# Abdominal Wall and Cavity

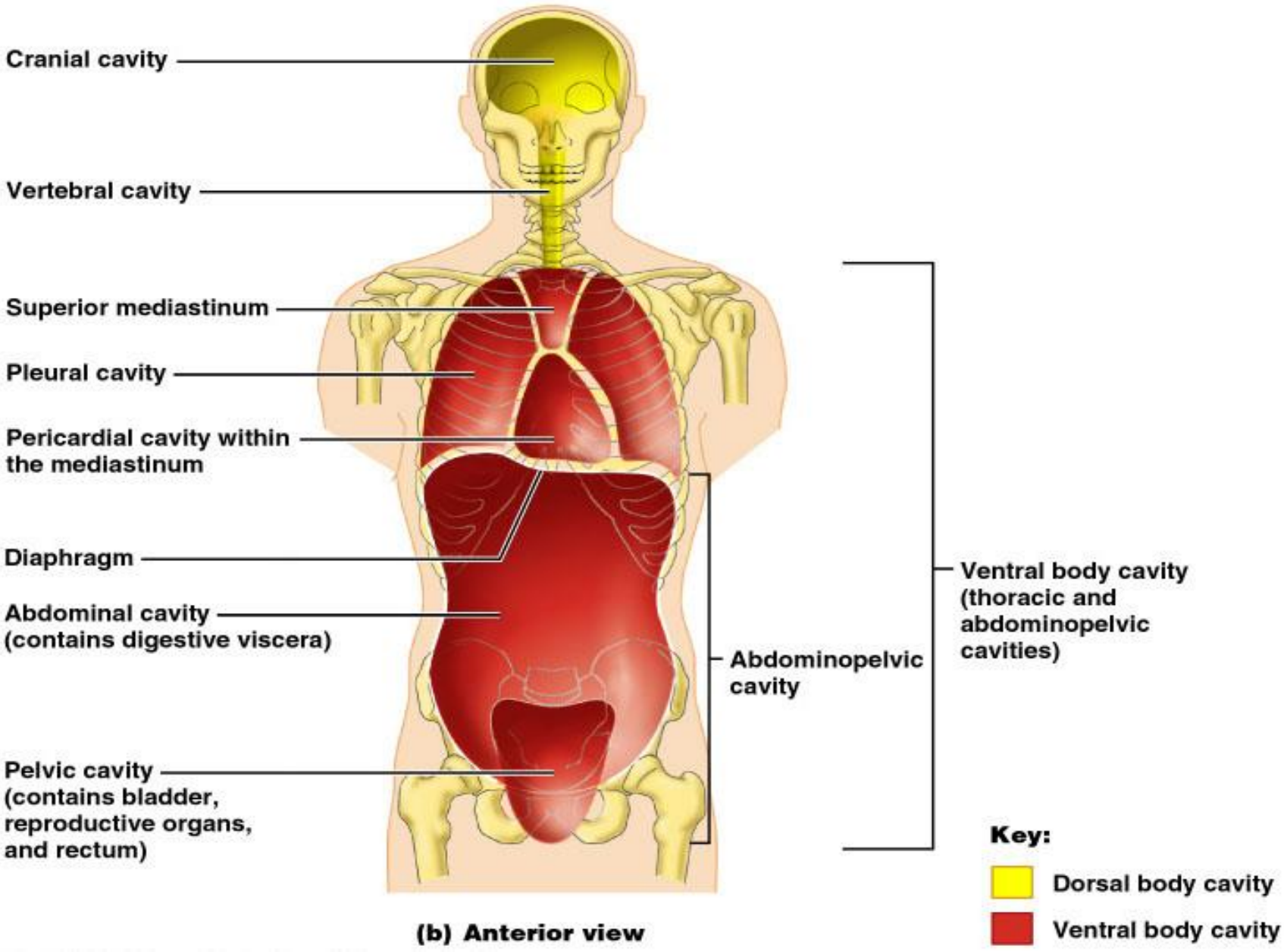
Dr. ALSHIKH YOUSSEF Haiyan

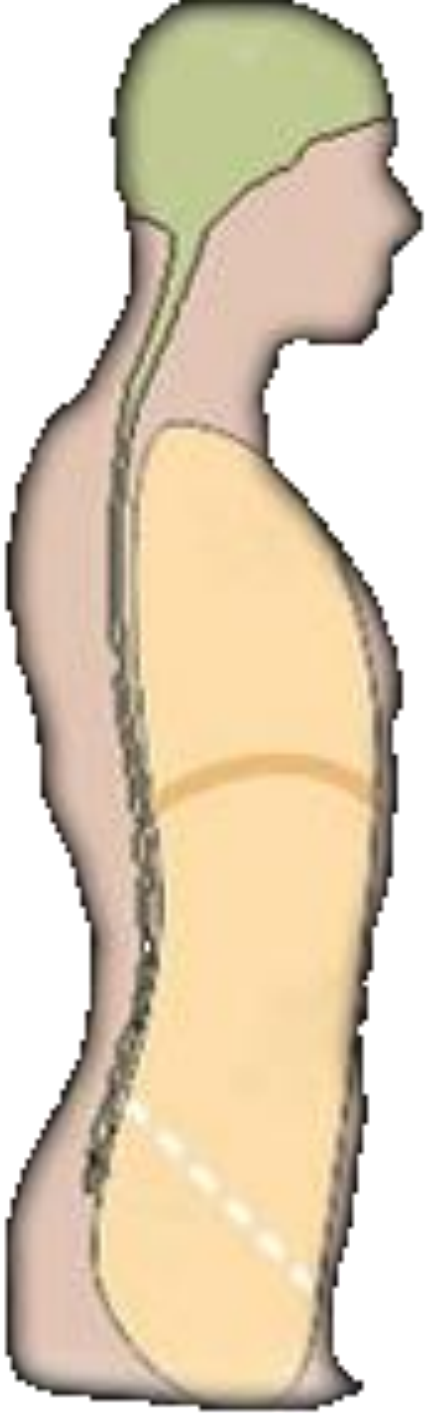
# BOUNDARIES

# Bony Landmarks around Abdomen

- Iliac crest
- Anterior superior iliac spine (ASIS)
- Pubic crest
- Inguinal ligament
- Costal margin
- Xiphoid process

# Body Cavities



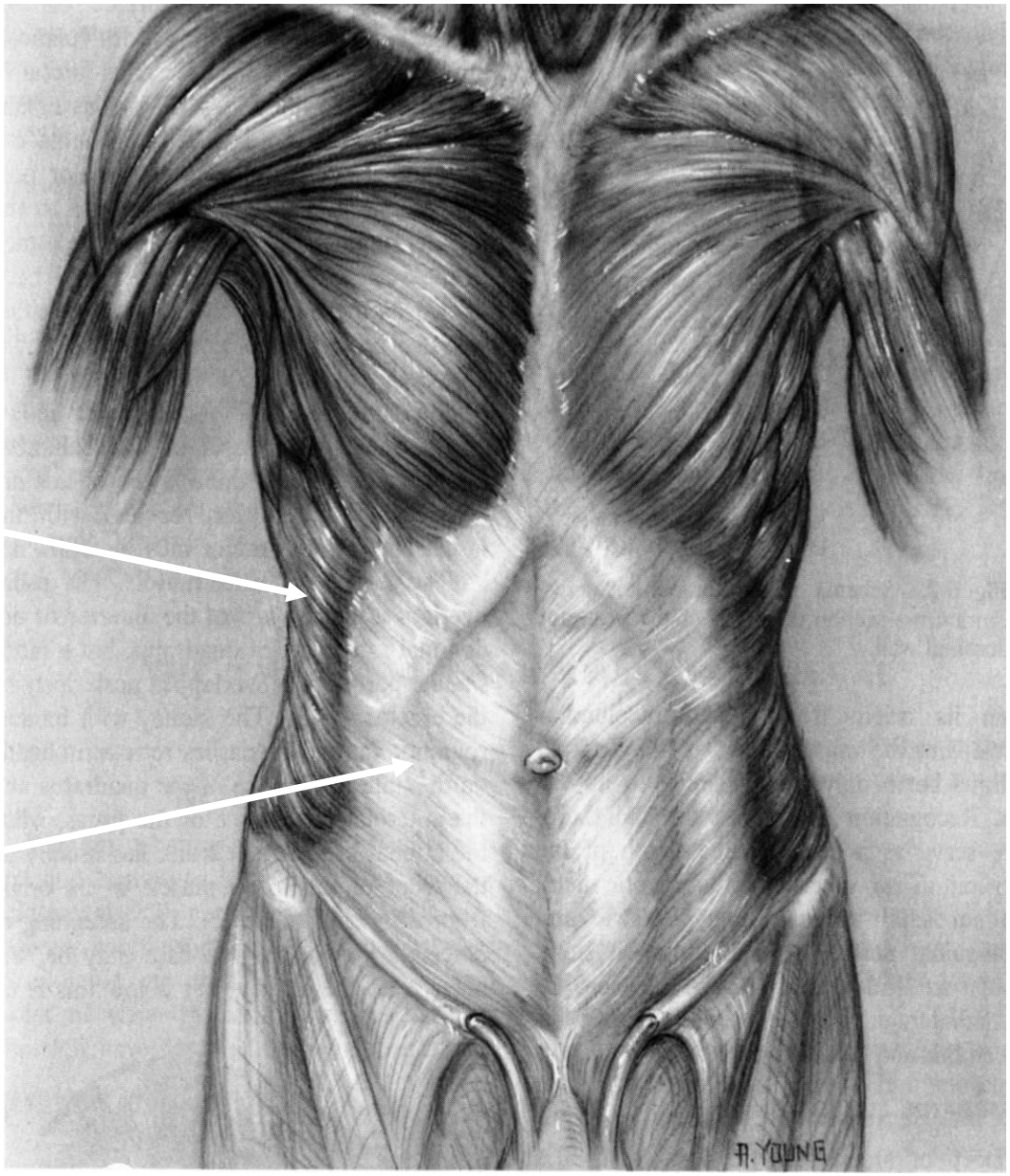


# Abdominopelvic Cavity

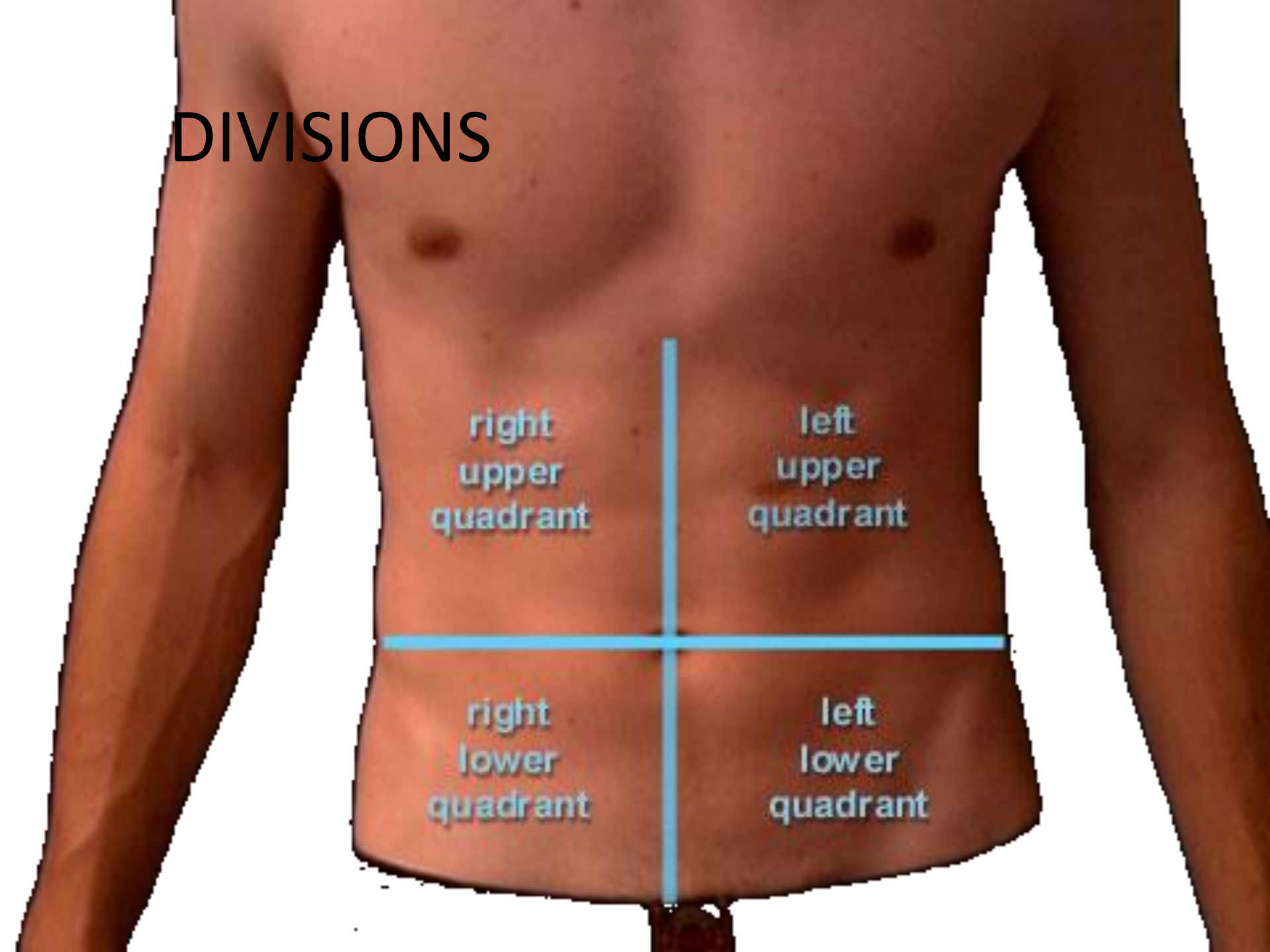
Abdominal Cavity –

Pelvic Cavity –

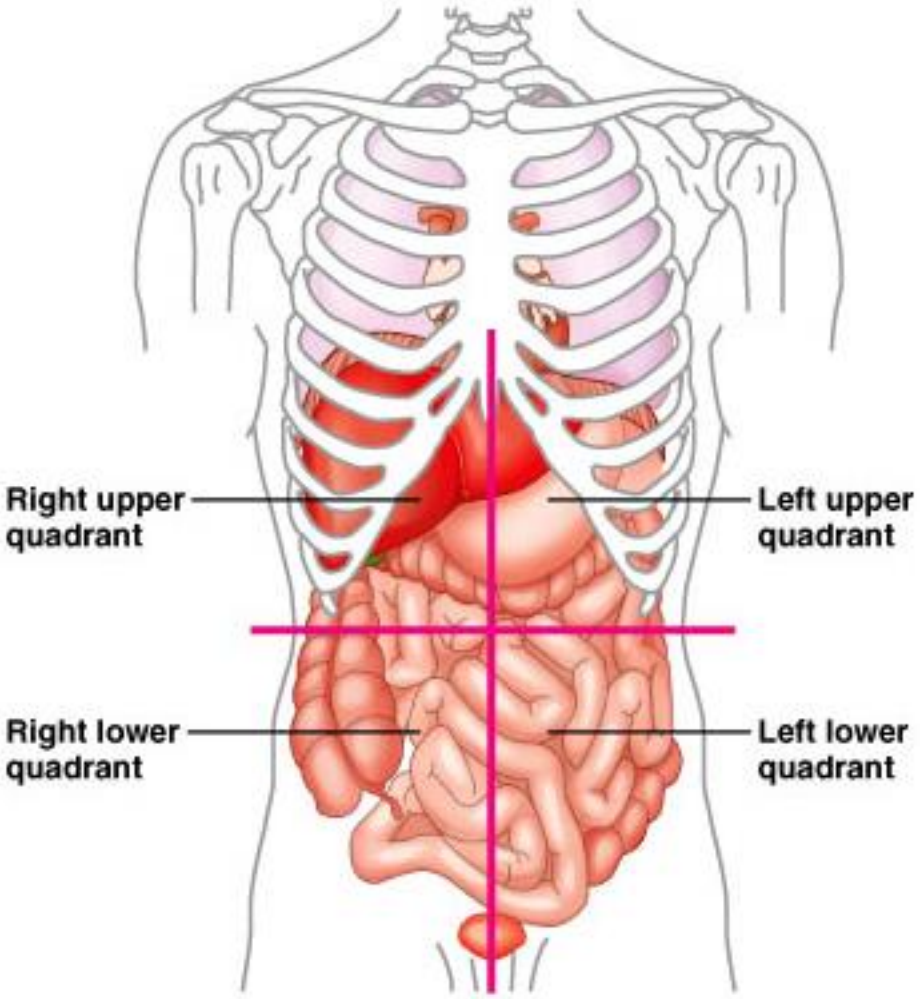
P242-fig.4.21


A. YOUNG

# DIVISIONS


right
upper
quadrant
left
upper
quadrant
right
lower
quadrant
left
lower
quadrant

