**, which extends from the **transverse process of L5** to the **iliac crest** and **ala of sacrum**, forming the **lumbosacral ligament**.

- The **lumbosacral (sacrovertebral) angle** measures about **120°**, opening backward.
- Variations include **sacralisation of L5**, **lumbarisation of S1**, **spina bifida**, and **spondylolisthesis**

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Sacrococcygeal and Intercoccygeal Joints

- The **sacrococcygeal joint** is a **secondary cartilaginous joint** between the **apex of the sacrum** and the **base of the coccyx**.
- United by:
  1. A thin **intervertebral disc**.
  2. **Ventral sacrococcygeal ligament** (analogous to anterior longitudinal ligament).
  3. **Deep dorsal sacrococcygeal ligament** (analogous to posterior longitudinal ligament).
  4. **Superficial dorsal sacrococcygeal ligament**, completing the lower end of the sacral canal.
  5. **Lateral sacrococcygeal ligament**, forming the foramen for the **fifth sacral nerve**.
  6. **Intercornual ligament**, connecting cornua of sacrum and coccyx.
- In old age, this joint **ossifies**, while in some people it may be **synovial and mobile**.
- **Intercoccygeal joints** exist in youth but **fuse by age 30**

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Sacroiliac Joint

Type

- **Synovial joint (plane type)**, allowing limited gliding movement.

Articular Surfaces

- Between **auricular surface of sacrum** (fibrocartilage) and **auricular surface of ilium** (hyaline cartilage).

Ligaments

1. **Fibrous capsule:** encloses the joint and is lined by **synovial membrane**.
2. **Ventral sacroiliac ligament:** thickening of the anterior and inferior capsule, attached to **preauricular sulcus**.
3. **Interosseous sacroiliac ligament:** strongest; connects rough non-articular areas of sacrum and ilium, forming the **chief bond of union**.
4. **Dorsal sacroiliac ligament:** covers the interosseous ligament and has two parts —
    - **Short posterior sacroiliac ligament:** from ilium to first two sacral tubercles.
    - **Long posterior sacroiliac ligament:** from **posterior superior iliac spine** to **third and fourth sacral tubercles**, blending laterally with **sacrotuberous ligament**.
5. **Accessory (vertebropelvic) ligaments:**

- **Iliolumbar ligament:** from **L5 transverse process** to **iliac crest**, prevents forward slip of L5.
- **Sacrotuberous ligament:** from **posterior inferior iliac spine and sacrum** to **ischial tuberosity**.
- **Sacrospinous ligament:** from **lateral sacrum** to **ischial spine**, forming the **greater and lesser sciatic foramina**

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Dissection

- Remove **thoracolumbar fascia** and posterior muscles.
- Identify **iliolumbar** and **dorsal sacroiliac ligaments**.
- Cut through **dorsal sacroiliac ligament** to expose the **interosseous ligament**, then open the joint posteriorly.
- Define and cut **ventral sacroiliac ligament** to open the joint anteriorly

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Clinical Anatomy

- **Pregnancy:** Pelvic joints and ligaments become relaxed, increasing movement and reducing stability; may lead to **sacroiliac strain** that persists postpartum.
- **Subluxation** can occur if the hip bones remain rotated after childbirth, causing **low back pain**.

- **Differentiation of pain:**
    - *Lumbosacral lesions* ? tenderness above the **posterior superior iliac spine** (iliolumbar region).
    - *Sacroiliac lesions* ? tenderness **inferomedial to the PSIS** (posterior sacroiliac region).
- **Interosseous sacroiliac ligament** is considered the **strongest ligament in the body**

Factors Providing Stability

The pelvis is primarily designed for **stability** rather than mobility, as it transmits body weight from the **vertebral column to the lower limbs**. Stability is maintained through:

1. **Interlocking articular surfaces** of the sacroiliac joint, which resist shear forces.
2. **Strong interosseous and dorsal sacroiliac ligaments**, the chief stabilizers of the joint.
3. **Vertebropelvic ligaments** — *iliolumbar, sacrotuberous,* and *sacrospinous* — which limit movement and enhance stability.
4. **Partial synostosis** of the sacroiliac joint with advancing age, which further reduces motion and increases rigidity

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Blood Supply

The **sacroiliac joint** receives blood from branches of the **posterior division of the internal iliac artery**, including:

- **Iliolumbar artery**
- **Lateral sacral artery**
- **Superior gluteal artery**

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Nerve Supply

Innervation is provided by:

- **Superior gluteal nerve**
- **Ventral rami and lateral branches of dorsal rami** of the **first and second sacral nerves (S1–S2)**

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Movements

The **sacroiliac joint** allows minimal **anteroposterior rotatory movement** (tilting) around a transverse axis located 5–10 cm below the sacral promontory.

