GLUTEAL REGION & LOWER LIMB

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1. **GLUTEAL REGION** (G. gloutos, buttocks)
   transitional region between the trunk and free lower limbs / Posterior surface of pelvis

- lies posterolateral to the bony pelvis and proximal end of the femur.

- **Bounded:**
  - Superiorly by iliac crest
  - Medially by intergluteal cleft
  - Inferiorly by skin fold (groove) underlying the buttock ➔ *gluteal fold* (L. sulcus glutealis)
  - Laterally by a line joining anterior superior iliac spine (ASIS) & great trochanter.

*Superficial fascia* is thick, especially in women. It has large quantities of fat. It contributes to the prominence of the buttoc.

*Deep fascia* is continuous below with the deep fascia of the thigh *fascia lata* (L. large).

On the lateral surface of the thigh, fascia lata becomes thick ➔ forms a strong, wide band: *iliotibial tract*.

Iliotibial tract ➔ passes down the lateral side of the thigh to attach to the proximal end of the tibia in the leg.

**MUSCLES @ GLUTEAL REGION**

In two groups

1. Superficial group (larger muscles) 2. Deep group (smaller muscles)

Many of the important nerves in the gluteal region are in the plane between the superficial and deep groups of muscles.

**SUPERFICIAL GROUP**

*Gluteus maximus* is the largest and most superficial of the 3 muscles in this group.

Gluteus maximus ➔ **Extensor of the hip joint + thigh**/ **External rotation of hip**

supports the extended knee through the iliobibial tract as it inserts on iliobibial tract (also on gluteal tuberosity on femur). It is an important muscle in maintaining the trunk in the erect posture.

Under gluteus maximus, gluteus medius and below gluteus minimus.

**DEEP GROUP**

mainly lateral rotators of the femur at the hip joint

One of the lateral rotators of thigh ➔ *piriformis muscle* is an important muscle as a landmark.

An additional muscle @ gluteal region ➔ *tensor fasciae latae* ➔ stabilizes the knee in extension by acting on a specialized longitudinal band of deep fascia (iliotibial tract)

Usually 3 bursae are associated with the gluteus maximus: 1. Trochanteric bursa: This bursa is commonly the largest of the bursae formed in relation to bony prominences and is present at birth. Other such bursae appear to form as a result of postnatal movement. 2. Ischial bursa 3. Gluteofemoral bursa.

Two arteries enter the gluteal region from the pelvic cavity through the greater sciatic foramen ➔ inferior gluteal artery & superior gluteal artery (both branches of *internal iliac artery*). They have important collateral anastomoses with branches of the femoral artery. The gluteal veins are tributaries of the internal iliac veins that drain blood from the gluteal region.

2. **THIGH & POPLITEAL FOSSA**

region of the free lower limb between the gluteal, abdominal, and perineal regions proximally & knee region distally

Vessels & nerves passing between thigh & leg pass through the popliteal fossa posterior to the knee joint.

The thigh is divided into 3 compartments by intermuscular septa between posterior aspect of femur & fascia lata. Each compartment has its own muscles, nerves, and arteries.

1) **Anterior compartment of thigh** contains muscles that mainly extend the leg at the knee joint;
2) **Medial compartment of thigh** consists of muscles that mainly adduct the thigh at the hip joint;
3) **Posterior compartment of thigh** contains muscles that mainly extend the thigh at the hip joint and flex the leg at the knee joint.

**Anterior compartment of thigh** 1. sartorius & 2. four large quadriceps femoris muscles (rectus femoris, vastus lateralis, vastus medialis, and vastus intermedius). Iliopsoas (combination of two muscles: iliaus & psoas major) also considered as a thigh muscle. Iliopsoas muscle is formed by these two muscles

Iliopsoas ➔ Chief flexor of thigh. **The most powerful of the hip flexors** with the longest range

Quadriceps femoris ➔ Extensor of knee. **Great extensor of the leg**
Sartorius: tailor's muscle” (L. sartus, patched or repaired), is long and ribbon-like. It is the most superficial muscle in the anterior compartment of thigh. It descends obliquely through the thigh and descends inferiorly as far as the medial side of the knee. With an average of 61 cm. of length, sartorius is the longest muscle of the body (The shortest muscle of the body is stapedius in the ear, See @ http://www.health-pictures.com/muscle/images/Stapedius-muscle.jpg).

