Epithelium

The upper two-thirds is lined by columnar epithelium but the lower third with stratified columnar epithelium.

Blood supply of rectum and anal canal

Arterial supply is from:

(i) Superior rectal — branch of inferior mesenteric artery
(ii) Middle rectal — branch of internal iliac artery
(iii) Inferior rectal — branch of the internal iliac artery

Venous drainage

The rectum and upper third of the anal canal drain via superior rectal veins to portal circulation. The lower third of the anal canal drains on both sides into inferior rectal veins (systemic system).

Lymphatics of rectum and anal canal

The lymphatics from the rectum and upper third of the anal canal drain into internal iliac and pre-aortic nodes, while the lower third of the anal canal drains into the superficial inguinal nodes.

Nerve supply of rectum and anal canal

The rectum and the upper two-thirds of the anal canal are supplied by autonomic through pelvic plexuses. The lower third of the anal canal is supplied by inferior haemorrhoidal nerve.

Development of rectum and anal canal

The rectum and the upper two-thirds of the anal canal are developed from the dorsal part of cloaca (endoderm). The lower one-third of the anal canal is developed from the anal pit (ectoderm).

PELVIC MUSCLES

The most important muscle supporting the pelvic organs is the levator ani which forms the pelvic floor. The small muscles of the perineum also have got some contribution in the support.

PELVIC FLOOR
(Syn: Pelvic diaphragm)

Pelvic floor is a muscular partition which separates the pelvic cavity from the anatomical perineum. It consists of three sets of muscles on either side — pubococcygeus, iliococcygeus and ischiococcygeus. These are collectively called levator ani. Its upper surface is concave and slopes downwards, backwards and medially and is covered by parietal layer of pelvic fascia. The interior surface is convex and is covered by anal fascia. The muscle with the covering fascia is called the pelvic diaphragm.

Origin

Each levator ani arises from the back of the pubis, rami, from the condensated fascia covering the

---

Fig. 1.18. Levator ani muscles viewed from above
obturator internus (white line) and from the inner surface of the ischial spine.

**Insertion**

From this extensive origin, the fibres are inclined downwards, backwards and medially to be inserted in the midline from before backwards to the vagina (lateral and posterior walls), perineal body, and anal canal (lateral and posterior walls), anococcygeal body, lateral borders of the coccyx and lower part of the sacrum (Fig. 1.18).

**Gaps**

There are two gaps in the midline: (1) The anterior one is called hiatus urogenitalis which is bridged by the muscles and fascia of urogenital triangle and pierced by the urethra and vagina. (2) The posterior one is called hiatus rectalis, transmitting the rectum.

**Structure in relation to pelvic floor**

The superior surface is related with the following:

1. Pelvic organs from anterior to posterior are bladder, vagina and rectum.
2. Pelvic cellular tissues between the pelvic peritoneum and upper surface of the levator ani which fill all the available spaces.
3. Uterus lies on the floor in relation to the lateral vaginal fornix. The uterine artery lies above and the vaginal artery lies below it.
4. Pelvic nerves
   - The inferior surface is related to the anatomical perineum.

**Nerve supply**

- The muscle is supplied by the 3rd and 4th sacral nerve, inferior rectal nerve and a perineal branch of pudendal nerve (S2, S3, S4).

**Functions**

1. To support the pelvic organs — The pubovaginalis which forms a 'U' shaped sling, supports the vagina which in turn supports the other pelvic organs — bladder and uterus. Weakness or tear of this sling during parturition is responsible for prolapse of the organs concerned.
2. To maintain intra-abdominal pressure by reflexly responding to its changes.
3. Facilitates anterior internal rotation of the presenting part when it presses on the pelvic floor.

(4) Puborectalis plays an ancillary role action of the external anal sphincter.
(5) Ischiococcygeus helps to stabilise the sacroiliac and sacrococcygeal joints.
(6) To steady the perineal body.