# Abdominal Quadrants

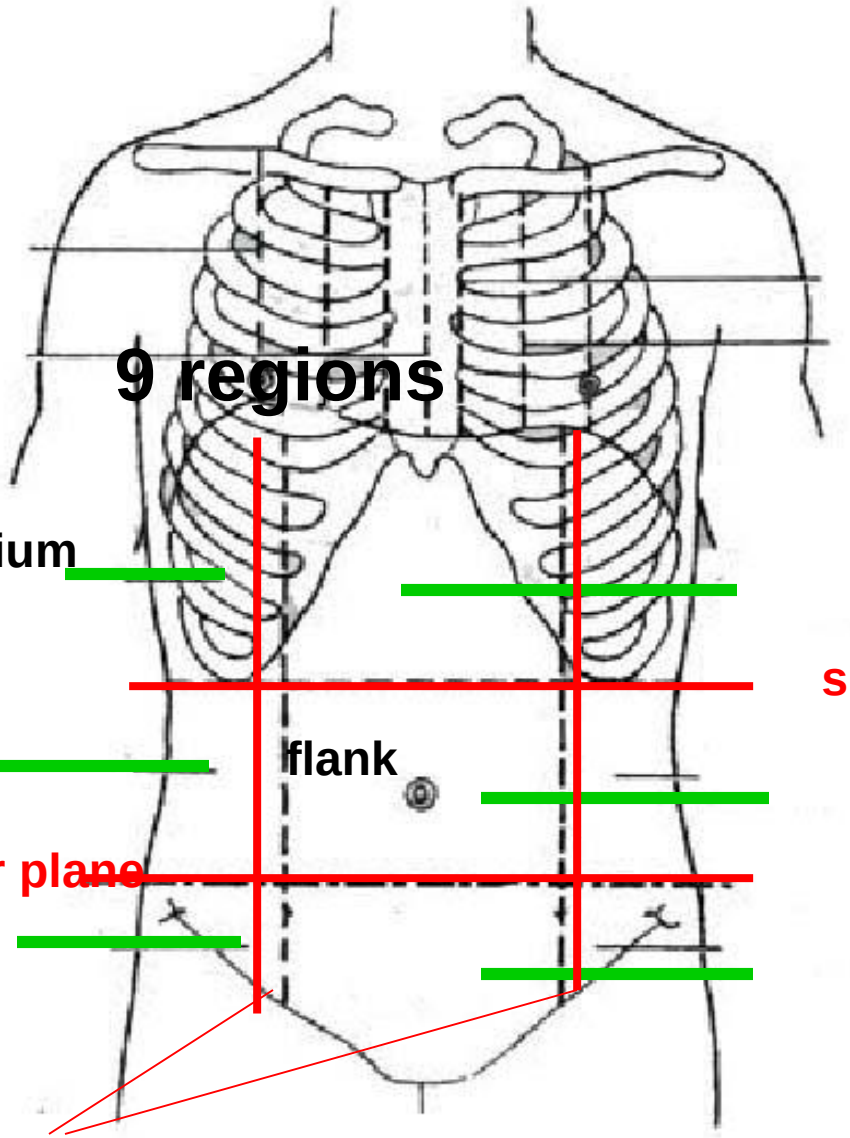


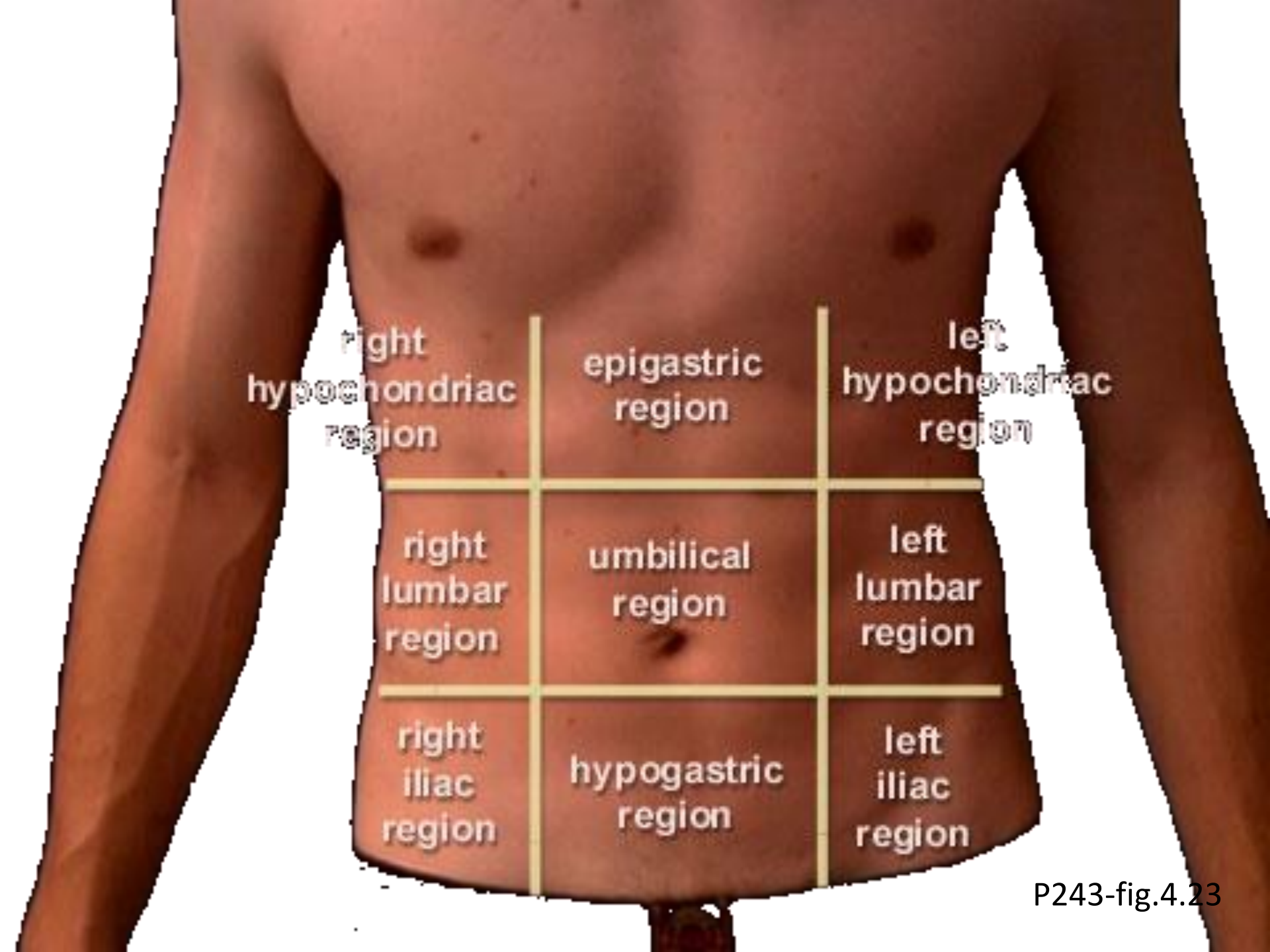
# Applied Anatomy

- Abdomen is divided into 9 regions via four planes:
  - Two horizontal [sub-costal (10th) and trans – tubercules plane] (L5).
  - Two vertical (midclavicular planes). –
- They help in localization of abdominal signs and symptoms

# Abdomen

## Boundaries



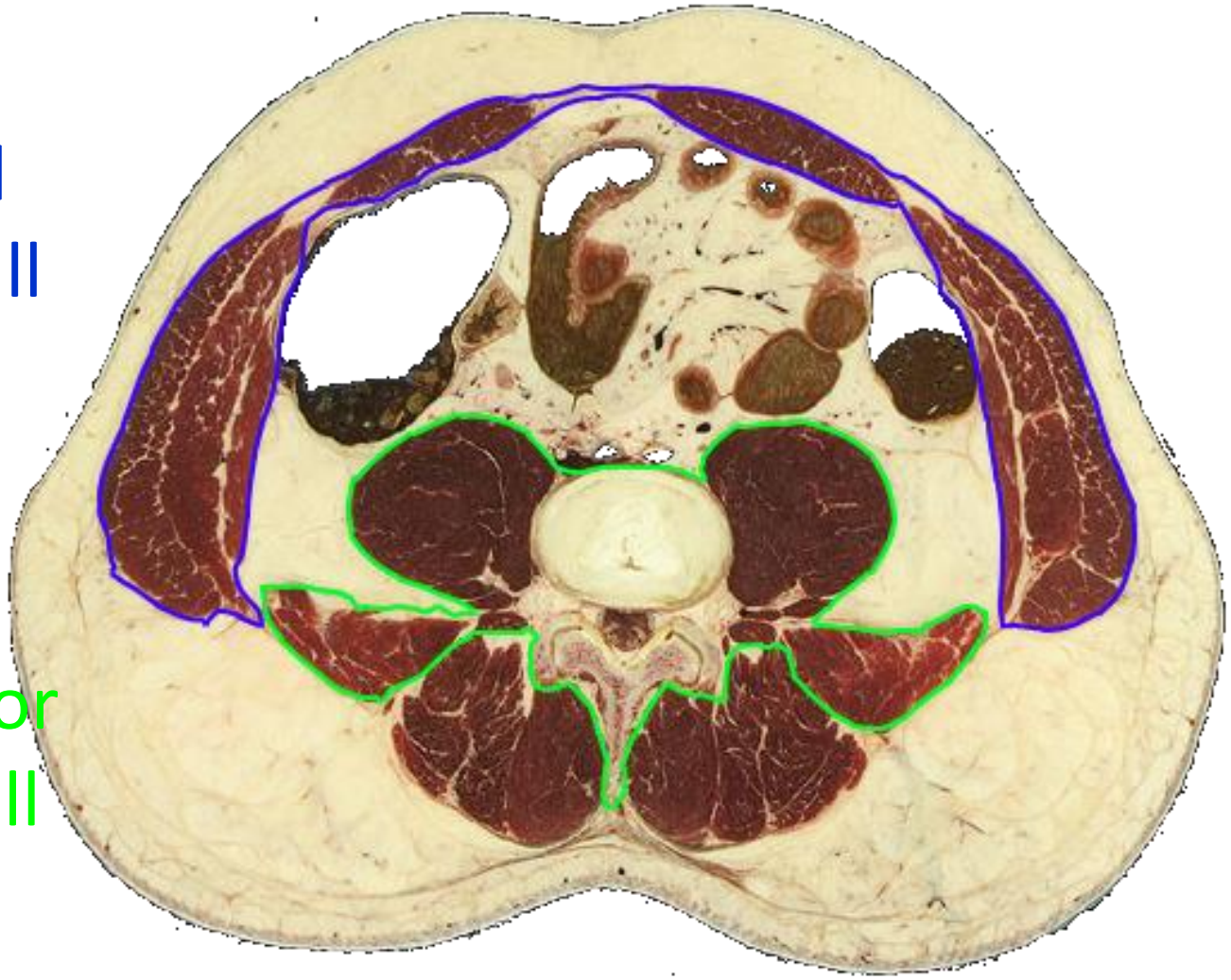

right hypochondriac region
epigastric region
left hypochondriac region
right lumbar region
umbilical region
left lumbar region
right iliac region
hypogastric region
left iliac region