The sartorius (@ anterior compartment), gracilis (@ medial compartment), and semitendinosus (@ posterior compartment) muscles attach to the tibia in a three-pronged pattern on the tibia, so their combined tendons of insertion are often termed the pes anserinus (Latin for 'goose foot').

The sartorius, the longest muscle in the body, acts across two joints. It flexes the hip joint and participates in flexion of the knee joint. It also weakly abducts the thigh and laterally rotates it. The actions of both sartorius muscles bring the lower limbs into the cross-legged sitting position.

**Medial compartment of thigh** six muscles. All except pectineus (innervated by femoral nerve + obturator nerve: dual innervation), and part of the adductor magnus, (innervated by sciatic nerve), are innervated by obturator nerve. These muscles are adductors of the thigh.

**Posterior compartment of thigh** contains three large muscles termed the "hamstrings." All are innervated by the sciatic nerve.

Features of hamstring muscles
- Proximal attachment to ischial tuberosity
- Deep to the gluteus maximus.
- Distal attachment to the bones of the leg.
- Act on two joints, producing
- Extension @ hip joint & flexion @ knee joint.
- Innervation by tibial division of the sciatic nerve

The sciatic nerve innervates muscles in the posterior compartment of thigh, the femoral nerve innervates muscles in the anterior compartment of thigh, and the obturator nerve innervates most muscles in the medial compartment of thigh (Kaan’s note: F.O.S. anterior-medial-posterior compartments of the thigh).

**POPLITEAL FOSSA**

An important area of transition between the thigh and leg formed between muscles in the posterior compartments of thigh and leg

**BORDERS**
- Superolaterally by the biceps femoris (superolateral border).
- Superomedially by the semimembranosus, lateral to which is the semitendinosus (superomedial border).
- Inferolaterally and inferomedially by the lateral and medial heads of the gastrocnemius, respectively (inferolateral and inferomedial borders).
- Posteriorly by skin and popliteal fascia (roof).

**CONTENTS**
1) Termination of the small saphenous vein
2) Popliteal arteries and veins and their branches and tributaries
3) Tibial and common fibular nerves
4) Posterior cutaneous nerve of thigh
5) Popliteal lymph nodes and lymphatic vessels

**3. LEG** (L. regio cruris)

Part between the knee and ankle joint.
- Includes most of the tibia (shin bone) and fibula (calf bone).
- Connects the knee and foot.

Often laypersons refer incorrectly to the entire lower limb as “the leg.”

Two intermuscular septa pass from its deep aspect to be attached to the fibula. These, together with the interosseous membrane, divide the leg into 3 compartments “anterior, lateral, and posterior”; each having its own muscles, blood supply, and nerve supply.
Inferiorly, two band-like thickenings of the fascia form retinacula that bind the tendons of the anterior compartment muscles before and after they cross the ankle joint, preventing them from bowstringing anteriorly during dorsiflexion of the joint.

**Anterior compartment of leg (Dorsiflexor compartment)**

Four muscles - tibialis anterior, extensor hallucis longus, extensor digitorum longus, and fibularis tertius. Pass and insert anterior to the transversely oriented axis of the ankle joint ➔ **dorsiflexors of the ankle joint** ➔ elevating the forefoot and depressing the heel [Collectively they dorsiflex the foot at the ankle joint, extend the toes, and invert the foot].

The nerve associated with the anterior compartment of the leg ➔ deep fibular (peroneal) nerve. It is one of the two terminal branches of the common fibular nerve, arising between the fibularis longus muscle and the neck of the fibula in the lateral compartment. A lesion of this nerve results in an inability to dorsiflex the ankle (footdrop).

**Lateral compartment of the leg (Evertor compartment)**

- smallest (narrowest) leg compartment
- two muscles: fibularis longus and fibularis brevis
- both evert the foot (turn the sole outward)
- innervated by the superficial fibular nerve ➔ a branch of the common fibular nerve.

**Posterior compartment of the leg (Plantarflexor compartment)**

- largest of the three leg compartments,
- organized into two groups, superficial and deep, by the transverse intermuscular septum.
- muscles mainly plantarflex and invert the foot and flex the toes.
- all are innervated by the tibial nerve.