**Pelvic floor during pregnancy and parturition**

During pregnancy, levator muscles hypertrophy, become less rigid and more distensible. Due to water retention, it swells up and sags down. In the second stage, the pubovaginals and puborectalis relax and the levator ani is drawn up over the advancing presenting part in the second stage. Failure of the levator ani to relax at the crucial moment may lead to extensive damage of the pelvic structures. The effect of such a displacement is to elongate the birth canal which is composed solely of soft parts below the bony outlet. The soft canal has got deep lateral and posterior walls and its axis is in continuation with the axis of the bony pelvis.

**PERINEUM**

**Anatomical perineum**

Anatomically, the perineum is bounded above by the inferior surface of the pelvic floor, below by the skin between the buttocks and thighs. Laterally, it is bounded by the ischiopubic rami, ischial tuberosities and sacrotuberous ligaments and posteriorly, by the coccyx. The diamond-shaped space of the bony pelvic outlet is divided into two triangular spaces with the common base formed by the free border of the urogenital diaphragm. The anterior triangle is called the urogenital triangle which fills up the gap of the hiatus urogenitalis and is important from the obstetric point of view. The posterior one is called the anal triangle.

**Urogenital triangle**

It is pierced by the terminal part of the vagina and the urethra. The small perineal muscles are situated in two compartments formed by the ill-defined fascia. The compartments are superficial and deep perineal pouch. The superficial pouch is formed by the deep layer of the superficial perineal fascia (Colles fascia) and inferior layer of the urogenital diaphragm (perineal membrane). The contents are (Fig. 1.3 & 1.19) superficial transverse perinei (paired), bulbocavernosus covering the bulb of the vestibule, ischiocavernosus (paired) covering the crura of the clitoris and the Bartholin's gland (paired). The deep perineal pouch is formed by the
**PERINEUM**

1. **Ans.** is ‘d’ i.e., Membranous urethra [Ref: BDC Vol II 6/e p. 361]

<table>
<thead>
<tr>
<th>Features</th>
<th>Superficial perineal space</th>
<th>Deep perineal space</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Situation</strong></td>
<td>Superficial to perineal membrane</td>
<td>Deep to perineal membrane</td>
</tr>
<tr>
<td><strong>Boundaries</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) Superficial</td>
<td>Colles’ fascia</td>
<td>Perineal membrane</td>
</tr>
<tr>
<td>b) Deep</td>
<td>Perineal membrane</td>
<td></td>
</tr>
<tr>
<td>c) Lateral</td>
<td>Ischiopubic rami</td>
<td></td>
</tr>
<tr>
<td>d) Posterior</td>
<td>Closed by union of the perineal membrane with Colles’ fascia</td>
<td>Closed by the union of perineal membrane with superior fascia of the urogenital diaphragm</td>
</tr>
<tr>
<td>e) Anterior</td>
<td>Open and continuous with the spaces of scrotum, penis and anterior abdominal wall</td>
<td>Closed by the union of perineal membrane with superior fascia of the urogenital diaphragm at transverse perineal ligament.</td>
</tr>
</tbody>
</table>

**Contents**

1. **Root of penis,** made up of two crura and one bulb.
2. **Muscles**
   - a) Sphenicter urethrae
   - b) Deep transverse perinei
3. **Nerves**
   - a) Three sets of branches from the perineal nerve—posterior scrotal nerve to the bulb and muscular branches.
   - b) Perineal nerve from the posterior cutaneous nerve of thigh.
4. **Vessels**
   - a) Branch of perineal artery
   - b) Deep artery of the penis
5. **Glands and ducts**
   - a) Bulbourethral glands in males

2. **Ans.** is ‘a’ i.e., Sphincter urethrae muscle [Ref: BDC Vol II 6/e p. 361]

3. **Ans.** is ‘c’ i.e., Root of penis [Ref: BDC Vol II 6/e p. 361, 364]
   - o Root of penis (crura and bulb of penis) lies in superficial perineal space.
   - o Dorsal nerve of penis, bulbourethral gland and sphincter urethrae are contents of deep perineal space.