P243-fig.4.23

# Abdominal wall

Anterolateral abdominal wall

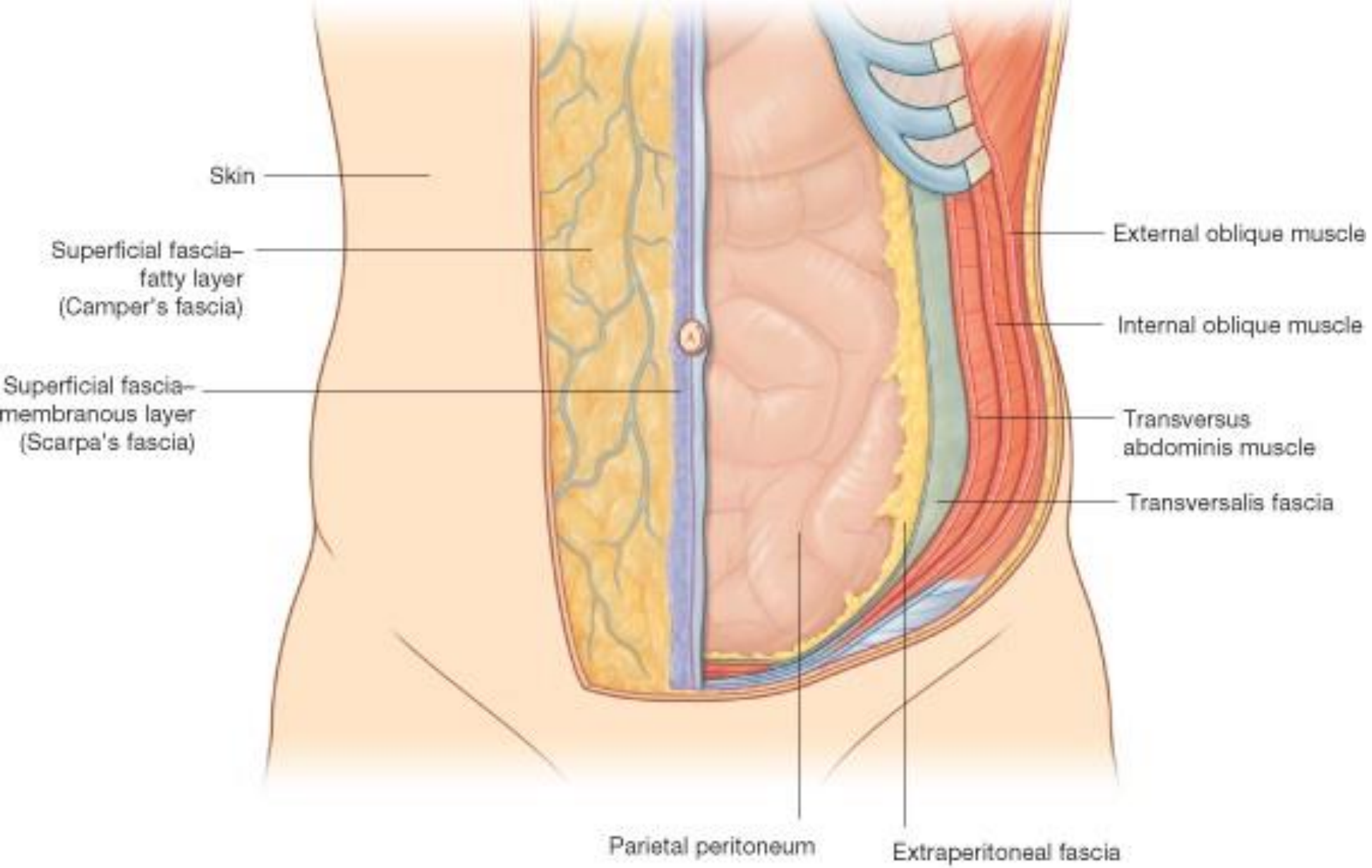
Posterior abdominal wall

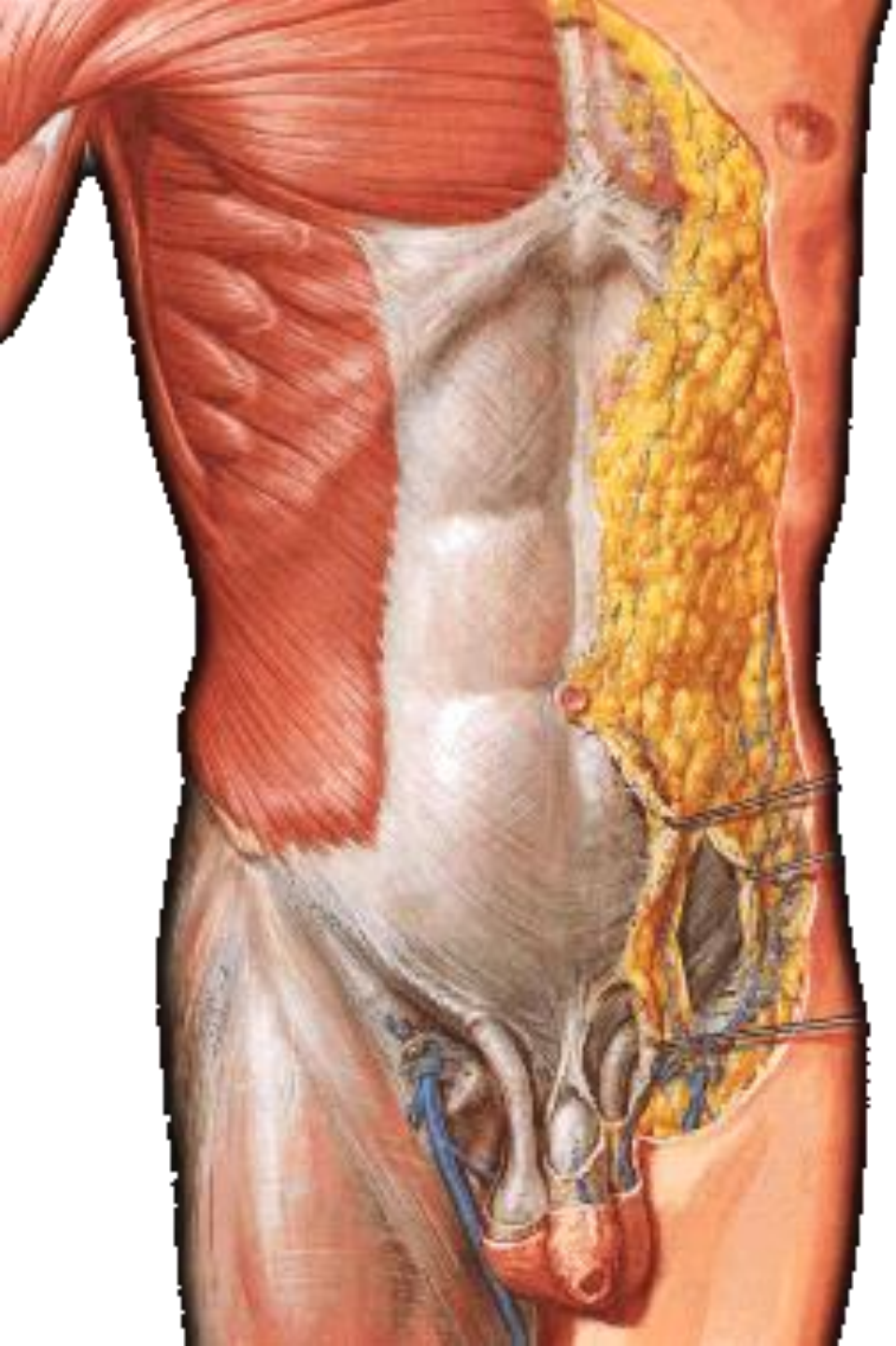


# Anterolateral abdominal wall

**Layers** ( from superficial to deep)

- Skin
- Superficial fascia
- Anterolateral muscles
- Transverse fascia
- Extraperitoneal fascia
- Parietal peritoneum





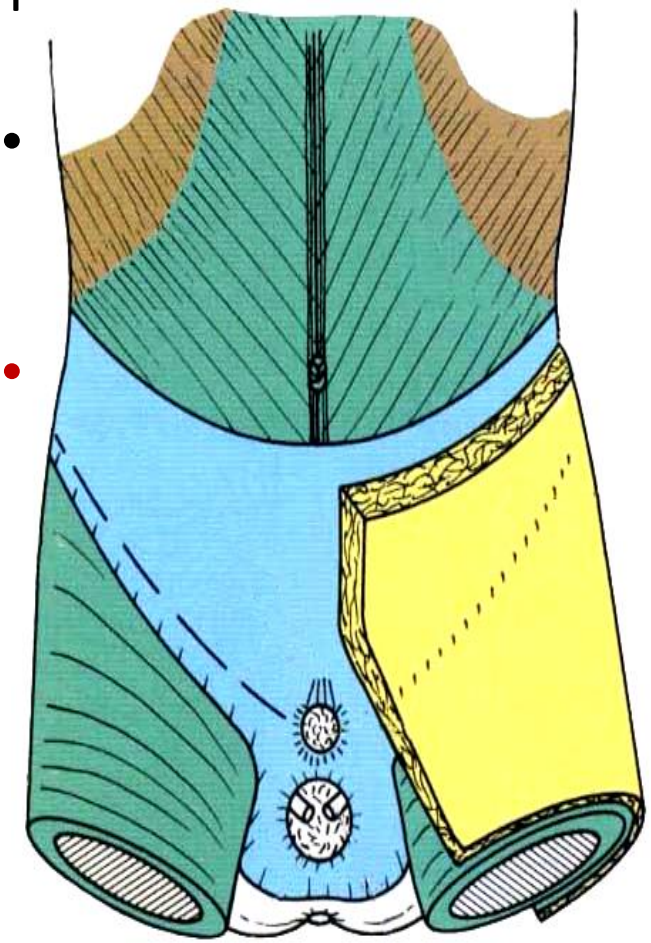
# Superficial fascia

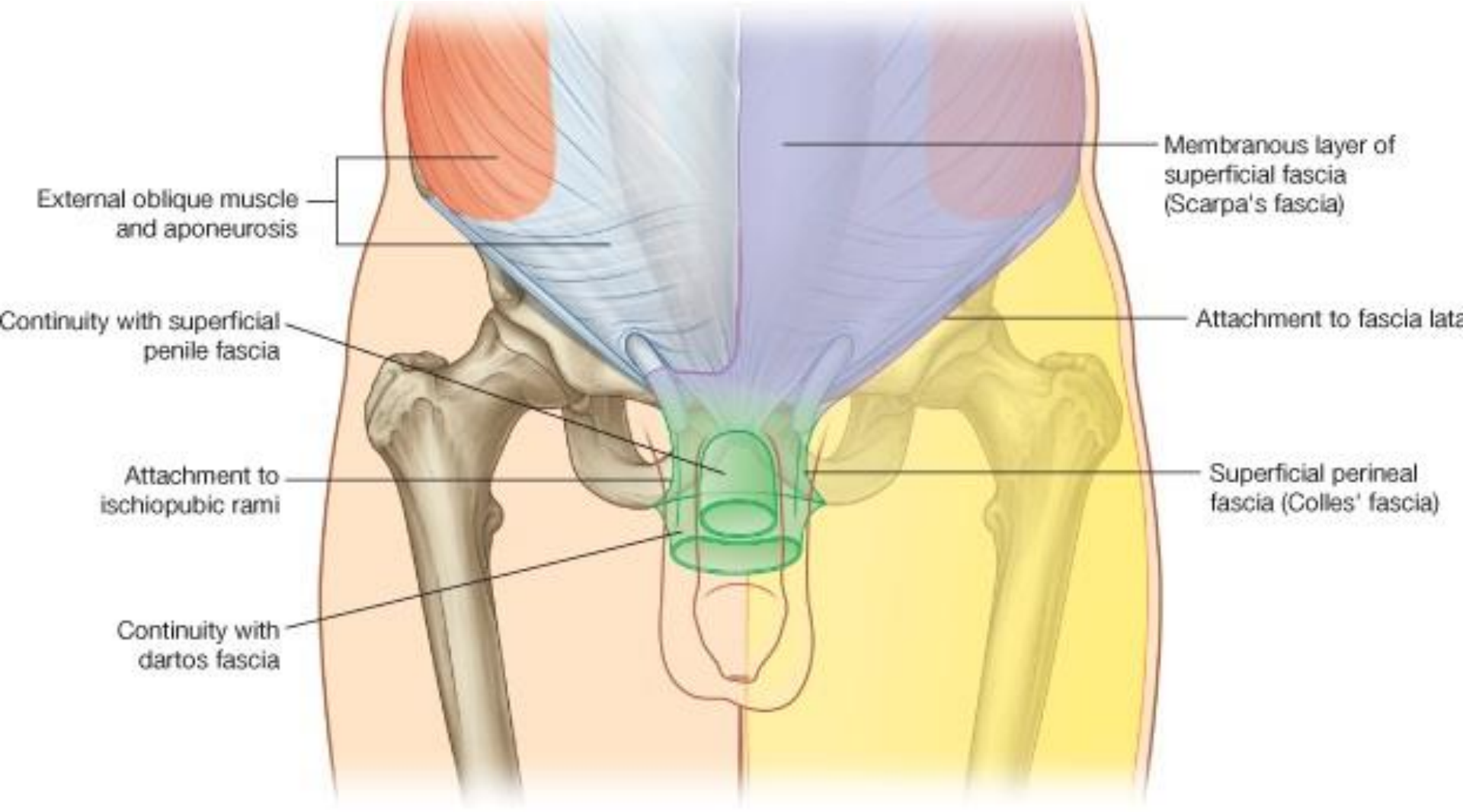
- Camper’s fascia
- Scarpa's fascia

# Anterolateral abdominal wall

**Superficial fascia :** — division below umbilicus

- = Fatty layer (**Camper's fascia**) continuous with the superficial fascia over the rest of the ( Thigh –thorax )body.
- **= Membranous layer (Scarpa's fascia)** passes over the inguinal ligament to fuse the deep fascia of the thigh (fascia lata) approximately one fingerbreadth below the inguinal ligament. In the midline, it is not attached to the pubis but instead from a tubular sheath for the penis (clitoris). In the perineum, it is attaches on each side to the margins of the pubic arch and is know as Colles' fascia.
- **deep fascia : thin layer covering abdominal musceles .**

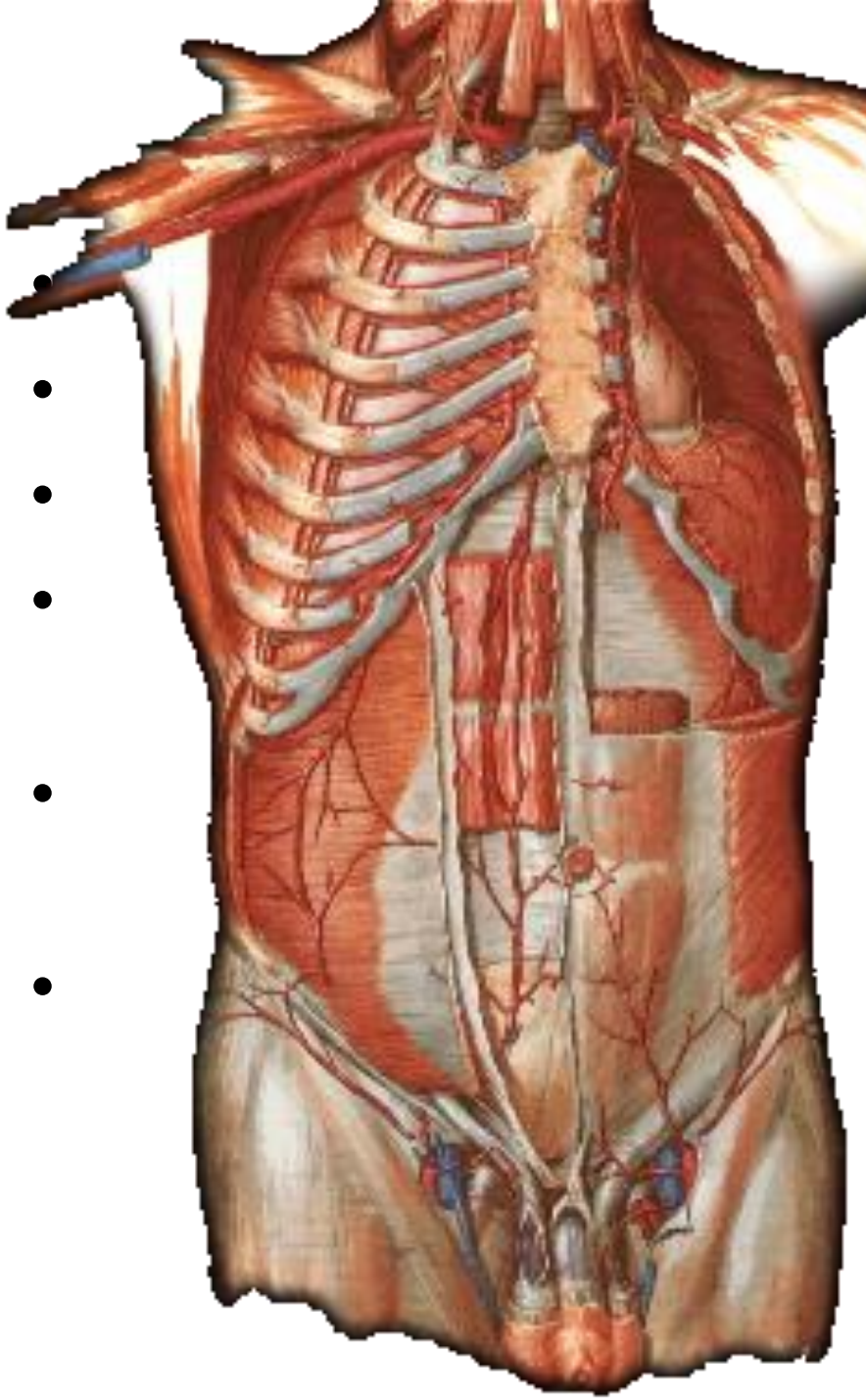





Umbilicus ("Belly Button")
Superficial Fasci
Skin
Deep Fascia
Right Nipple

# Arteries

- 5 intercostal arteries
- subcostal arteries
- 4 lumbar arteries
- Superior epigastric artery— internal thoracic artery
- Inferior epigastric artery - external iliac artery
- Deep iliac circumflex artery- external iliac artery