The gastrocnemius muscle is the most superficial of the muscles in the posterior compartment and is one of the largest muscles in the leg. It originates from two heads, one lateral and one medial.

At the knee, the facing margins of the two heads of the gastrocnemius form the lateral and medial borders of the lower end of the popliteal fossa. In the upper leg, the heads of the gastrocnemius combine to form a single elongate muscle belly, which forms much of the soft tissue bulge identified as the calf.

In the lower part of the leg, the muscle fibers of the gastrocnemius converge with those of the deeper soleus muscle to form the calcaneal tendon ➔ attaches to the calcaneus (heel) of the foot. The gastrocnemius plantarflexes the foot at the ankle joint and can also flex the leg at the knee joint.

The large size of the gastrocnemius and soleus muscles is a human characteristic that is directly related to our upright stance. These muscles are strong and heavy because they lift, propel, and accelerate the weight of the body when walking, running, jumping, or standing on the toes.

The calcaneal tendon (L. tendo calcaneus, Achilles tendon) is the most powerful (thickest and strongest) tendon in the body. Approximately 15 cm in length, it is a continuation of the flat aponeurosis formed halfway down the calf where the bellies of the gastrocnemius terminate.

Plantarflexion is a powerful movement (four times stronger than dorsiflexion) produced over a relatively long range (approximately 50° from neutral) by muscles that pass posterior to the transverse axis of the ankle joint.

The nerve associated with the posterior compartment of leg is the tibial nerve, a major branch of the sciatic nerve that descends into the posterior compartment from the popliteal fossa.

**4. FOOT**

Region of the lower limb distal to the ankle joint

Divided into the ankle, the metatarsus, and the digits. There are five digits consisting of the medially positioned great toe (digit I) and four more laterally placed digits, ending laterally with the little toe (digit V). The foot has a superior surface (dorsum of foot) and an inferior surface (sole).

The skin of the dorsum of the foot is much thinner and less sensitive than skin on most of the sole. The subcutaneous tissue is loose deep to the dorsal skin; therefore, edema (G. oidēma, a swelling) is most marked over this surface, especially anterior to and around the medial malleolus.
**Flexor retinaculum** a strap-like layer of connective tissue attaches above to the medial malleolus and below and behind to the inferomedial margin of the calcaneus.

Two extensor retinacula strap the tendons of the extensor muscles to the ankle region and prevent tendon bowing during extension of the foot and toe.

**Plantar aponeurosis** thickening of deep fascia in the sole of the foot.

The plantar fascia of the deep fascia has a thick central part and weaker medial and lateral parts. The thick, central part plantar fascia forms the strong plantar aponeurosis, longitudinally arranged bundles of dense fibrous connective tissue investing the central plantar muscles. It resembles the palmar aponeurosis of the palm of the hand but is tougher, denser, and elongated.

Of the 20 individual muscles of the foot, 14 are located on the plantar aspect, 2 are on the dorsal aspect, and 4 are intermediate in position. From the plantar aspect, muscles of the sole are arranged in four layers within four compartments. Despite their compartmental and layered arrangement, the plantar muscles function primarily as a group during the support phase of stance, maintaining the arches of the foot.

Intrinsic muscles of the foot originate and insert in the foot. There are two intrinsic muscles - extensor digitorum brevis and extensor hallucis brevis - on the dorsal aspect of the foot. All other intrinsic muscles are on the plantar side of the foot in the sole where they are organized into four layers. Intrinsic muscles mainly modify the actions of the long tendons and generate fine movements of the toes.

The foot is supplied by the tibial, deep fibular, superficial fibular, sural, and saphenous nerves:

- All five nerves contribute to cutaneous or general sensory innervation;
  - tibial nerve innervates all intrinsic muscles of the foot except for the extensor digitorum brevis, which is innervated by the deep fibular nerve;
  - deep fibular nerve often also contributes to the innervation of the first and second dorsal interossei.

**Cutaneous innervation of the foot**

Medially by the saphenous nerve, which extends distally to the head of 1st metatarsal.

Superiorly (dorsum of foot) by the superficial (primarily) and deep fibular nerves.

 Inferiorly (sole of foot) by the medial and lateral plantar nerves; the common border of their distribution extends along the 4th metacarpal and toe or digit. (This is similar to the pattern of innervation of the palm of the hand.)