- These slight movements absorb **shock** during jumping or heavy loading.
- During **pregnancy**, the range of movement **temporarily increases** due to **hormonal ligament relaxation**, aiding **fetal delivery**

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Pubic Symphysis

This is a **secondary cartilaginous joint** between the **bodies of right and left pubic bones**.

- Each articular surface is covered by **hyaline cartilage**, with a **fibrocartilaginous disc** in between.
- The joint is reinforced by **ligamentous fibers**, thickest inferiorly to form the **arcuate pubic ligament** and anteriorly forming the **anterior pubic ligament**.
- It allows **slight movement** to **absorb shocks**, and **mobility increases during pregnancy** under hormonal influence

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Mechanism of Pelvis

The **pelvis acts as a weight-transmitting structure**, transferring the **trunk's load to the lower limbs** through the **alae of the sacrum** and the **acetabular region**.

- The weight at the **lumbosacral joint** divides into two components:
  a. One drives the **sacrum downward and backward** between the ilia — resisted by **pubic symphysis ligaments**.
  b. The other pushes the **upper sacrum downward and forward** — resisted by the **middle sacroiliac joint**, where the **posterior wedge-shaped surface** interlocks with the ilium.
- **Rotation of sacrum:** Body weight causes the **anterior sacral segment to tilt downward** and **posterior segment upward**.
  - *Dorsal and interosseous sacroiliac ligaments* prevent anterior tilt.
  - *Sacrotuberous and sacrospinous ligaments* prevent posterior tilt.
  - *Sacroiliac, iliolumbar,* and *pubic ligaments* resist lateral separation of hip bones

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Dissection

1. Identify the **posterior sacroiliac, sacrotuberous, and sacrospinous ligaments**.
2. Trace the **iliolumbar ligament** from the **L5 transverse process to the iliac crest**.
3. Dissect anteriorly to reveal **interosseous and ventral sacroiliac ligaments**.
4. Note **pubic symphysis** anteriorly and **lumbosacral junction** superiorly.

Clinical Anatomy

- **Pregnancy:** Hormonal relaxation increases pelvic joint mobility, causing **sacroiliac strain** and **low back pain**.
- **Pelvic instability** may persist postpartum due to ligament laxity.
- **Subluxation** or **rotation of hip bones** can cause chronic pelvic discomfort.
- **Pubic symphysis diastasis** may occur after difficult labor.
- The **sacroiliac interosseous ligament** is among the **strongest in the human body**, crucial for pelvic stability

Facts to Remember

- **Uterine artery** is an additional branch of the internal iliac artery, exclusive to females.
- The **ventral ramus of L4** contributes to both lumbar and sacral plexuses and is termed **nervus furcalis**.
- **Nerves forming the sacral plexus** lie **outside** the parietal layer of pelvic fascia, while **pelvic blood vessels** lie **inside** it.
- The **interosseous sacroiliac ligament** is the **strongest ligament in the body**, providing chief stability to the pelvic ring.
- **Free anastomoses** between the **superior rectal vein** (portal system) and the **middle and inferior rectal veins** (systemic circulation) explain **metastatic spread to the liver** from genital organ cancers.
- The **sensory supply of ovary and fallopian tube** arises from **T10–T12 spinal segments**

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Clinicoanatomical Problem

Case:
An elderly person was struck and run over by a speeding vehicle.

Questions & Answers:

- **Which bones are likely to be fractured?**
  The **pubic bone** on one side is typically fractured, and the **sacroiliac joint** on the opposite side may be dislocated.
- **What structures form the pelvic ring?**
  The **pelvic ring** is formed by the **pubic rami**, **acetabulum**, **ilium**, **ischium**, **sacrum**, and

pubic symphysis—forming a continuous bony and ligamentous loop.

- **Which viscera are likely to be injured?**
  The **urinary bladder**, **urethra**, **rectum**, and **reproductive organs** (e.g., prostate or uterus) are vulnerable due to their close relation to the pelvic floor and pubic symphysis.