# SUPERFICIAL ARTERIES

## Lateral

Posterior intercostal a. –

Subcostal a. –

Lumbar a. –

## Median

Epigastric a. –

hypogastric a. –

## Inferior

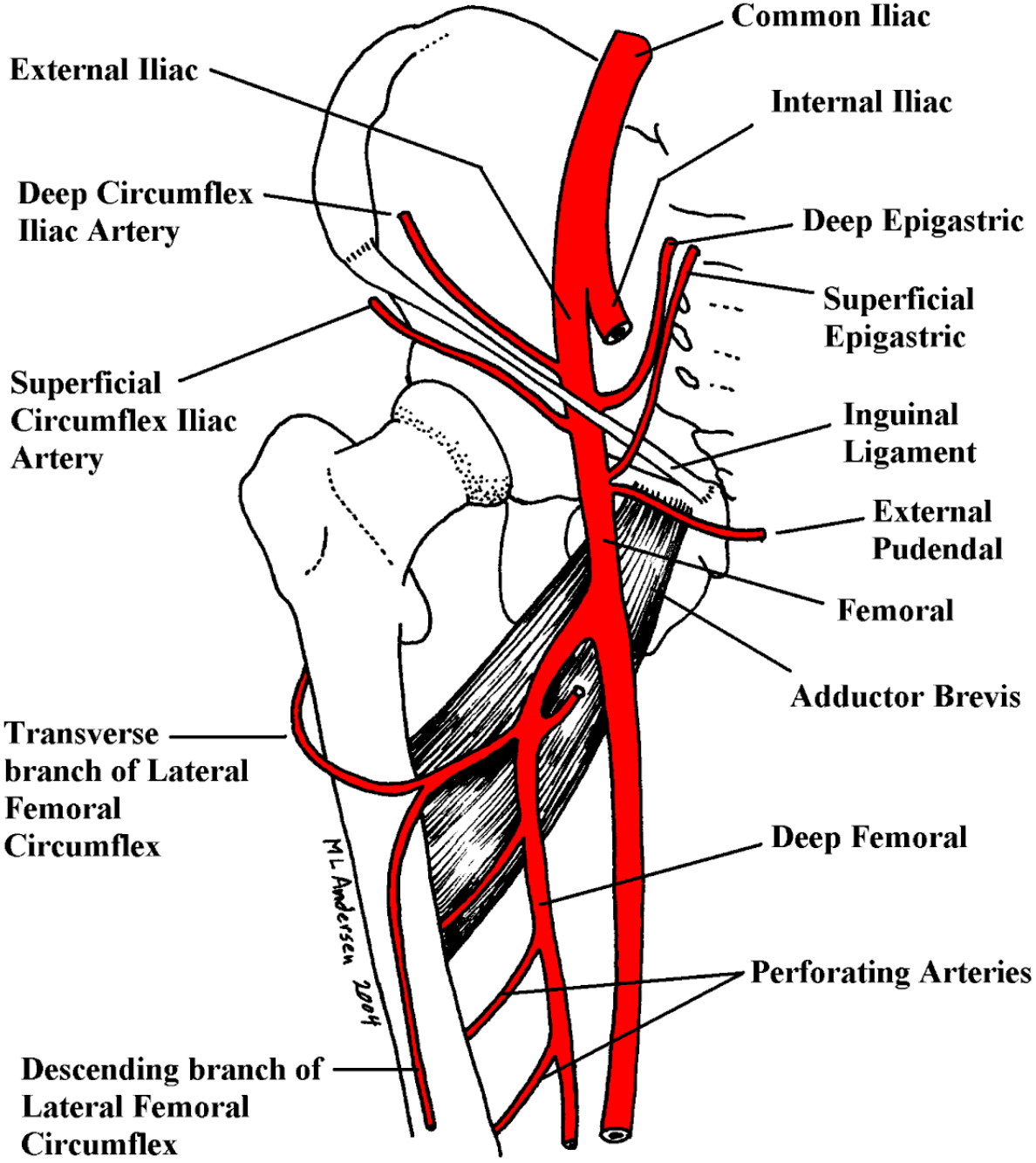
Superficial epigastric a. –

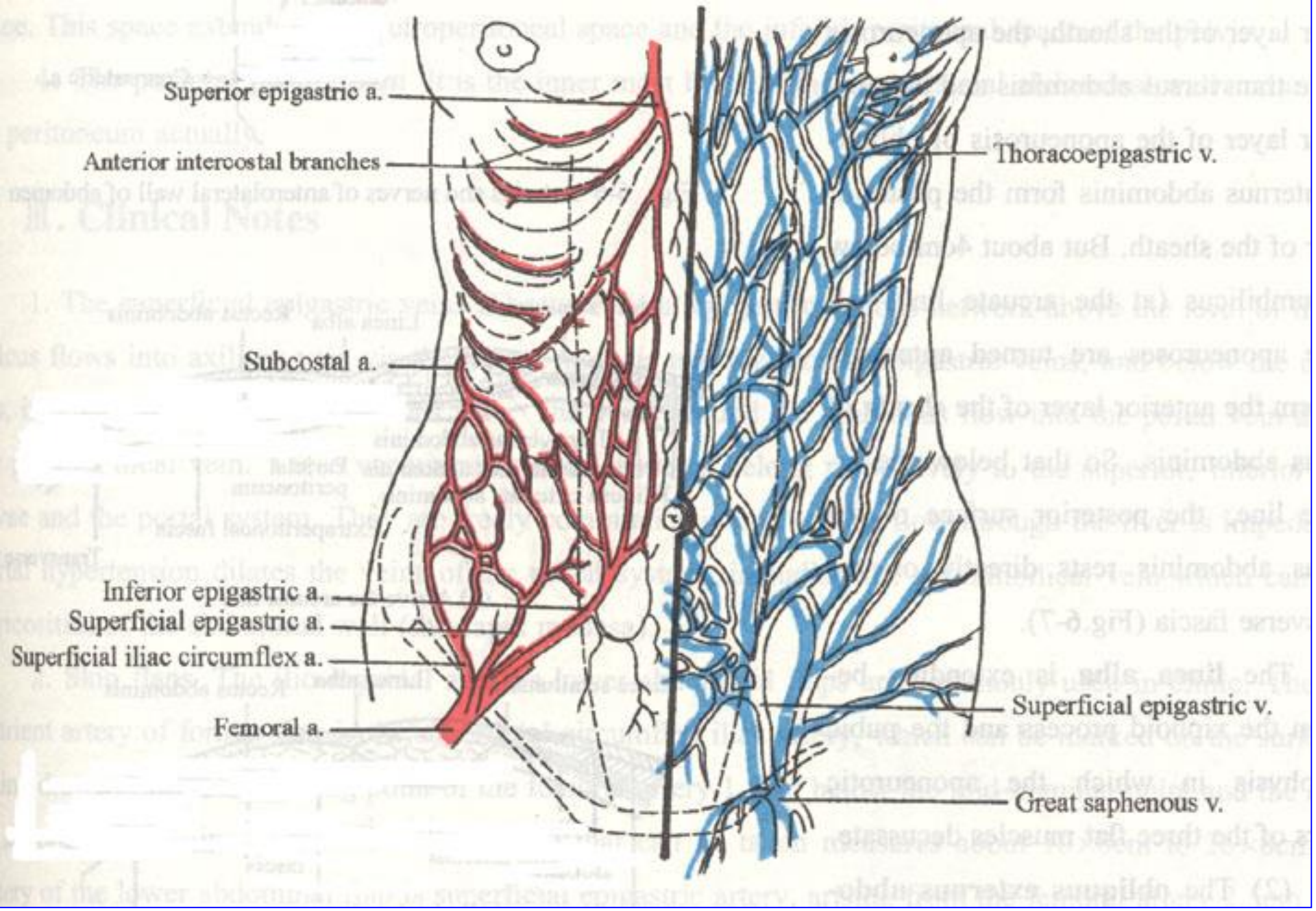
Superficial iliac a. –

$P_{255}$-fig.4

# Arterial Supply Below Umbilicus

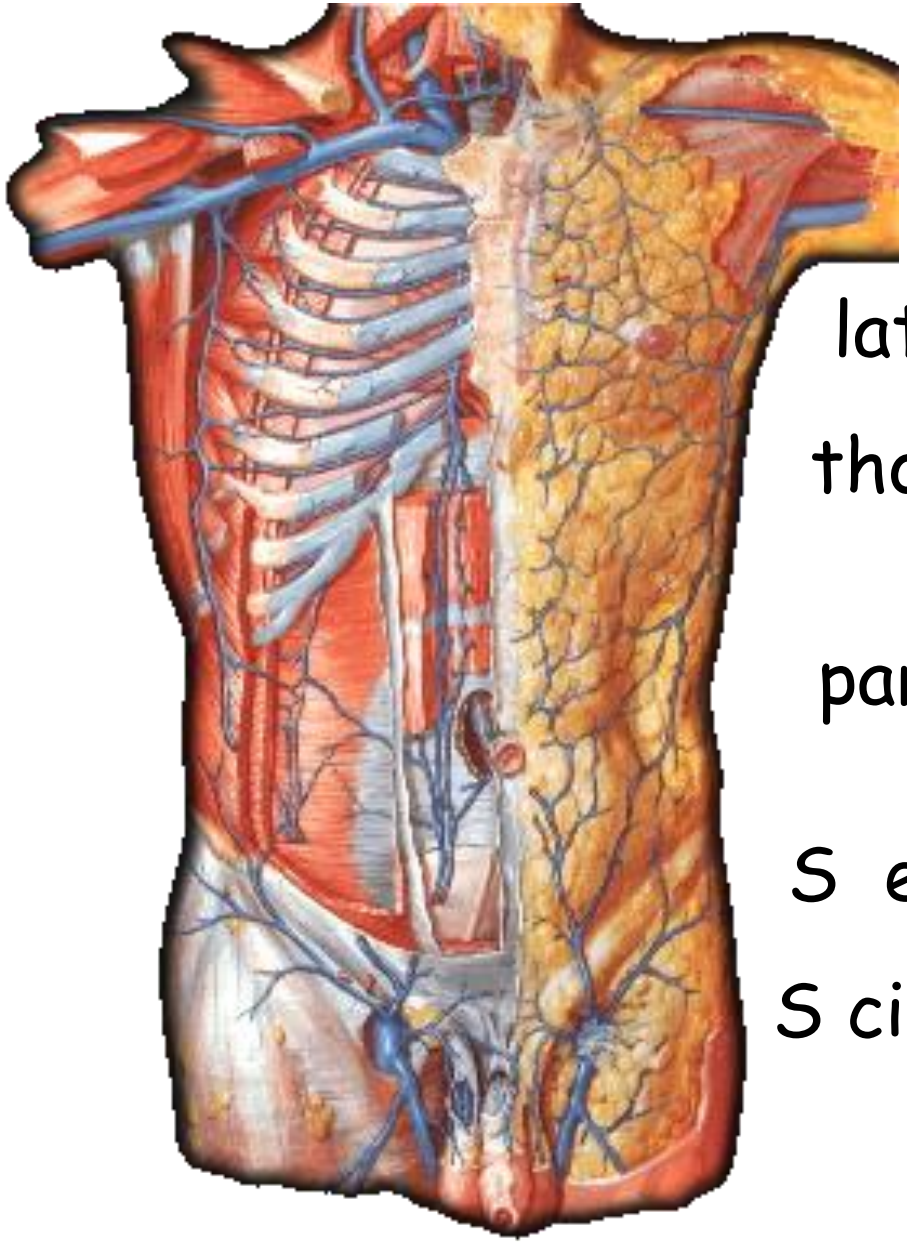
- Superficial epigastric arteries( femoral artery)
- Superficial circumflex iliac arteries ( femoral artery )
- Deep circumflex iliac artery ( external iliac)
- Superficial external pudendal arteries ( femoral artrey )
- Inferior epigastric ; arises from external iliac artery, and enters rectus sheath at arcute line , branches: gremasteric artery
-


Common Iliac
External Iliac
Internal Iliac
Deep Circumflex Iliac Artery
Deep Epigastric
Superficial Epigastric
Superficial Circumflex Iliac Artery
Inguinal Ligament
External Pudendal
Femoral
Adductor Brevis
Transverse branch of Lateral Femoral Circumflex
Deep Femoral
Perforating Arteries
Descending branch of Lateral Femoral Circumflex
M L Andersen 2004


Superior epigastric a.
Anterior intercostal branches
Subcostal a.
Inferior epigastric a.
Superficial epigastric a.
Superficial iliac circumflex a.
Femoral a.
Thoracoepigastric v.
Superficial epigastric v.
Great saphenous v.

# Venous Drainage

- Superficial veins are paired with arteries.
- Above the umbilicus:
  - Drain into the azygos venous system.
- Below the umbilicus:
  - Drain into the femoral system (via great saphenous).