Laterally by the sural nerve, including part of the heel.

Posteriorly (heel) by medial and lateral calcaneal branches of the tibial and sural nerves, respectively.

5. **LUMBAR, SACRAL AND COCCYGEAL PLEXUSES**

- Lumbar, sacral and coccygeal plexuses, closely related to one another.
- Formed by the anterior rami (branches) of the lumbar, sacral and coccygeal spinal nerves.

Sensory & motor innervation of the lower limb by “Lumbo-sacral-plexus” = Lumbar plexus+Sacral plexus.

Lumbosacral plexus is formed by spinal roots of L1-S4.

**Lumbar plexus (ANTERIOR RAMI OF L1+L2+L3+L4 - CONTRIBUTIONS FROM L5 + T12 SPINAL NERVES**

- upper component of lumbosacral plexus
- lies in the posterior abdominal wall anterior to the lumbar transverse processes.
- formed by anterior rami of upper 4 lumbar spinal nerves with contributions from the fifth lumbar spinal nerve) and contribution of subcostal nerve (T12)
- formed in the lumbar region, within the psoas major muscle.
- Is @ lateral to the intervertebral foramina of lumbar region.

Lumbar nerve roots are situated in the posterior part of the psoas muscle.

**BRANCHES OF THE LUMBAR PLEXUS**

⇒ iliouinguinal and iliohypogastric nerves
⇒ Genitofemoral nerve
⇒ Lateral femoral cutaneous nerve (Skin on the anterolateral surface of the thigh)
⇒ Femoral nerve
⇒ Obturator nerve

L4 + L5 give rise to the lumbosacral trunk which joins sacral nerves to form the sacral plexus.
**Femoral nerve** - largest branch of the lumbar plexus
- both motor and sensory.
- emerges from the lateral border of the psoas major.
- passes deep to the inguinal ligament/iliopubic tract to the anterior thigh.
- supplying the flexors of the hip and extensors of knee. Skin on anterior+lateral thigh/medial leg & foot

Saphenous nerve ➔ largest cutaneous branch of the femoral nerve.
innervates skin of medial aspects of leg and foot.

**Obturator nerve** - Adductor muscles of the thigh
- emerges from the medial border of the psoas major and passes into the lesser pelvis.
  - Sensory innervation ➔ skin on the superior medial thigh.
  - The motor innervation ➔ the adductor muscles of the thigh

**Sacral plexus** (ANTERIOR RAMI OF S1+S2+S3+S4 - CONTRIBUTIONS FROM LUMBOSACRAL TRUNK)
- The sacral plexus on each side is formed by the anterior rami of S1 to S4, and the lumbosacral trunk (L4 and L5).
- The plexus is formed in relation to the anterior surface of the **piriformis muscle**, which is part of the posterolateral pelvic wall.

**BRANCHES OF THE SACRAL PLEXUS**
- Superior and inferior gluteal nerves  [Inferior gluteal nerve: Nerve of the **gluteus maximus muscle**]
- Sciatic nerve
- Nerve to quadratus femoris
- Posterior cutaneous nerve of the thigh
- Nerve to obturator internus
- **Pudendal nerve**  *In Latin it means 'that of which one should be ashamed'* a derivion of pudere, to be ashamed.
  - All of these branches of the sacral plexus leave the pelvis through the greater sciatic foramen. Except for the superior gluteal nerve, they all emerge inferior to the piriformis.

**Sciatic nerve** - largest nerve in the body
- continuation of the main part of the sacral plexus.
- lies just deep to gluteus maximus midpoint between ischial tuberosity & greater trochanter.
- formed as the large anterior rami of spinal nerves L4-S3 converge on the anterior surface of the piriformis.
- supplies no structures in the gluteal region.
- supplies the posterior thigh muscles that flex the knee and all muscles that work the ankle and foot.
- also supplies the articular branches to all joints of the lower limb.

When giving gluteal intramuscular (I.M.) **injections**, it is safest to use the upper outer quadrant of the gluteal region.
In the thigh, the sciatic nerve divides into its two major branches:
1. Common fibular nerve (common peroneal nerve) 2. Tibial nerve.

Common fibular (peroneal) nerve divides into superficial and deep peroneal nerves.