- **What types of joints are the pubic symphysis and sacroiliac joints?**

  - **Pubic symphysis:** *Secondary cartilaginous joint* (amphiarthrosis).

  - **Sacroiliac joint:** *Synovial plane joint*, reinforced by strong ligaments

Clinicoanatomical Problems

1. Pelvic Joint Pathology in Pregnancy
During pregnancy, **relaxin hormone** softens the ligaments of the sacroiliac and pubic symphysis joints. This increases joint mobility and widens the pelvic outlet for childbirth. However, the relaxation also leads to **sacroiliac strain**, **pelvic girdle pain**, and sometimes **subluxation of pubic symphysis**, causing **difficulty in walking or standing**

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2. Distinguishing Sacroiliac from Lumbosacral Lesions

- In **lumbosacral disease**, tenderness appears **above the posterior superior iliac spine** (iliolumbar region).

- In **sacroiliac disease**, tenderness is felt **inferomedial** to the same point (posterior sacroiliac ligament region).

- Movements: lumbosacral lesions restrict **all spinal movements**, whereas sacroiliac lesions cause pain mainly during **forward bending**, when tension on **hamstrings** rotates the hip bones opposite to the sacrum

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3. Pelvic Ring Fracture (Run-over Injury)

A **run-over accident** may cause **fracture of the pubic rami on one side** and **dislocation of the opposite sacroiliac joint**. This disrupts the **pelvic ring**, which is formed by the **pubic rami, acetabulum, ilium, ischium, sacrum, and pubic symphysis**. Such injuries often involve **bladder, urethra, rectum, or genital organs**, demanding urgent management

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4. Sacroiliac Joint Disorders

Chronic **infection (tuberculosis)** or **ankylosing spondylitis** can lead to **fibrous or bony ankylosis** of the sacroiliac joint, causing **low back pain and stiffness**. Radiographic evaluation shows **erosion, sclerosis, or fusion** of articular margins.

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5. Degenerative Osteoarthritis of Pubic Symphysis

Common in **elderly and postmenopausal women**, degeneration of the **fibrocartilaginous disc** at the pubic symphysis produces **pain during walking** or **rising from sitting**, due to reduced shock absorption.

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6. Pelvic Fracture and Urethral Injury (Males)

In males, a **fracture of the pubic arch or dislocation of pubic symphysis** may **tear the membranous urethra**, leading to **extravasation of urine** into the **deep perineal space** and **scrotum**.

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7. Obstetric Implication of Sacral Curvature

Excessive **forward curvature of the sacrum** (sacral kyphosis) may **narrow the pelvic inlet**, causing **obstructed labor**, while a **flat sacrum** can reduce the **pelvic outlet angle**, complicating delivery.

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8. Postpartum Sacroiliac Locking

After childbirth, if the **pelvic ligaments** re-tighten while the **hip bones remain rotated**, the sacroiliac joints may **lock in a rotated position**, causing **chronic low backache** and **pelvic asymmetry**

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9. Referred Pain in Pelvic Disorders

Due to shared segmental innervation (L4–S2), diseases of **pelvic viscera** may refer pain to the **sacroiliac region**, **buttock**, or **posterior thigh**, often mimicking sciatica.

Frequently Asked Questions

Q1. What are the main joints of the pelvis?

The pelvic joints include the **lumbosacral joint**, **sacroiliac joints**, **sacrococcygeal and intercoccygeal joints**, and the **pubic symphysis**

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Q2. What type of joint is the sacroiliac joint?

It is a **synovial plane joint**, allowing minimal gliding movement. Stability is mainly ensured by strong ligaments and the interlocking articular surfaces.

Q3. What type of joint is the pubic symphysis?

A **secondary cartilaginous joint (amphiarthrosis)** between the bodies of the pubic bones united by a fibrocartilaginous disc.

Q4. Which ligaments strengthen the sacroiliac joint?

- **Interosseous sacroiliac ligament** (strongest)
- **Ventral and dorsal sacroiliac ligaments**
- **Iliolumbar, sacrotuberous, and sacrospinous ligaments** (accessory stabilizers)

Q5. What are the main functions of the pelvic joints?
They **transmit body weight** from the vertebral column to the lower limbs, **absorb shocks**, and **provide limited flexibility** for childbirth and locomotion.

Q6. What maintains the stability of the pelvis?