# Superficial veins

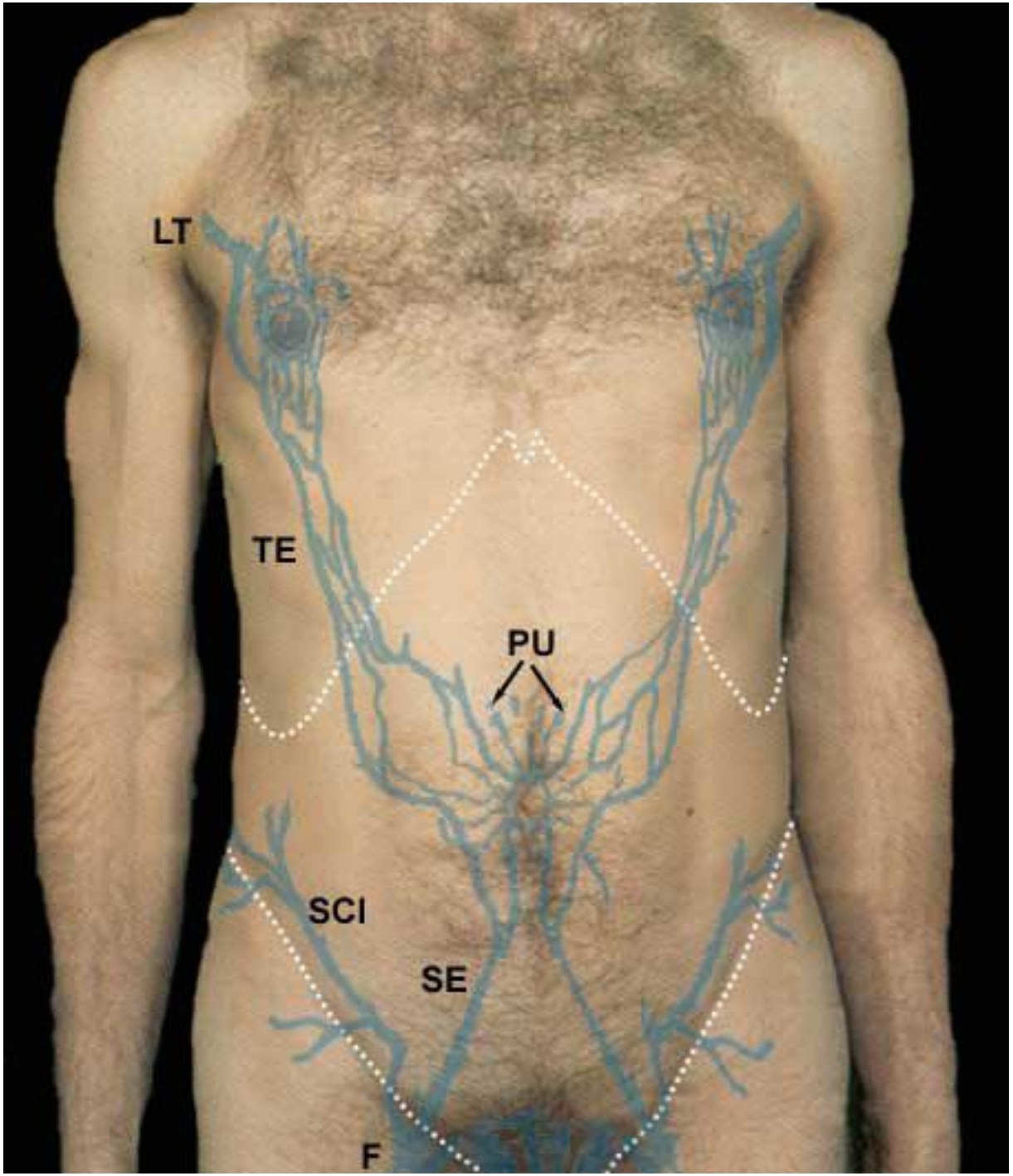
lateral thoracic — subclavian

thoracoepigastric — subclavian

paraumbilical — portal

S epigastric — femoral

S circumflex iliac — femoral

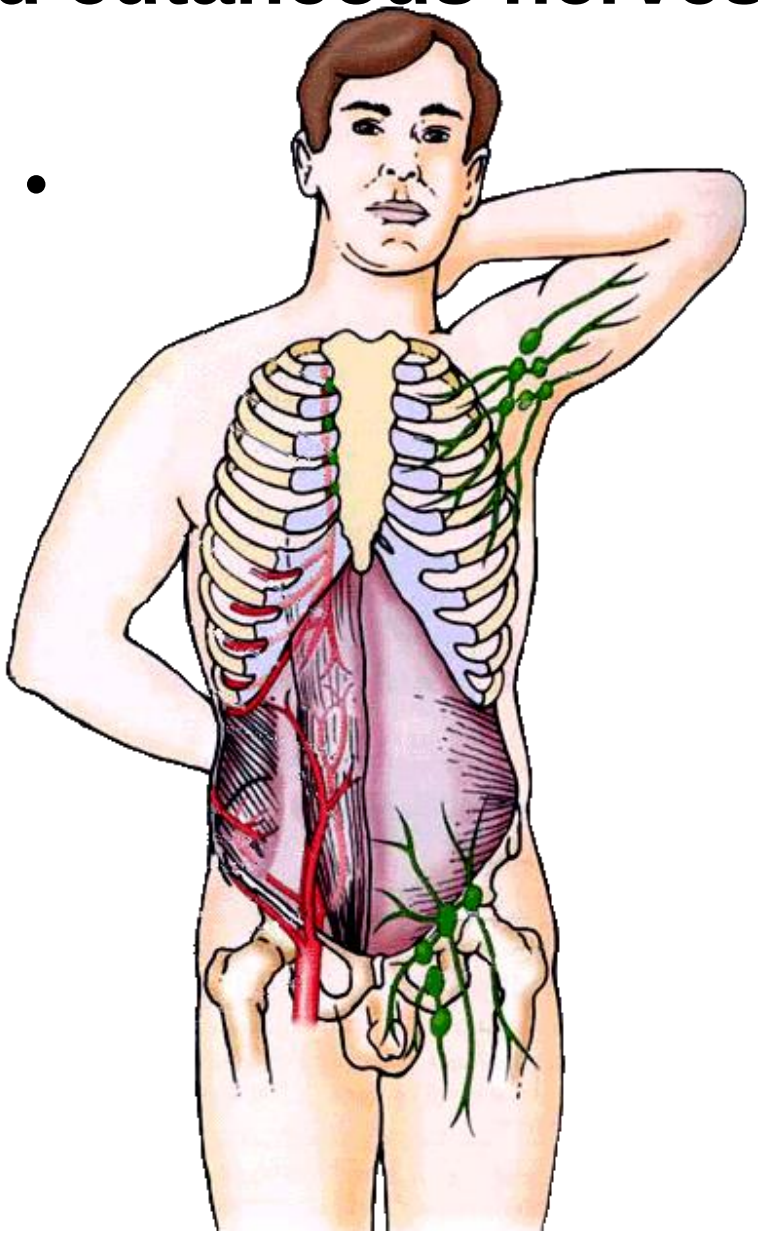

LT
TE
PU
SCI
SE
F

# Superficial vessels and cutaneous nerves

- **Lymph drainge**

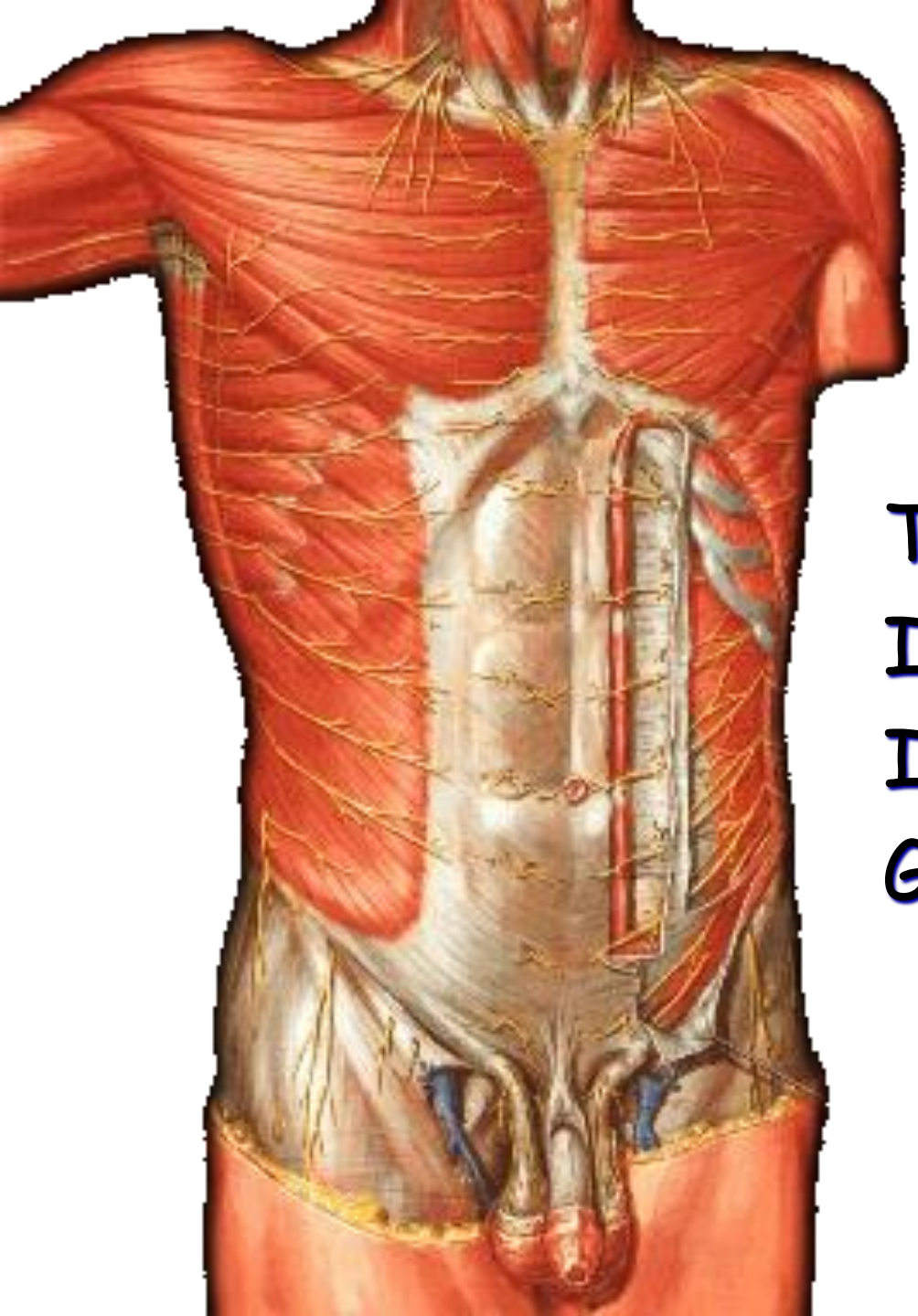
Superficial lymph vessels – above the level of the umbilicus grain upward into the pectoral Ln.

The vessels below this – level drain downward into the superficial inguinal Ln.

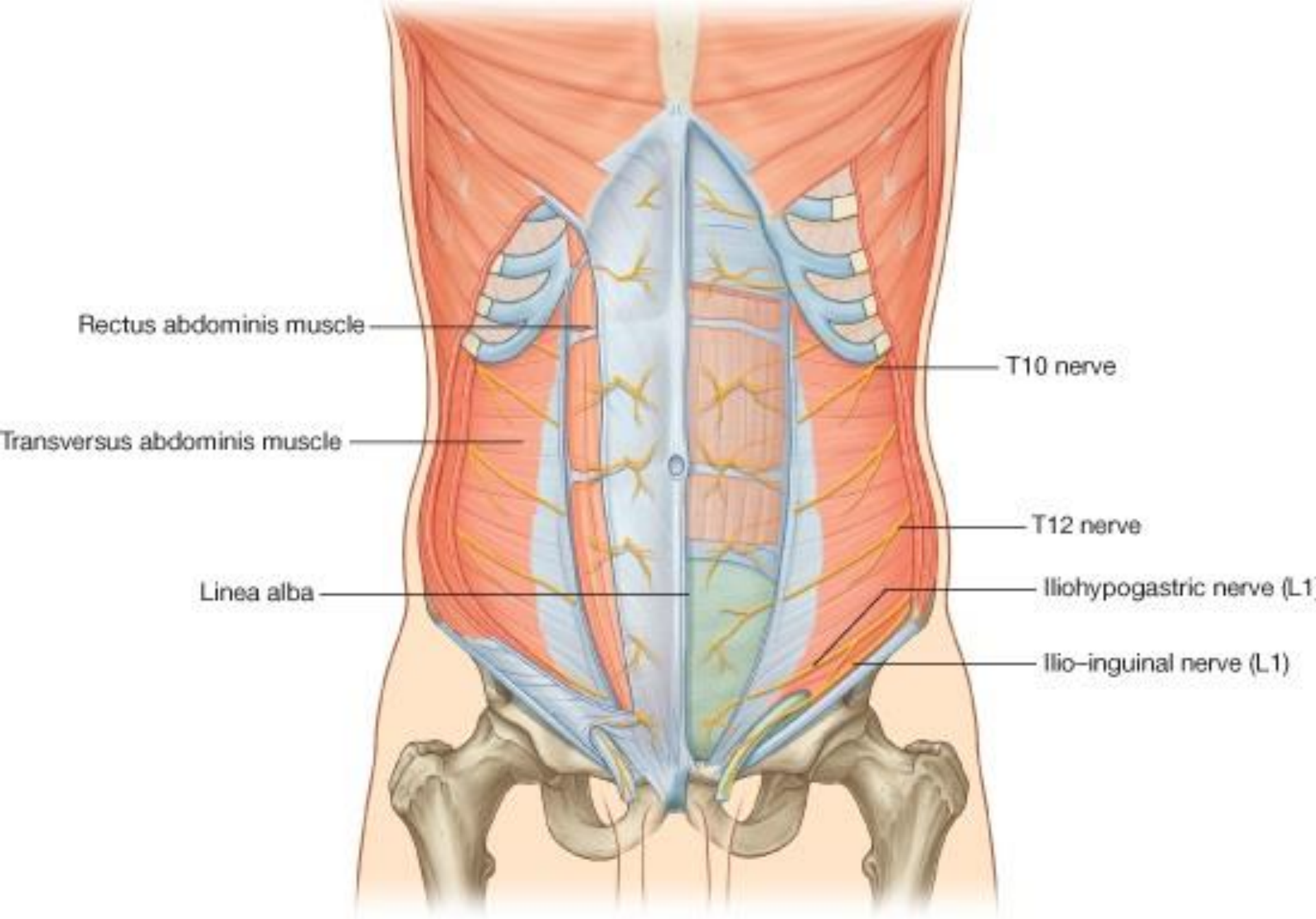


# Lymphatic Drainage

| | | |
|---|---|---|
| Anterior | → | Intercostal Lymphatic Nodes<br>Parasternal Lymphatic Nodes |
| Middle | → | Lumbar Lymphatic Nodes |
| Lower | → | External Iliac Lymphatic Nodes |



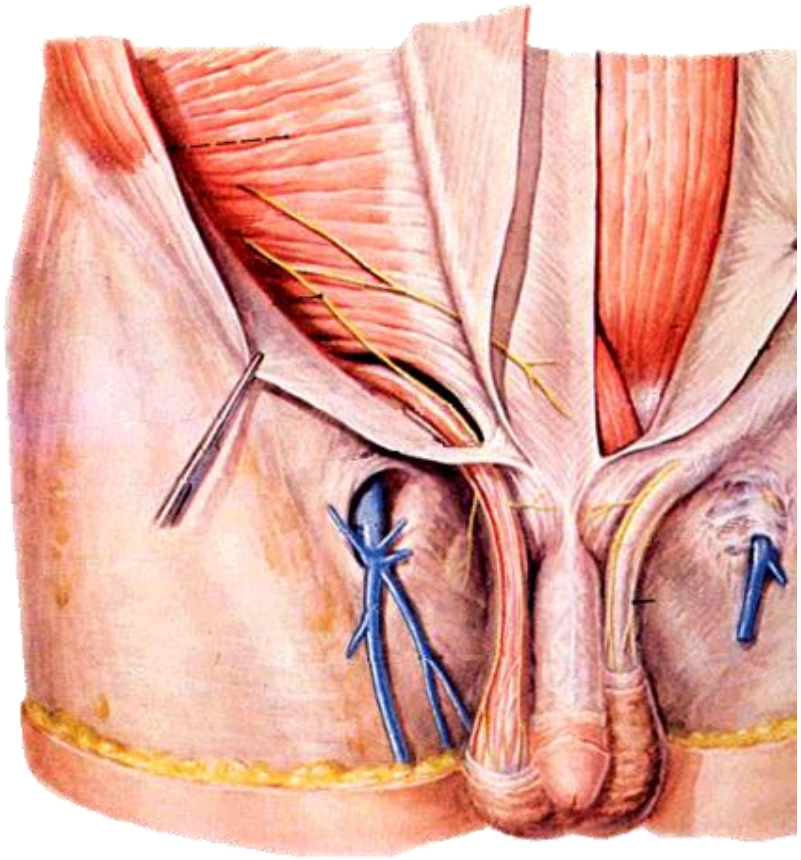
- T7-12 thoracic n.
- Iliohypogastric n.
- Ilioinguinal n.
- Genitofemoral n.



# Deep nerves of abdomen

## Iliohypogastric n.

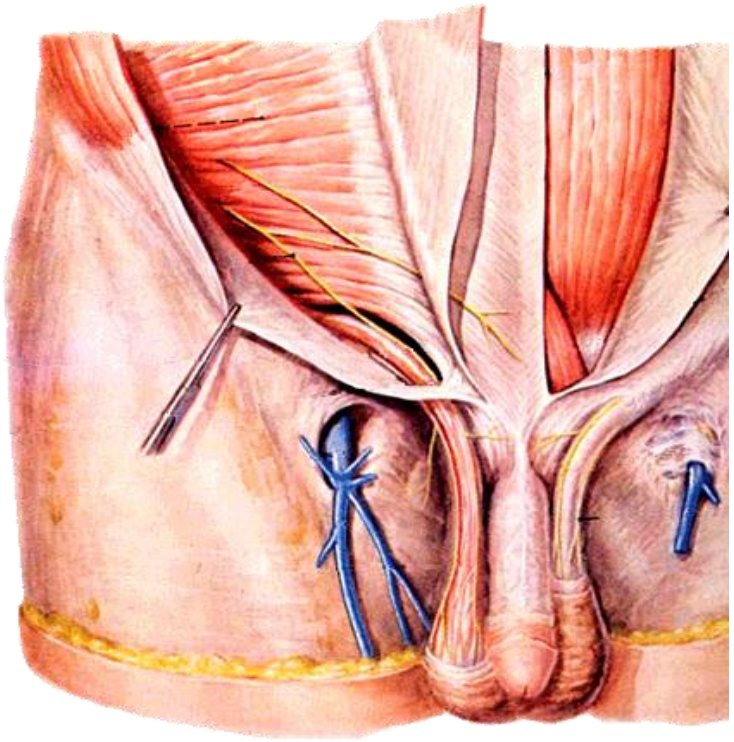
- Arises from lumbar plexus
- Passes forward in the interval between obliquus internus and tranversus abdominis
- Pieces obliquus internus abdominis 2.5 cm medial to anterior superior iliac spine
- Pieces aponeurosis of obliquus externus abdominis about 2.5 cm above superficial inguinal ring



# Deep nerves of abdomen

## Ilioinguinal n.

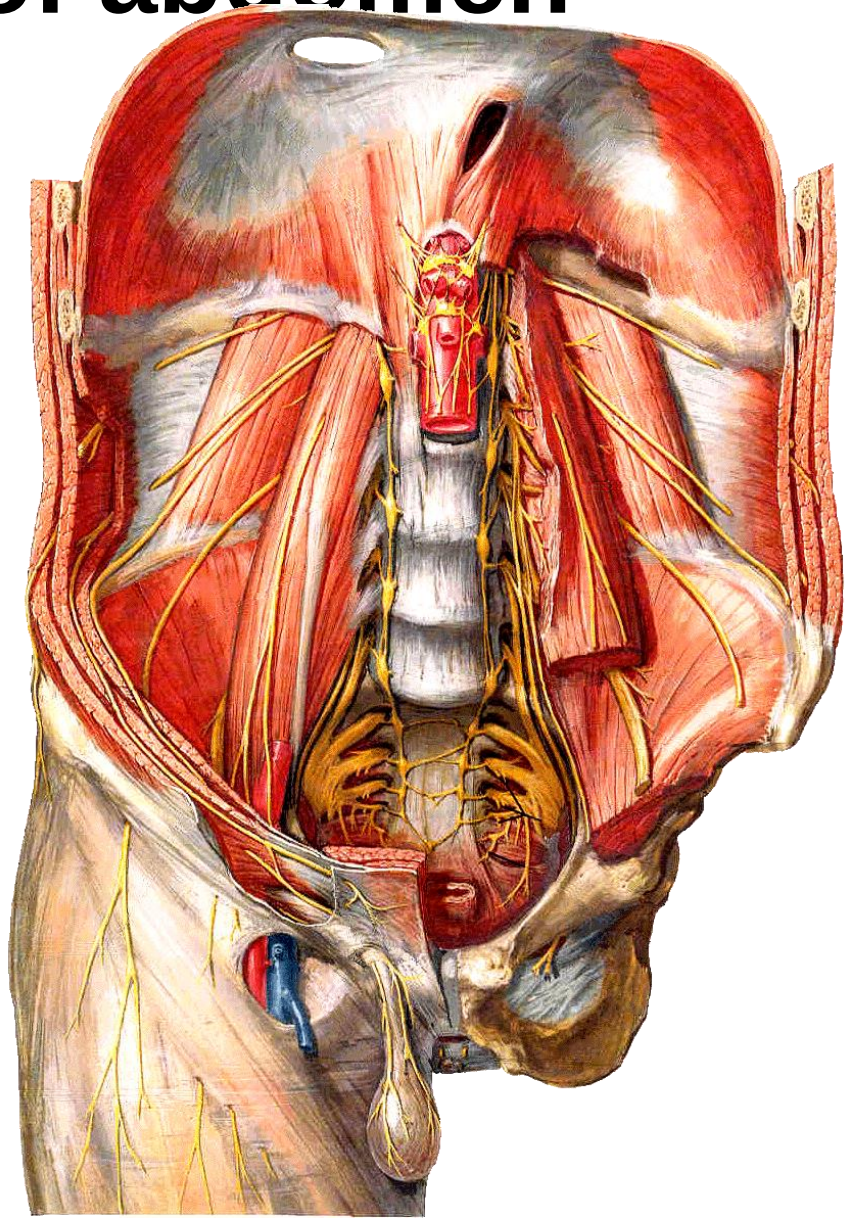
- Arises from lumbar plexus
- Runs parallel with iliohypogastric n. at a lower level
- Enters inguinal canal and exits through superficial inguinal ring
- Supplies the transversus abdominis, obliquus internus, and obliquuse externus abdiminis. It also supplies the skin just above the symphysis pubis and the scrotum or greater lip of pudendum.