4. **Ans.** is ‘d’ i.e., Membranous urethra [Ref: BDC Vol II 6/e p. 361, 364]

5. **Ans.** is ‘c’ i.e., Bulbospongiosus [Ref: BDC Vol II 6/e p. 362]
   - o Superficial muscles of perineum (lie in superficial perineal pouch) are ischiocavernosus, bulbospongiosus and superficial transverse perinei.
   - o Deep muscles (lie in deep perineal pouch) are sphincter urethrae, deep transverse perinei, and in females, compression urethrae and sphincter urethrovaginalis.

6. **Ans.** is ‘a’ i.e., Ischiocavernous [Ref: BDC Vol II 6/e p. 362]

7. **Ans.** is ‘a’ i.e., Superficial transverse perinei; ‘b’ i.e., Bulbospongiosus & ‘c’ i.e., Ischiocavernosus [Ref: BDC Vol II 6/e p. 362]
8. Ans. is ‘d’ i.e., Communications with the other side Posteriorly [Ref: Clinical anatomy 5/e p. 786]
   - Both ischeorectal fossae are connected to each other posteriorly behind anal canal through a horse-shoe recess.

9. Ans. is ‘b’ i.e., Inferior rectal nerve [Ref: Last’s 12/e p. 311-12, 316-17, 168; Gray’s 40/e p. 1094, 1154-58; BDC Vol II 5/e p. 335; Snell’s 7/e p. 422-26]
   - During dissection of ischeorectal fossa, inferior rectal, pudendal, posterior scrotal or labial nerve & vessels along with perforating branches of S2-S3 and perineal branches of S4 nerve may get damaged.

10. Ans. is ‘c’ i.e., Colle’s fascia [Ref: Gray’s Anatomy 40/e p. 1093-97; Last Anatomy 11/e p. 328-29, 333; Keith Moore 5/e p. 441; BDC Vol II 4/e p. 332]
    - Urogenital diaphragm consists of:­
      i) Two muscles: Sphincter urethrae and deep transverse perinei (also called transverse perinei profundus).
      ii) Two fascia: Inferior fascia of urogenital diaphragm (perineal membrane) and superior fascia of urogenital diaphragm.

11. Ans. is ‘d’ i.e., Transverse perenii superficialis [Ref: Has been explained]

    - If the membranous urethra is ruptured below the perineal membrane, extravasated urine collects in the superficial perineal pouch which is closed on all sides except in front.
    - On further accumulation, the urine passes forwards deep to dartos muscle and fascia of penis, and appears in the anterior abdominal wall in the superficial inguinal space between fascia of scarpa and aponeurosis of external oblique.

13. Ans. is ‘d’ i.e., S2-S3 roots [Ref: BDC Vol II 6/e p. 363,364]
    - Pudendal nerve arises from sacral plexus from S,S, S, nerve roots (ventral divisions).

14. Ans. is ‘d’ i.e., Main nerve supply of pelvic organs [Ref: BDC Vol II 6/e p. 363,364]
    - Pudendal nerve arises from S2S354 and is a mixed nerve (motor + sensory).
    - It enters the gluteal region through greater sciatic notch and leaves it through lesser sciatic notch to enter pudendal canal.
    - Pudendal nerve is the chief nerve of perineum and external genitalia (not pelvic organs).

15. Ans. is ‘a’ i.e., Pudendal nerve [Ref: BDC Vol II 6/e p. 363,364]

**PELVIS**

16. Ans. is ‘b’ i.e., Uterine; ‘c’ i.e., Obturator & ‘d’ i.e., Internal Pudendal [Ref: BDC Vol II 6/e p. 420,421]
    - Branches of anterior division of internal iliac artery are: (i) Superior vesical, (ii) Middle rectal, (iii) Inferior vesical (in males), (iv) Internal pudendal, (v) Vaginal (in females), (vi) Uterine (in females), (vii) Obturator, and (viii) Inferior gluteal.
    - Branches of posterior division are: (i) IIiolumbar, (ii) Lateral sacral, and (iii) Superior gluteal.