- Interlocking sacroiliac surfaces
- Strong interosseous ligaments
- Pubic symphysis integrity
- Vertebropelvic ligament system (iliolumbar, sacrotuberous, sacrospinous)

Q7. Which ligament is considered the strongest in the body?
The **interosseous sacroiliac ligament**, lying between the sacrum and ilium, is the chief stabilizer of the pelvis.

Q8. What are the movements at the sacroiliac joint?
Only slight **anteroposterior tilting** of the sacrum (nutation and counternutation) occurs, helping absorb forces during posture changes or childbirth.

Q9. What happens to the pelvic joints during pregnancy?
Hormones like **relaxin** cause ligament relaxation, increasing joint mobility to facilitate childbirth but also predisposing to **pelvic girdle pain**.

Q10. What is the mechanism of weight transmission in the pelvis?
Body weight at the **lumbosacral joint** is transmitted through the **sacrum to the ilia**, then to the **acetabula and femurs**. The **sacroiliac and pubic ligaments** prevent displacement during this transfer.

Q11. How can pelvic injury lead to visceral damage?
Fractures of the pelvic ring or dislocation of the pubic symphysis can injure the **urinary bladder, urethra, rectum**, or **reproductive organs**, due to their close anatomic relations.

Q12. What is the clinical difference between lumbosacral and sacroiliac pain?

- **Lumbosacral lesions**: Pain felt **above** the posterior superior iliac spine.
- **Sacroiliac lesions**: Pain **below or inferomedial** to the same point, worsened on forward bending.

Q13. Why do vertebral or pelvic metastases commonly occur?
Because the **valveless Batson's venous plexus** connects pelvic veins with the vertebral venous system, allowing retrograde spread of infection or malignancy.

Q14. What is the importance of the pubic symphysis during delivery?
Its **fibrocartilaginous disc** allows slight separation of the pubic bones, increasing the **anteroposterior diameter** of the pelvic outlet to aid childbirth.

Q15. What is the consequence of injury to the pelvic floor muscles or ligaments?
Damage or stretching (especially of the **levator ani** or **perineal body**) leads to **uterine or vaginal prolapse**, **urinary incontinence**, and **chronic pelvic instability**.

Multiple Choice Questions

1. Which of the following joints is a *secondary cartilaginous joint*?

A. Sacroiliac joint

B. Lumbosacral joint

C. Pubic symphysis

D. Hip joint

Answer: C. Pubic symphysis

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2. The sacroiliac joint is of which type?

A. Hinge joint

B. Plane synovial joint

C. Pivot joint

D. Condyloid joint

Answer: B. Plane synovial joint

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3. The strongest ligament in the human body is the:

A. Sacrotuberous ligament

B. Interosseous sacroiliac ligament

C. Sacrospinous ligament

D. Iliolumbar ligament

Answer: B. Interosseous sacroiliac ligament

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4. Which hormone causes relaxation of pelvic ligaments during pregnancy?

A. Progesterone

B. Relaxin

C. Estrogen

D. Oxytocin

Answer: B. Relaxin

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5. Which ligament converts the greater sciatic notch into a foramen?

A. Sacrotuberous ligament

B. Sacrospinous ligament

C. Interosseous sacroiliac ligament

D. Iliolumbar ligament

Answer: B. Sacrospinous ligament

6. The lumbosacral joint between the fifth lumbar vertebra and the sacrum forms an angle called:

A. Sacrococcygeal angle

B. Lumbosacral angle

C. Pelvic tilt angle

D. Pubic angle

Answer: B. Lumbosacral angle

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7. The pelvic ring is composed of all the following EXCEPT:

A. Pubic symphysis

B. Sacrum

C. Coccyx

D. Acetabulum

Answer: C. Coccyx

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8. Which structure transmits weight from the vertebral column to the lower limbs?

A. Sacrococcygeal joint

B. Sacroiliac joint

C. Pubic symphysis

D. Ischiopubic ramus

Answer: B. Sacroiliac joint

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9. In which joint is movement most limited in adults due to ossification with age?

A. Sacrococcygeal joint

B. Lumbosacral joint

C. Sacroiliac joint

D. Pubic symphysis

Answer: A. Sacrococcygeal joint

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10. During parturition, the diameter of which part of the pelvis increases due to ligament relaxation?

A. Pelvic inlet

B. Pelvic outlet

C. Pelvic cavity

D. None of these

Answer: B. Pelvic outlet

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11. The sacroiliac joint is stabilized by which of the following ligaments?