# Deep nerves of abdomen

## Genitofemoral n.

- Arises from lumbar plexus
- Emerges through superficial inguinal ring and supplies the **cremaster muscle**



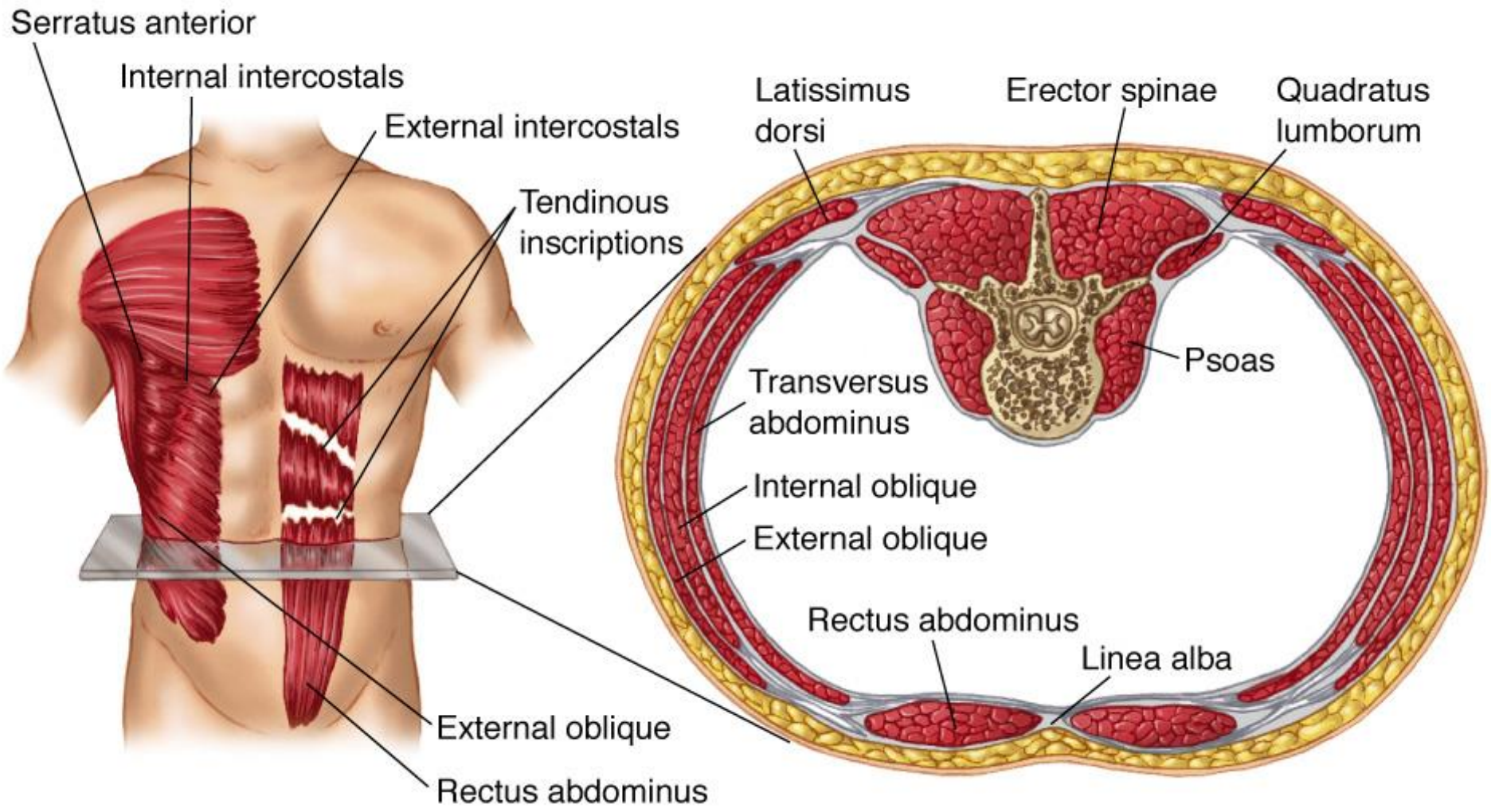
# Abdominal Wall

- The muscles of the abdomen may be divided into two groups:
- (1) the **anterolateral muscles**
- (2) the **posterior muscles.**
- **Antero-lateral Muscles of the Abdomen**—The muscles of this group are:

*Rectus. *Obliquus externus.

*Obliquus internus. *Transversus.

*Pyramidalis.




a. Anterior view of the trunk, showing superficial and deep members of the oblique and rectus groups.

b. Diagrammatic sectional view through the abdominal region.

# MUSCLES

Anterior Group

- Rectus Abdominis
- Pyramidalis

Lateral Group

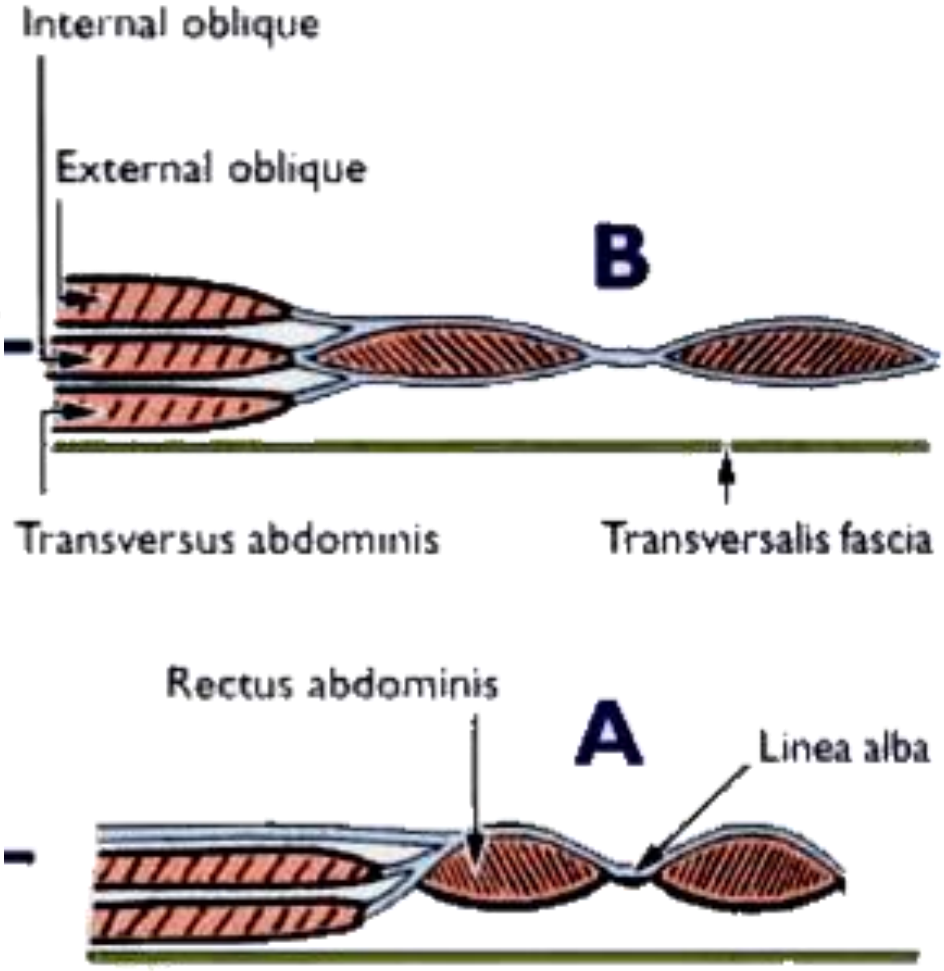
- External Oblique
- Internal Oblique
- Transversus

# Sheath of rectus abdominis•

**Ant layer**—formed by fusion of aponeurosis of obliquus externus abdominis and anterior leaf of aponeurosis of obliquus internus abdominis

**Post layer**

- Formed by fusion of posterion leaf of aponeurosis of obliquus internus abdominis and aponeurosis of transverses abdominis
- Absent in about 4-5cm below the umbilicus
- Below this line rectus abdominis in contact with transverse fascia



# RECTUS ABDOMINIS

- Tendinous Intersection (3)
- Linea Semilunaris

# Surface Features

- **Linea semilunaris:**

Along lateral margin of rectus abdominus.

Crosses costal margin near tip of 9$^{th}$ costal cartilage.

- **Arcuate line:**

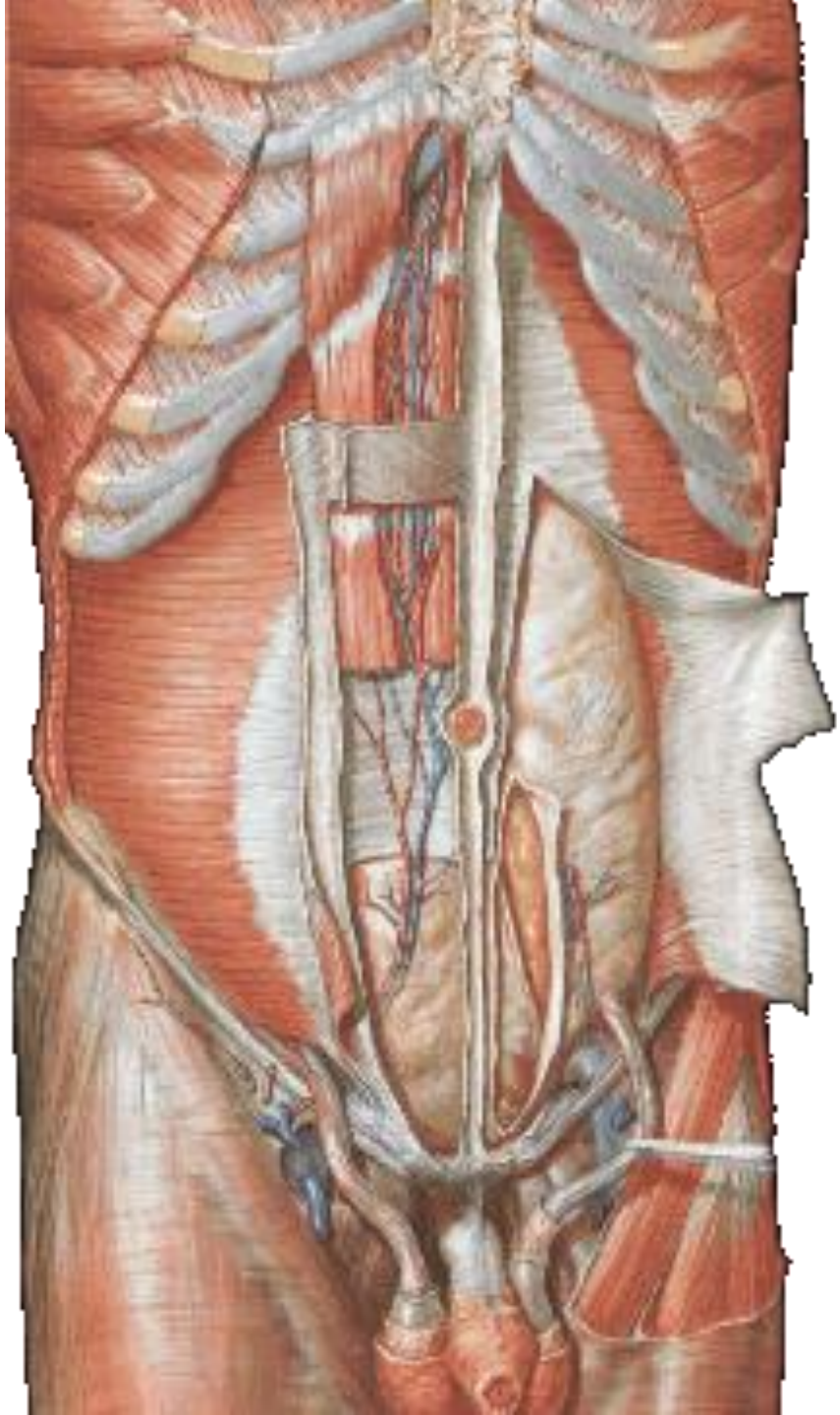
Lower free edge of posterior lamina.

Lies midway between umbilicus and pubis.

# Linea Alba

- Median raphe
- Extends from xiphoid to pubic symphysis.
- Lies between paired rectus abdominus muscles.
- = fusion of aponeuroses of transversus abdominus, internal oblique, and external oblique.

LINEA ALBA



Arcuate line

# External oblique Muscle

**Origin:t : outer surface of The lower eight ribs ( 5-12)**

**Insertion:**

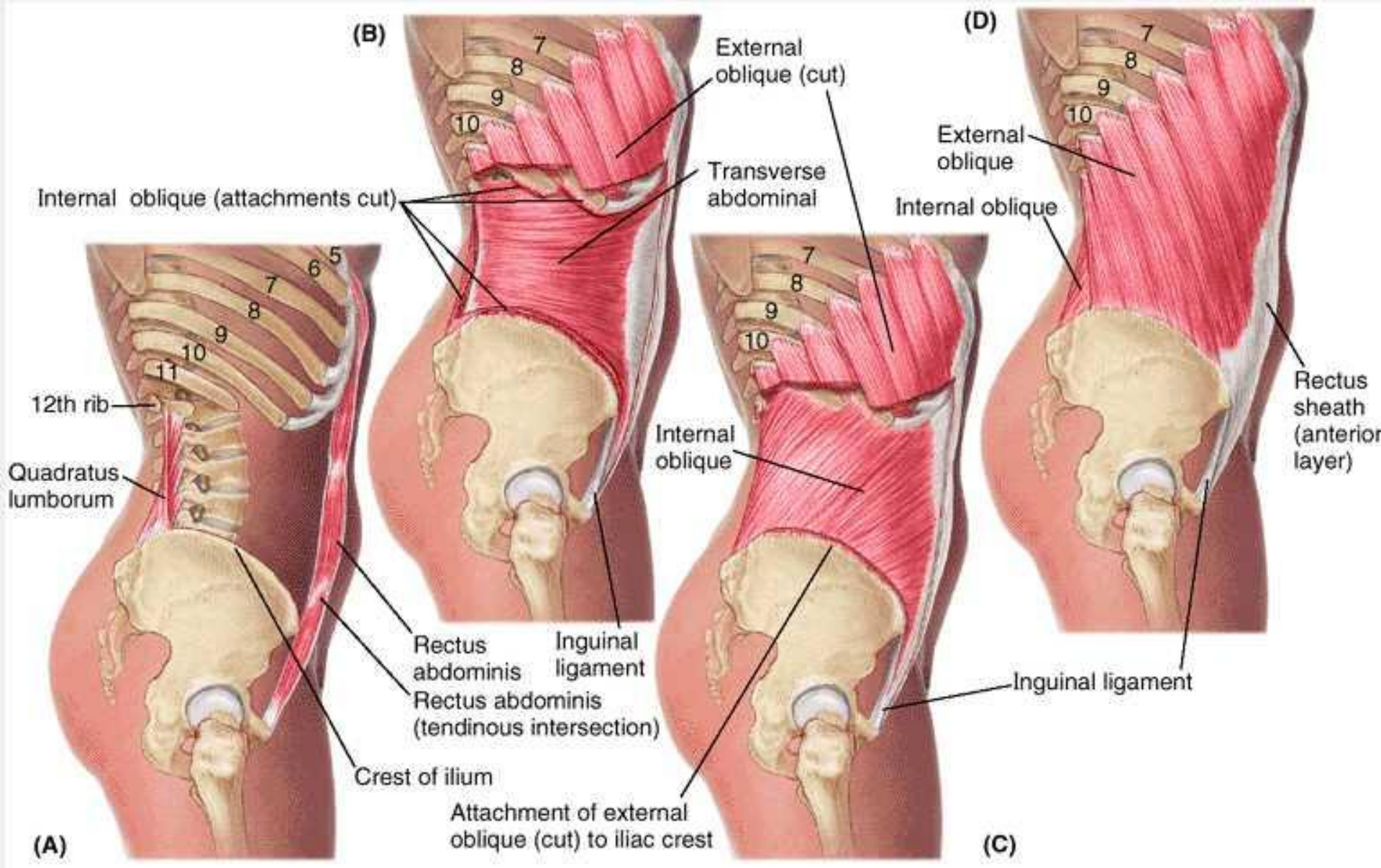
**Xiphoid process, linea alba, pubic crest, pubic tubercle, anterior half of iliac crest.**