17. Ans. is ‘c’ i.e., Superior vesical [Ref: BDC Vol II 6/e p. 420,421]

18. Ans. is ‘b’ i.e., Inferior gluteal artery, ‘c’ i.e., Superior vesical artery & ‘d’ i.e., Obturator artery [Ref: BDC Vol II 6/e p. 420,421]

19. Ans. is ‘a’ i.e., Superior gluteal artery [Ref: BDC Vol II 6/e p. 420,421]

20. Ans. is ‘d’ i.e., Anterior rami of S, S, S, S [Ref: BDC Vol II 6/e p. 423]
    - Pelvic splanchnic nerve arise from ventral (anterior) rami of S, S, S, S.

21. Ans. is ‘a’ i.e., Ventral rami of S, S, S, & ‘d’ i.e., Pelvic Splanchnic nerve [Ref: BDC Vol II 6/e p. 423]
    - Preganglionic parasympathetic fibers to pelvic organs are conveyed by pelvic splanchnic nerve (S, S, S).

22. Ans. is ‘c’ i.e., Appendix
    - Pelvic splanchnic nerve supply following pelvic viscer where inferior hypogastric plexus:­
      i) Middle rectal plexus: Supplies the rectum.
      ii) Prostatic plexus: Supplies prostate, seminal vesicles, and ejaculatory ducts.
      iii) Vesical plexus: Supplies urinary bladder, terminal part of ureter and seminal vesicles.
      iv) Utero-vaginal plexus: Supplies uterus, uterine tube, ovaries and erectile tissue of vestibule.

23. Ans. is ‘d’ i.e., On the side of rectum [Ref: BDC Vol II 6/e p. 346]
    - Location of inferior hypogastric plexus:
**Content**

**Mus.** = Ischæocavernous  
Bulbospongiosus  
Sup. from. perinei

Vessels = Post. Scrotal  
N. to bulb  
Muscular Branch

**Vessels = Post. Scrotal**  
Deep from. perinei

- Dorsal N. of penis
- Muscular
- Arterey to penis  
Int. pudended  
Arterey stems  
inoret.

Glands = Greater vestibular gland in female  
Duets of bulbourethral  
in male  
→ Bulbospongious gland in male.

Applying  
Penile Meathrica erepti = Scrotal & penile  
Erepture

Membranous Meathrica = Deep extravaginal  
Hypelying  
Free floating Meathrica.
Q. Superficial and deep perineal space

- UB
- Prostate
devator ani
- Dorsal N. of penis
- Int. Pudendal Ar.
- Perineal memb.
- Bulbourethral gland
- Bulbospongiosus
- Post. & Crural vcss. & N.
- Colles fascia
- Deep Dorsal N. of clitoris
- Deep. Tr. penii
- Int. Pudendal Ar.

Sup. — Sup. to perineal memb. — Deep — Deep to S. M.

Sup. = Colles —> Perineal memb.
Deep = Perineal memb. —> Sup. fascia of urogenital diaphragm
Post = Colles penis men. —> Perineum + Sup. fascia closes

Aut = Continue rectum space —> Aut. = Closed by
of scrotum & Aut. 4 bar wall.

Wound/fascia & Perineum memb.
4. **Posterior scrotal**: These supply the skin of the medial part of the urogenital region and the medial part of the posterior two-thirds of the scrotum.
5. The mucous membrane of urethra is supplied by the perineal branch of the pudendal nerve.

**Clinical Anatomy**

The cutaneous nerves of perineum are derived from the sacral nerves (S2, S3, S4). These segments also supply parasymathetic fibres to the pelvic organs. Diseases of these organs may, therefore, cause referred pain in the perineum.

**Superficial Fascia**

It is made up of two layers as in the lower part of the anterior abdominal wall. The superficial fatty layer is continuous with the superficial fascia of the surrounding regions. The deep membranous layer or Colles’ fascia is attached posteriorly to the posterior border of perineal membrane, and on each side to pubic arch below the crus penis. Anteriorly, it is continuous with the fascia of the scrotum containing the dartos fascia of the penis, and with the membranous layer of the superficial fascia of the anterior abdominal wall or fascia of Scarpa.