A. Interosseous sacroiliac ligament

B. Sacrospinous ligament

C. Sacrotuberous ligament

D. All of the above

Answer: D. All of the above

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12. Which of the following is *not* a function of the pelvic joints?

A. Weight transmission

B. Locomotion

C. Speech

D. Shock absorption

Answer: C. Speech

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13. Pain in sacroiliac disease is typically felt:

A. Over the sacral promontory

B. Inferomedial to the posterior superior iliac spine

C. Over the iliac crest

D. Over the pubic symphysis

Answer: B. Inferomedial to the posterior superior iliac spine

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14. Which joint of the pelvis shows nutation and counternutation movements?

A. Pubic symphysis

B. Sacroiliac joint

C. Sacrococcygeal joint

D. Lumbosacral joint

Answer: B. Sacroiliac joint

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15. Which of the following structures passes through the lesser sciatic foramen?

A. Piriformis muscle

B. Obturator internus tendon
C. Sciatic nerve
D. Superior gluteal artery
Answer: B. Obturator internus tendon

Viva Voce

Q1. What are the main joints forming the pelvic ring?
The **lumbosacral**, **sacroiliac**, and **pubic symphysis** joints together form the **pelvic ring**, which transmits body weight to the lower limbs

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Q2. What type of joint is the sacroiliac joint?
It is a **synovial plane joint**—its movements are minimal but crucial for stability and shock absorption.

Q3. What type of joint is the pubic symphysis?
A **secondary cartilaginous joint** (amphiarthrosis), united by a fibrocartilaginous disc.

Q4. Name the ligaments strengthening the sacroiliac joint.

- **Ventral and dorsal sacroiliac ligaments**
- **Interosseous sacroiliac ligament** (strongest)
- **Sacrotuberous** and **sacrospinous ligaments** (accessory stabilizers)

Q5. Which ligament forms the greater and lesser sciatic foramina?
The **sacrospinous ligament** (with the sacrotuberous ligament).

Q6. What is the function of the interosseous sacroiliac ligament?
It is the **chief bond of union** between the sacrum and ilium, resisting separation and shear forces.

Q7. Which movements occur at the sacroiliac joint?
Small **anteroposterior rotations** (nutation and counternutation) of the sacrum relative to the ilium.

Q8. What happens to these joints during pregnancy?
The hormone **relaxin** softens pelvic ligaments, increasing mobility of the **sacroiliac** and **pubic symphysis** joints to facilitate childbirth.

Q9. What is the function of the pubic symphysis?
It acts as a **shock absorber**, allowing slight movement between the two pubic bones during walking and childbirth.

Q10. Which ligaments resist rotation of the sacrum?

- **Interosseous** and **dorsal sacroiliac ligaments** resist **forward tilt**.
- **Sacrotuberous** and **sacrospinous ligaments** resist **backward tilt**.

Q11. What forms the main weight-transmitting path in the pelvis?
From **L5 vertebra ? sacrum ? ilium ? acetabulum ? femur**.

Q12. What is the lumbosacral angle?
The angle between the **long axis of L5** and the **sacral base**, normally about **120°**, opening backward.

Q13. What are common variations of the lumbosacral region?

- **Sacralisation of L5**

- **Lumbarisation of S1**
- **Spina bifida**
- **Spondylolisthesis**

Q14. Which artery supplies the sacroiliac joint?
Branches of the **superior gluteal**, **iliolumbar**, and **lateral sacral arteries**.

Q15. Which nerves supply the sacroiliac joint?

- **Superior gluteal nerve**
- **Ventral rami and dorsal branches of S1 and S2**

Q16. What are the clinical implications of sacroiliac joint weakness?
Can lead to **low back pain**, **sacroiliac strain**, or **pelvic instability**, especially after childbirth.

Q17. What happens to the sacrococcygeal joint with age?
It often **ossifies**, reducing mobility.

Q18. What is the mechanism of pelvic stability?
Mutual **wedging of the sacrum** between the hip bones, secured by strong ligaments and the **pubic symphysis**.

Q19. Which structures can be injured in pelvic fractures?
The **bladder, urethra, rectum, and reproductive organs**, due to their proximity to the pelvic floor.

Q20. Why is the sacroiliac joint more stable than mobile?
Because it is primarily designed for **weight transmission** rather than movement; its rough interlocking surfaces and strong ligaments prevent displacement.