**Nerve Supply:**

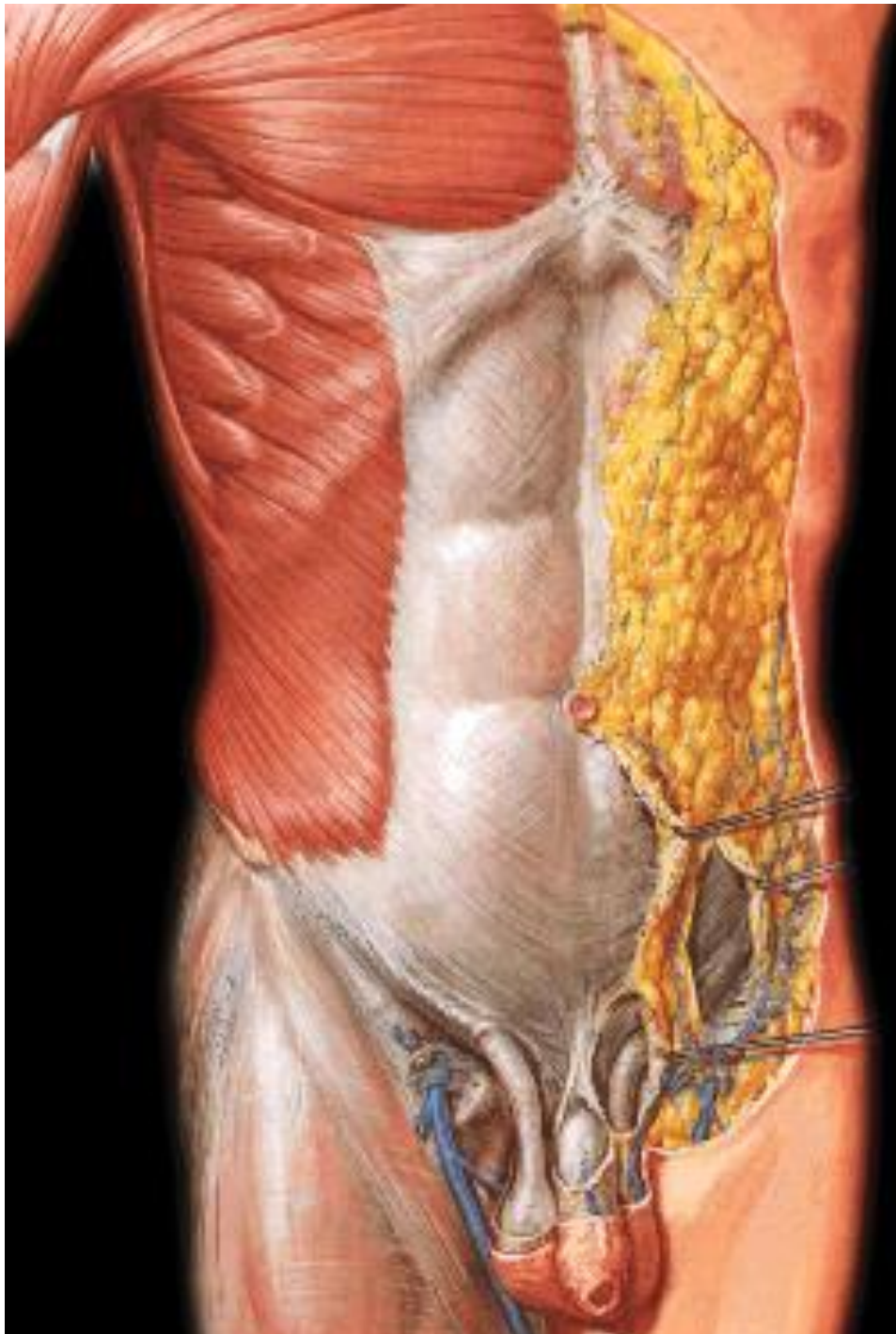
**Intercostal nerves ( anterior rami of T7- T 12 .**

**Action:**

**Increase the intra-abdominal pressure - flex trunk.**


(B)
7
8
9
10
External oblique (cut)
Transverse abdominal
Internal oblique (attachments cut)
(D)
7
8
9
10
External oblique
Internal oblique
Rectus sheath (anterior layer)
5
6
7
8
9
10
11
12th rib
Quadratus lumborum
Rectus abdominis
Inguinal ligament
Rectus abdominis (tendinous intersection)
Crest of ilium
Attachment of external oblique (cut) to iliac crest
Internal oblique
Inguinal ligament
(A)
(C)

# External Oblique Abdominis

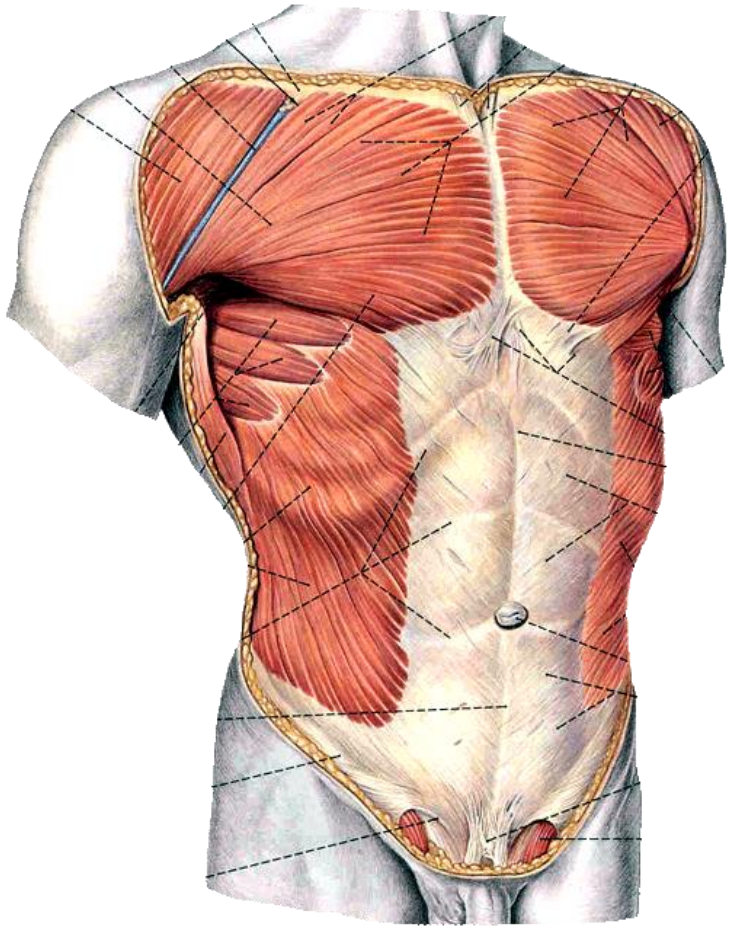


# Obliquus externus abdominis

**General direction of fibers**: downward, forward and medially (run down and inward)

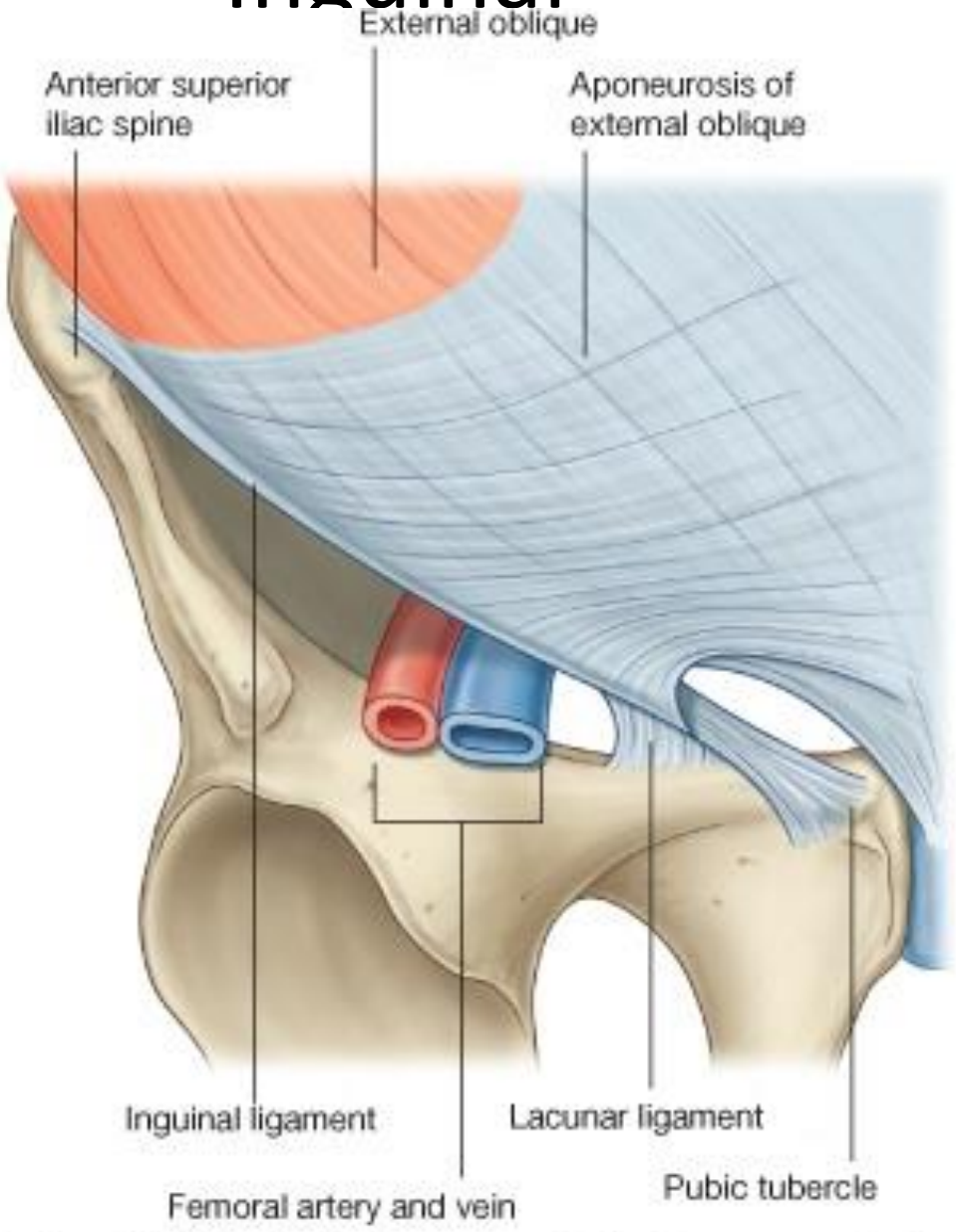
**Structures**

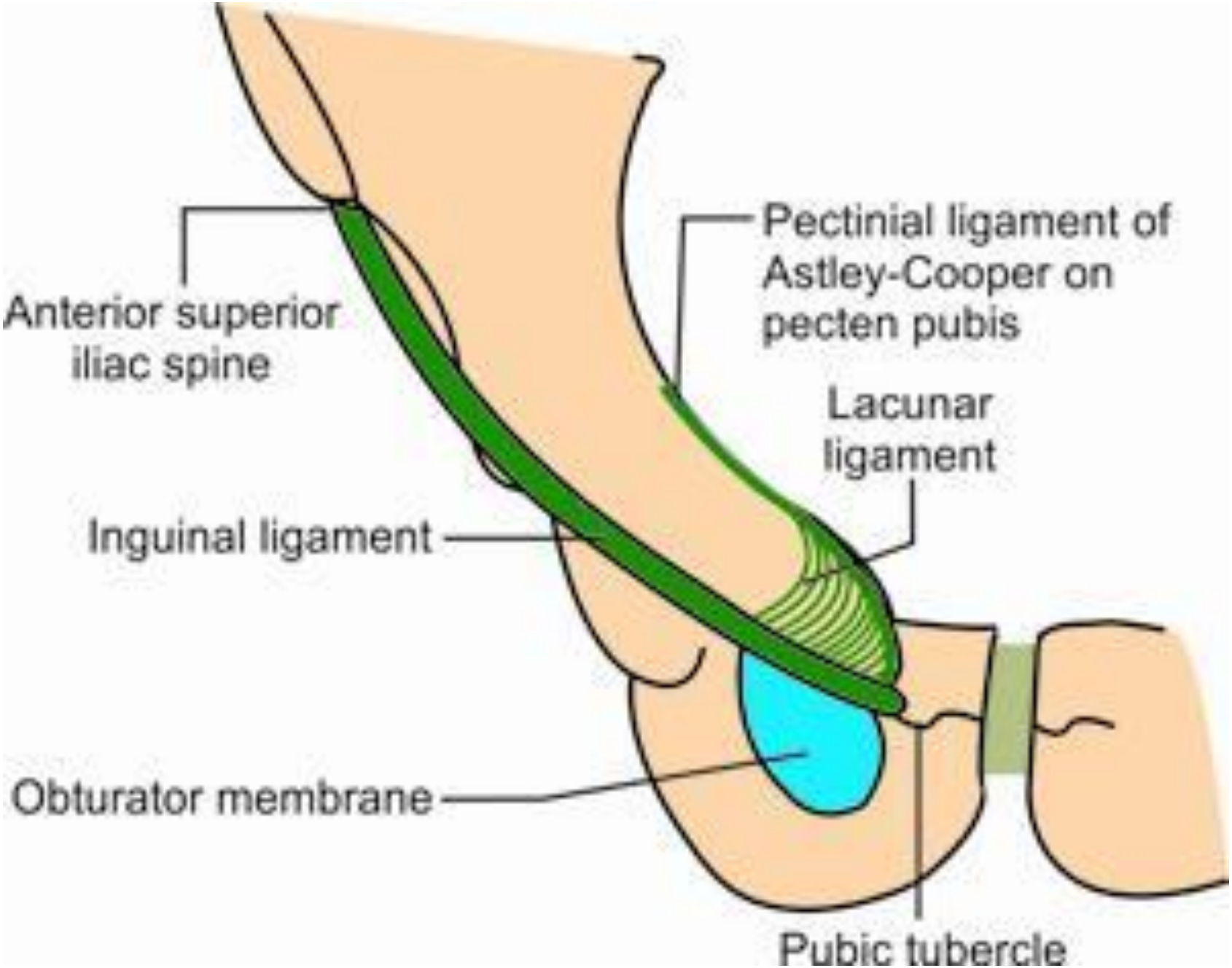
- **Inguinal ligament**
- **Lacunar ligament**
- **Superficial inguinal ring**

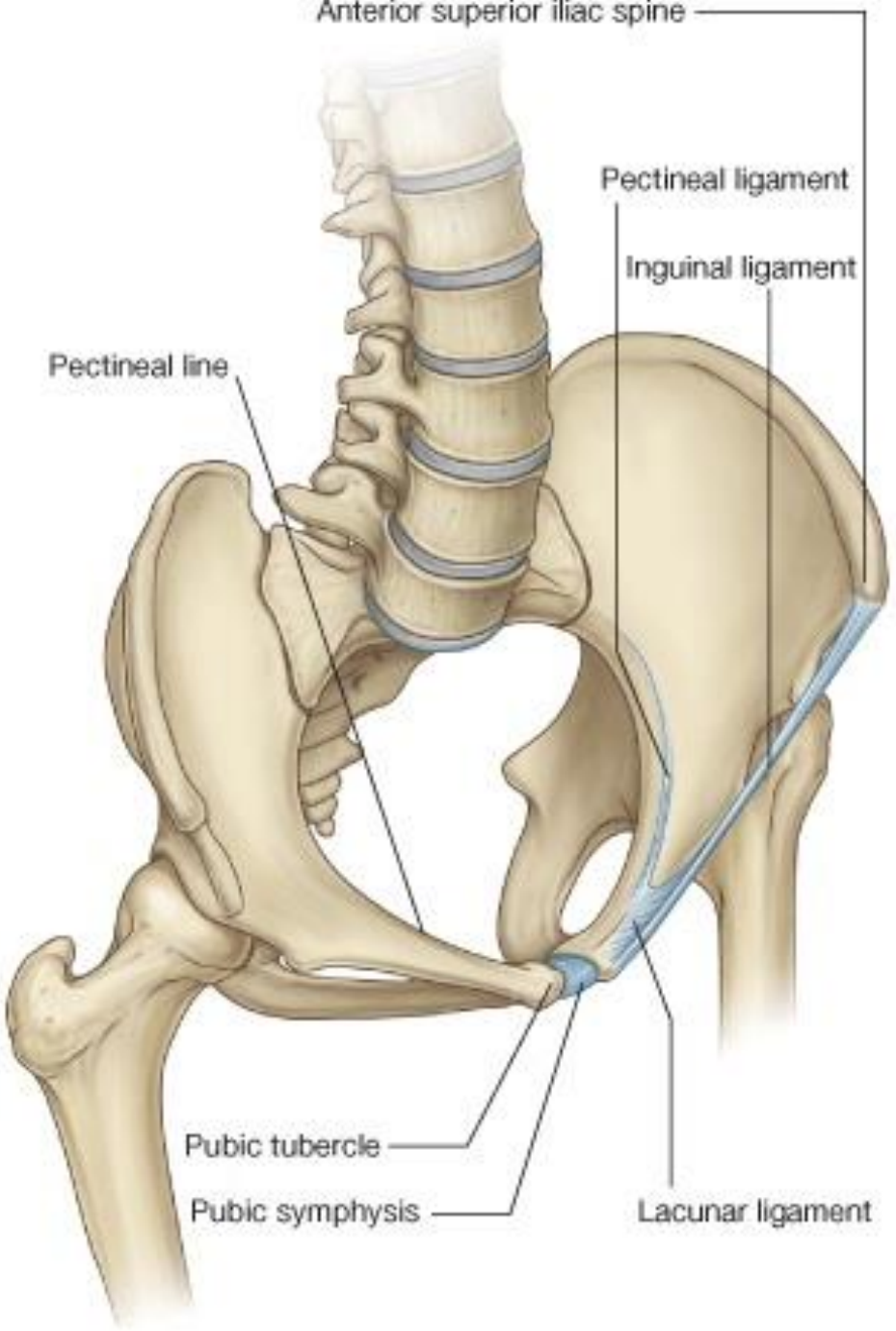


# Inguinal

li




Anterior superior iliac spine
Pectinial ligament of Astley-Cooper on pecten pubis
Lacunar ligament
Inguinal ligament
Obturator membrane
Pubic tubercle



# Internal oblique Muscle

**Origin:**

The lumbar fascia, anterior 2/3 of iliac crest, lateral 2/3 of inguinal ligament.