**Anterior compartment of leg muscles**: Deep peroneal nerve

**Lateral compartment of leg muscles**: Superficial peroneal nerve

**Posterior compartment of leg muscles & muscles @ sole of the foot**: Tibial nerve
- The pudendal nerve is the main nerve of the perineum and the chief sensory nerve of the external genitalia. The pudendal nerve forms anteriorly to the lower part of piriformis muscle from ventral divisions of S2 to S4.
- The superior gluteal nerve supplies muscles in the gluteal region-gluteus medius, gluteus minimus, and tensor fasciae latae (tensor of fascia lata) muscles. Of all the nerves that pass through the greater sciatic foramen, the superior gluteal nerve is the only one that passes above the piriformis muscle.

**Coccygeal plexus**
- A minor contribution from S4 and is formed mainly by the anterior rami of S5 and Co (first coccygeal spinal nerve, others are rudimentary) , which originate inferiorly to the pelvic floor.
6. VESSELS OF THE LOWER LIMB

FEMORAL ARTERY

The femoral artery, distal continuation of the external iliac artery, is the primary artery of the lower limb. It begins as the external iliac artery passes under the inguinal ligament. It traverses the femoral triangle and the adductor canal of Hunter. It enters the femoral triangle deep to the midpoint of the inguinal ligament (midway between the ASIS and the pubic tubercle), lateral to the femoral vein on the anterior aspect of the upper thigh. The femoral artery passes vertically through the femoral triangle and then continues down the thigh in the adductor canal. It leaves the canal by passing through the adductor hiatus in the adductor magnus muscle. It ends at the opening in the adductor magnus muscle, passing through the adductor canal and entering the popliteal space to become the popliteal artery behind the knee.

The femoral artery is palpable in the femoral triangle just inferior to the inguinal ligament midway between the anterior superior iliac spine and the pubic symphysis.

Deep artery of thigh

The largest branch of the femoral artery and the chief artery to the thigh (profunda femoris artery), which originates from the lateral side of the femoral artery in the femoral triangle and ends as the fourth perforating artery. Posterior compartment of thigh has no artery of its own. Profunda femoris artery supplies the posterior compartment of the thigh.

POPLITEAL ARTERY

The popliteal artery is the major blood supply to the leg and foot and enters the posterior compartment of leg from the popliteal fossa behind the knee. The popliteal artery passes into the posterior compartment of leg between the gastrocnemius and popliteus muscles. As it continues inferiorly it passes under the tendinous arch formed between the fibular and tibial heads of the soleus muscle and enters the deep region of the posterior compartment of leg where it immediately divides into an anterior tibial artery and a posterior tibial artery. The anterior tibial artery passes forward through the aperture in the upper part of the interosseous membrane and enters the anterior compartment of leg. It continues inferiorly onto the dorsal aspect of the foot. When crossing the line between the two malleoli it becomes dorsalis pedis artery.

The posterior tibial artery descends through the deep region of the posterior compartment of leg on the superficial surfaces of the tibialis posterior and flexor digitorum longus muscles. It passes through the tarsal tunnel behind the medial malleolus and continues into the sole of the foot. The posterior tibial artery enters the sole and bifurcates into lateral and medial plantar arteries. The lateral plantar artery joins with the terminal end of the dorsalis pedis artery (the deep plantar artery) to form the deep plantar arch. Branches from this arch supply the toes. Deep veins in the posterior compartment generally follow the arteries.

OBTURATOR ARTERY

The obturator artery originates as a branch of the internal iliac artery in the pelvic cavity and enters the medial compartment of thigh through the obturator canal. It accompanies the obturator nerve through the obturator canal (i.e., the upper part of the obturator foramen).

Veins in the thigh consist of superficial and deep veins. Deep veins generally follow the arteries and have similar names. Superficial veins are in the superficial fascia, interconnect with deep veins, and do not generally accompany arteries. The largest of the superficial veins in the thigh is the great saphenous vein. Many small veins curve around the medial and lateral aspects of the thigh and ultimately drain into the great saphenous vein. Superficial veins from the lower part of the back of the thigh join the small saphenous vein in the popliteal fossa.

FEMORAL VEIN

The femoral vein is the continuation of the popliteal vein proximal to the adductor hiatus. It ascends through the thigh, lying at first on the lateral side of the artery, then posterior to it, and finally on its medial side. The femoral vein enters the femoral sheath ends posterior to the inguinal ligament, where it becomes the external iliac vein. The femoral vein receives the deep vein of the thigh, the great saphenous vein, and other tributaries.