**Deep Fascia**

It is also made up of one-layer that lines the deep perineal space inferiorly.

This fascia of the urogenital diaphragm is thick. It is also called the perineal membrane.

**Boundaries**

The urogenital region is bounded posteriorly by the interischial line which usually overlies the posterior border of the transverse perineal muscles. Anteriorly and laterally, it is bounded by symphyses pubis and ischiopubic rami.

Urogenital region extends superficially to encompass the scrotum and root of penis.

Urogenital region is divided into two parts by strong perineal membrane.

Above it: Deep perineal space.

Below it: Superficial perineal space.

**Deep Perineal Space**

*Previous view*: Space between superior fascia of urogenital diaphragm and perineal membrane that contained urethra and urethral sphincter.

*Present view*: Now the urethral sphincter is known to be contained inside the urethra itself (within). The urogenital diaphragm does not exist. The deep perineal space is thin and open above (Fig. 28.12 and Table 28.1).
ABDOMEN AND PELVIS

Urinary bladder
Prostate
Levator ani
Obturator internus
Bulbourethral gland
Proximal urethral sphincter
Pelvic fascia
Dorsal nerve of penis
Deep transversus perinei
Membranous urethra with rhabdosphincter
Intrabulbar fossa
Superficial perineal space
Bulb of penis

Fig. 28.12: Coronal section through the urogenital region of the male perineum

Table 28.1: Deep perineal space

<table>
<thead>
<tr>
<th>Features</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Definition</strong></td>
<td>This is the thin space of the urogenital region situated deep to the perineal membrane. Contributes to pelvic floor.</td>
<td>Same (Fig 28.19)</td>
</tr>
<tr>
<td><strong>Boundaries</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Superficial</td>
<td>Perineal membrane (Fig. 28.12)</td>
<td>Same</td>
</tr>
<tr>
<td>b. Deep</td>
<td>Open above</td>
<td>Same</td>
</tr>
<tr>
<td>c. On each side</td>
<td>Ischiopubic rami</td>
<td>Same</td>
</tr>
<tr>
<td>d. Anteriorly</td>
<td>Gap between perineal membrane and inferior pubic ligament</td>
<td>Same</td>
</tr>
<tr>
<td><strong>Contents</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Tubes</td>
<td>Part of urethra</td>
<td></td>
</tr>
<tr>
<td>a. Sphincter urethrae or distal urethral sphincter within the wall of urethra</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Deep transversus perinei. Mainly skeletal muscle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Muscles</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Dorsal nerve of penis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Muscular branches from perineal nerve</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Artery of penis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Stems of origin of four branches namely, artery to the bulb of penis, urethral artery, deep and dorsal arteries of penis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Nerves on each side</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Vessels</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Bulbourethral glands</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Boundaries</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Deep aspect</strong>: Endopelvic fascia of pelvic floor.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Superficial aspect</strong>: Perineal membrane. Between these two fascial layers lie deep transverse perinei; superficial to the proximal urethral sphincter mechanism and pubourethralis (Fig. 28.12).</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The previous view was that sphincter urethrae extended between the two ischiopubic rami and was pierced by urethra but as of now the sphincter urethrae lies within wall of urethra as distal urethral sphincter. These muscles do not form a true diaphragmatic sheet as such because fibres from the several parts extend through the visceral outlet in the pelvic floor into the lower reaches of the pelvic cavity. (There is no sphincter urethrae outside urethra. So, no urogenital diaphragm exists).

**Contents**
Urethra, vessels and nerve to the bulb of penis, bulbourethral glands, deep dorsal vessels and nerves of penis, posterior scrotal vessels and nerves.

**Deep Transverse Perinei**
It forms an incomplete sheet of skeletal muscle extending across the urogenital triangle from the medial aspects of the ischiopubic rami. Posteriorly, the sheet
is attached to perineal body where its fibres decussate with those of opposite side.