GREAT SAPHENOUS VEIN
The **great saphenous vein** originates from a venous arch on the dorsal aspect of the foot and ascends along the medial side of the lower limb to the proximal thigh. Here it passes through the saphenous ring in deep fascia covering the anterior thigh to connect with the femoral vein.

**SMALL SAPHENOUS VEIN**

The **small saphenous vein** originates from a venous arch on the dorsal aspect of the foot and ascends along the lateral side of the lower limb. It ends by draining into popliteal vein at or above the knee joint. Popliteal vein continues as femoral vein proximally.

**PERINEUM (Apışarası, edep bölgesi, apışlık)**

Pelvic cavity is between the pelvic inlet and pelvic outlet. It continues above with the abdominal cavity until diaphragm. Below the pelvic cavity is covered by a region called perineum. The perineum is made by muscles, fasciae, spaces, vessels and nerves. Perineal region is at the bottom of the trunk. It is a dimaond-shaped region between thighs. Its peripheral boundary is the pelvic outlet. Its ceiling is the pelvic diaphragm.

The perineal region extends between the pubic symphysis and coccyx. It is pierced by three natural holes in females, two in males. The common holes in both sexes are anus and external urethral orifice. The females also have ostium vaginae. The pudendal nerve (S2-S4) and internal pudendal artery are the major nerve and artery of the perineal region.

**The borders of the perineum are as follows:** [1]

**ANTERIOR BORDER:** PUBIC SYMPHYSIS – INFERIOR (ARCUATE) PUBIC LIGAMENT

**POSTERIOR BORDER:** TIP OF COCCYX & SACROTUBEROUS LIGAMENT [actually this lig. forms the posterolateral border]

**LATERAL BORDER:** RIGHT & LEFT ISCHIAL TUBEROSITIES

Posterior point: Tip of the coccyx

The pubic symphysis, ischial tuberosities and coccyx can be palpated on the patient.

**The perineal region is divided into two triangular areas by an imaginary line.** This imaginary line is between the ischial tuberosities. The area anterior to this line is called urogenital triangle (subregion). It is related to openings of the urogenital system. The urogenital triangle is bordered by ischiopubic rami laterally. Anteriorly it is bordered by the inferior margin of the pubic symphysis. The urogenital triangle has the external genital organs. The urogenital hiatus allows the passage of urethra and vagina.

The area posterior to this line is called **anal triangle** (subregion). The anal triangle includes the same structures for both sexes. The two triangles are not on the same plane. The urogenital triangle is oriented in the horizontal plane. The anal triangle is tilted upward at the intertubercular line. It faces more posteriorly.

**PELVIC DIAPHRAGM DIAPHRAGMA PELVIS**

Pelvic diaphragm is a V-shaped structure at the base of the pelvic cavity. It is formed by mm.levatores ani, mm.coccygei, m. sphincter ani externus and pelvic fascia. The pelvic diaphragm separates the pelvic organs from the ischioanal fossa. This fossa is located on each side of the base of the pelvis.

**M. levator ani** forms most of the pelvic diaphragm. It is a wide and thin muscle. The roof of the perineum is mostly formed by this muscle. It separates the pelvic cavity above from the perineum below.

**INNERVATION:** Inferior rectal branch of pudendal nerve

**M. coccygeus**

**External anal sphincter muscle [M. sphincter ani externus]** surrounds the lower part of the anal canal. It works voluntarily. **INNERVATION:** Pudendal nerve

Pelvic diaphragm is critical in resisting the increased intraabdominal pressure. The weight of the mobile intestines, in the erected posture, sits mainly on the pubic bones and perineal body at the centre of the perineum. Perineal body is a fibromuscular structure. Anococcygeal ligament is between anus and coccyx. It also gets some weight of the intestines.

**UROGENITAL DIAPHRAGM DIAPHRAGMA UROGENITALE**

The urogenital diaphragm is under the pelvic diaphragm. It is the superficial diaphragm in the pelvic region. It is located in the urogenital triangle. It is a layer of muscles and fasciae extending between the right and left ischio-pubic rami. The urogenital diaphragm is pierced by membraneous urethra in males and by urethra and vagina in females.