Anteriorly, the muscles are deficient and the visceral structures pass across the endopelvic fascia and the perineal membrane. Some fibres pass to the deep part of external anal sphincter posteriorly and sphincter urethrae (contained within the urethra).

Together with superficial transverse perinei the muscles act to tether (hold) the perineal body in median plane. The muscle gives dynamic support for pelvic viscera.

Supplied by perineal branches of pudendal nerve and vessels.

Distal Urethral Sphincter Mechanism

Consists of intrinsic striated and smooth muscles of urethra and the pubourethralis component of levator ani which surrounds the urethra at the point of maximum concentration of those muscles. It surrounds the membranous urethra in the male.

Smooth muscle fibres also reach up to the lowest part of the neck of the bladder and between the two, fibres lie on the surface of prostate.

Bulk of fibres surround the membranous urethra. There are circularly disposed striated muscle fibres called raphe sphincter which forms main part of distal urethral sphincter mechanism (Fig. 28.12). Some fibres are attached to inner surface of the ischiopubic ramus, forming compressor urethrae.

Perineal membrane is almost triangular membrane:

- Laterally attached to periosteum of ischiopubic rami.
- Apex attached to arcuate ligament of pubis, where the membrane is attached to this arcuate ligament of pubis, it is particularly thick and is called transverse perineal ligament.
- Posterior border is fused to deep parts of perineal body and is continuous with the fascia over deep transversus perinei.

Perineal membrane (Fig. 28.13) is crossed by or pierced by:

- Urethra 2–3 cm behind the inferior border of pubic symphysis.
- Artery to the bulb of penis.
- Duct of bulbourethral gland.
- Muscular branches to muscles of Fig. 28.14.
- Deep artery of the penis, urethral artery.
- Dorsal artery and dorsal nerves of penis.
- Posterior scrotal vessels and nerves, anterior to transverse perinei.

Fig. 28.13: Structures piercing the perineal membrane (male)

Fig. 28.14: Superficial muscles of the male perineum

Superficial perineal space is given in Tables 28.2 and 28.3.

CLINICAL ANATOMY

- The membranous part of the male urethra is the narrowest and least dilatable part of the urethra. In inexperienced hands, it is likely to be ruptured during instrumentation. The urethra can also rupture in accidental injuries.
- Rupture of the urethra leads to extravasation of urine, which may be superficial or deep. In superficial extravasation, the urine spreads downwards deep to the membranous layer of the superficial fascia. It first fills the superficial perineal space; and then the scrotum, the penis and the lower part of the anterior abdominal wall. It is prevented from going to the ischiococcygeal fossa or the thigh by the firm attachment of the membranous layer of superficial fascia to their boundaries (Fig. 28.15).
- In deep extravasation, the urine spreads upwards into the extraperitoneal space of the pelvis around bladder and prostate into the anterior abdominal wall (Fig. 28.16).
FEMALE PERINEUM

It comprises of female external genital organs and female urogenital region.

FEMALE EXTERNAL GENITAL ORGANS/PUDENUM/VULVA

Pudendum includes:
- Mons pubis (Fig. 28.17)
- Labia majora
- Labia minora
- Clitoris
- Vestibule of the vagina
- Bulbs of the vestibule
- Greater vestibular glands

Mons Pubis

Mons pubis is a rounded eminence present in front of the pubic symphysis. It is formed by accumulation of subcutaneous fat. It is covered with pubic hair. The hair-bearing area has a nearly horizontal upper limit.

Labia Majora

Labia majora are two thick folds of skin enclosing fat. They form the lateral boundaries of the pudenda cleft. Their outer surfaces are covered with hair, and the inner surfaces are studded with large sebaceous glands. The larger anterior ends are connected to each other below the mons pubis to form the anterior commissure. The skin connecting the less prominent posterior ends of the labia is known as the posterior.

Fig. 28.17: The female external genital organs