**Insertion:**

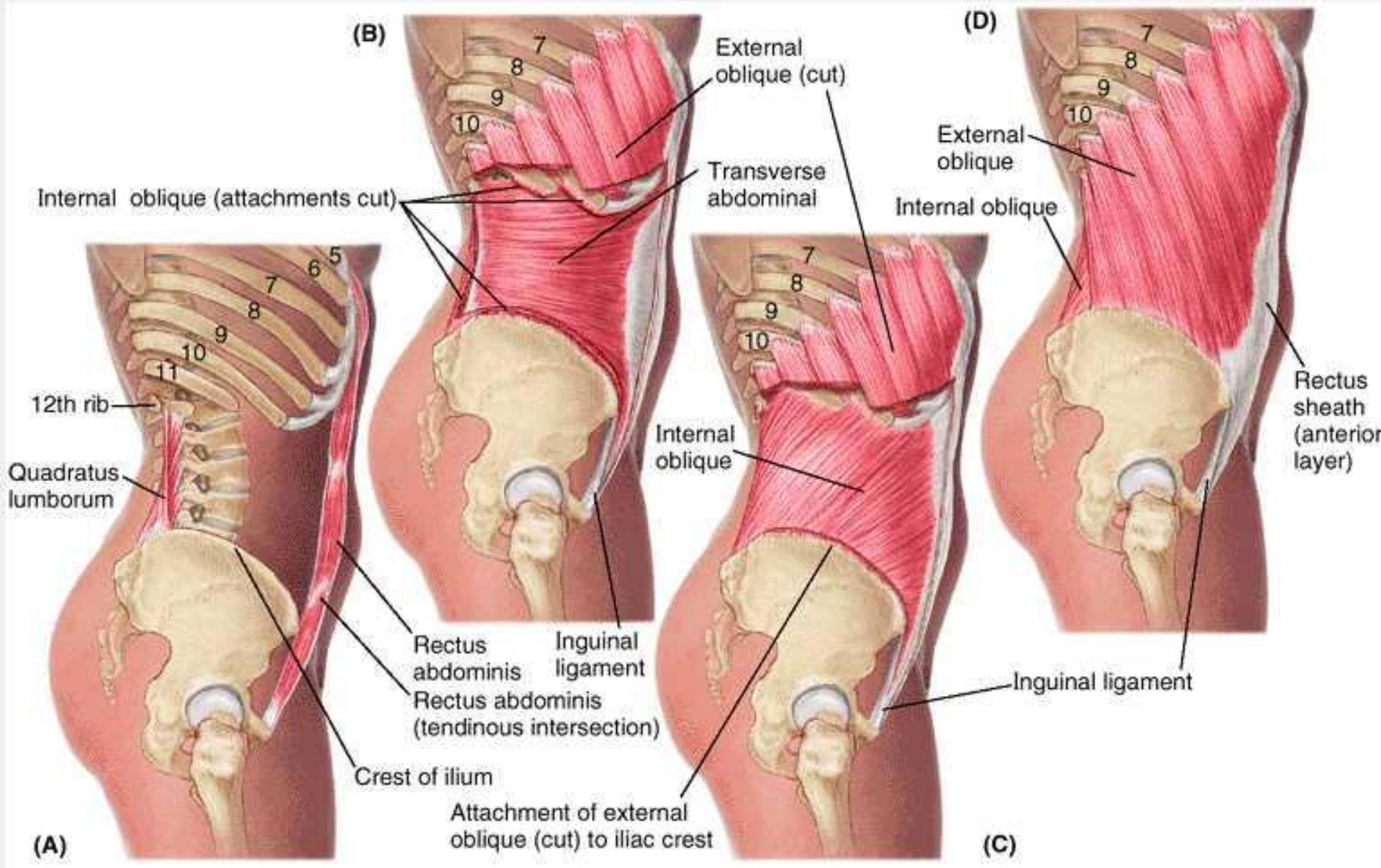
Inferior border of Lower 3 ribs or 4. and costal cartilage, xiphoid process, linea alba, pubic crest and pectineal line.

**Nerve Supply:**

Intercostal nerves ( anterior rami of T7-T12) and L 1.

**Action:**

Increase the intra-abdominal pressure.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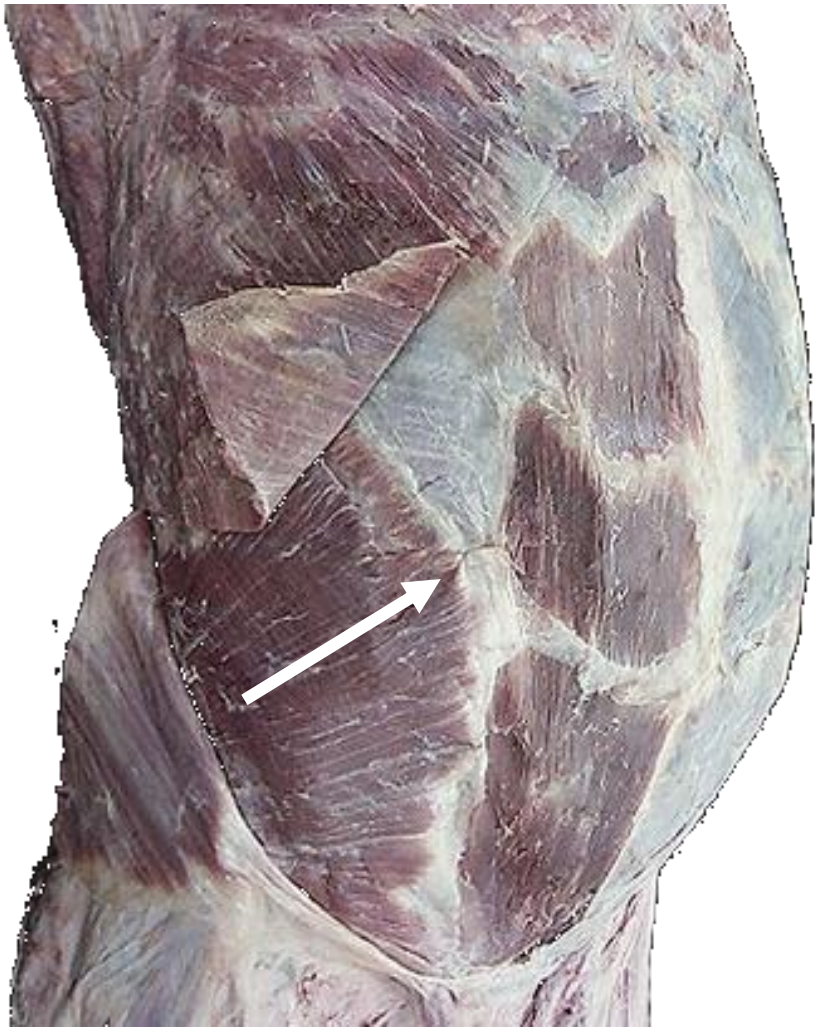
Rectus abdominis (tendinous intersection)
Crest of ilium
Attachment of external oblique (cut) to iliac crest
Internal oblique
Inguinal ligament
(A)
(C)

# Oblique Internal Abdominis



# Transversus Abdominis Muscle

**Origin:**

The lower 6 costal cartilage( rib 7 -12), lumbar fascia, anterior 2/3 of iliac crest, lateral 1/3 of inguinal canal.

**Insertion:**

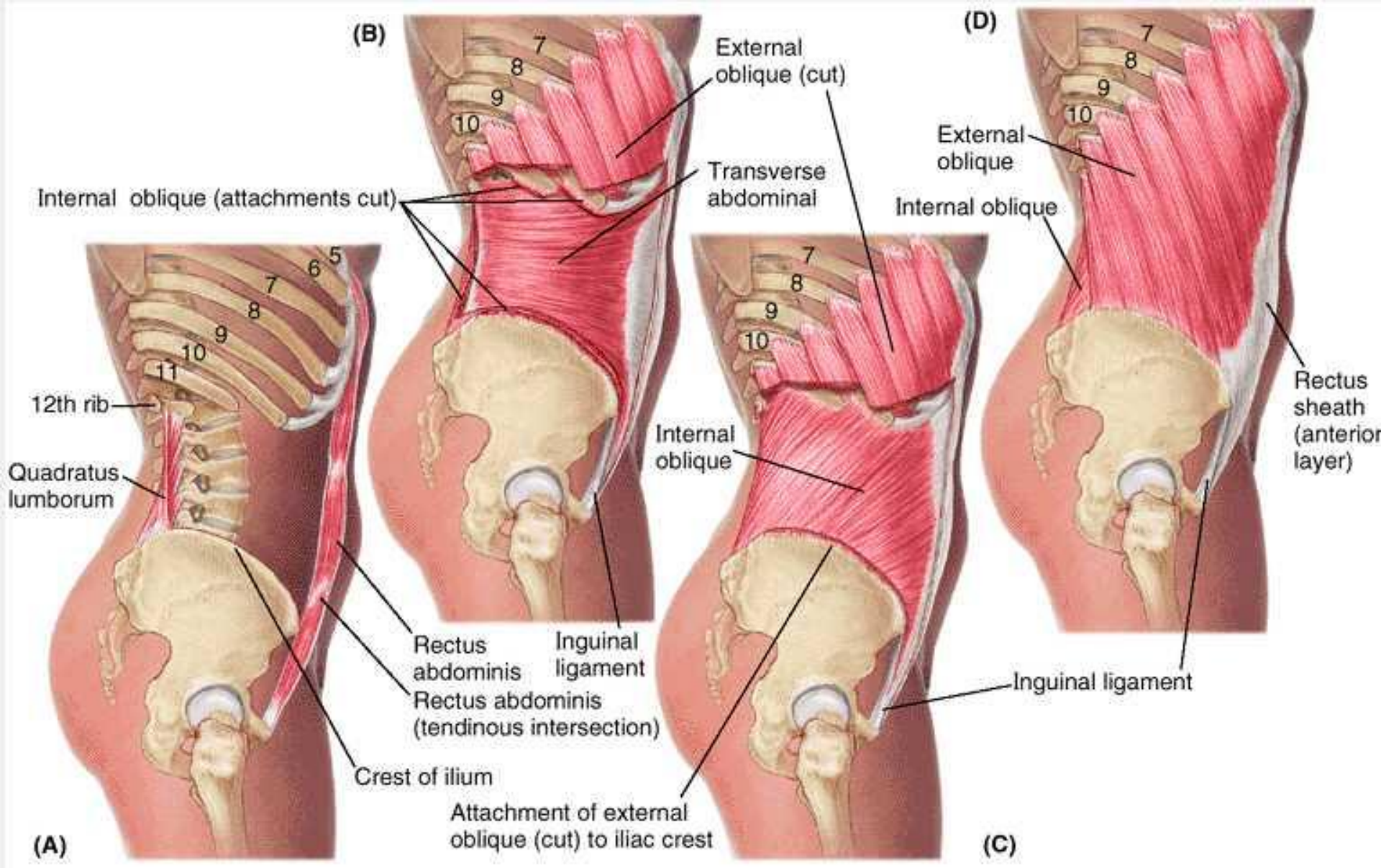
The xiphoid process, linea alba, pubic crest and pectineal line.

**Nerve Supply:**

Intercostal nerves ( T7-T12) and L1.

**Action:**

Increase the intra-abdominal pressure.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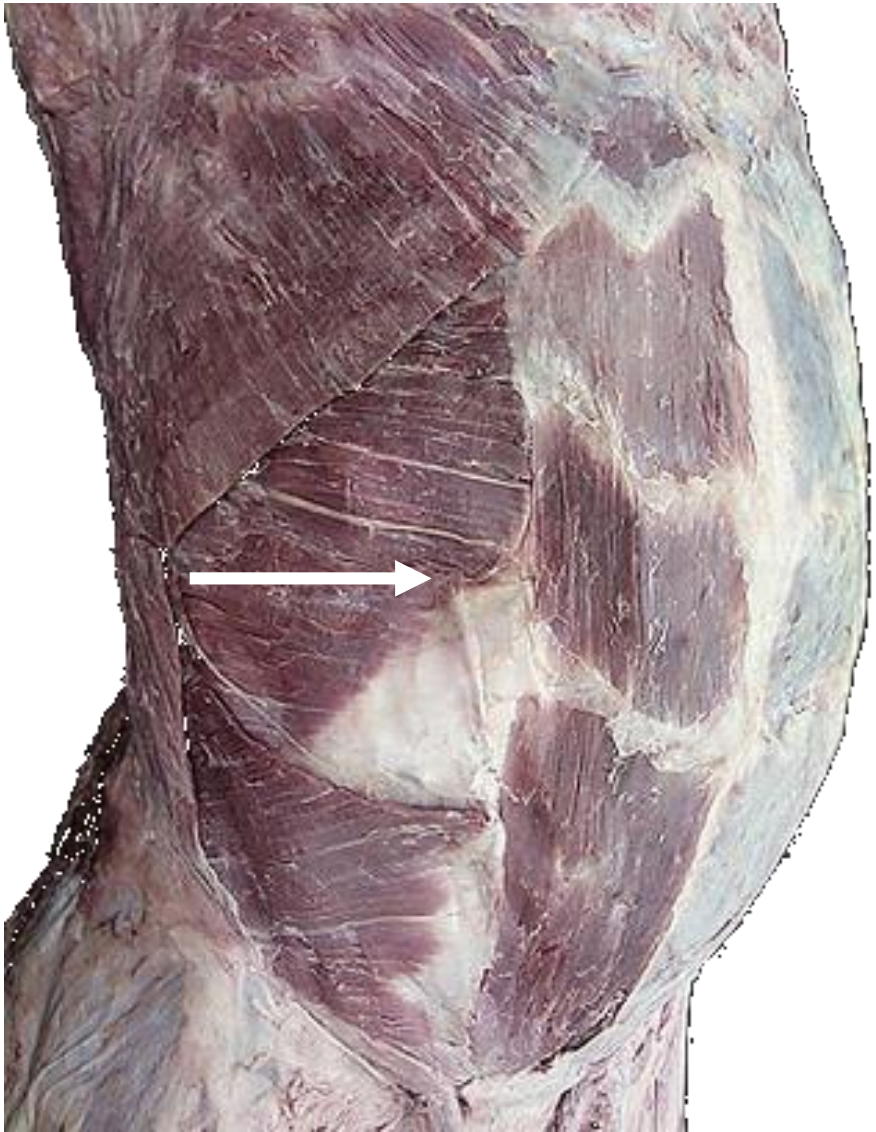
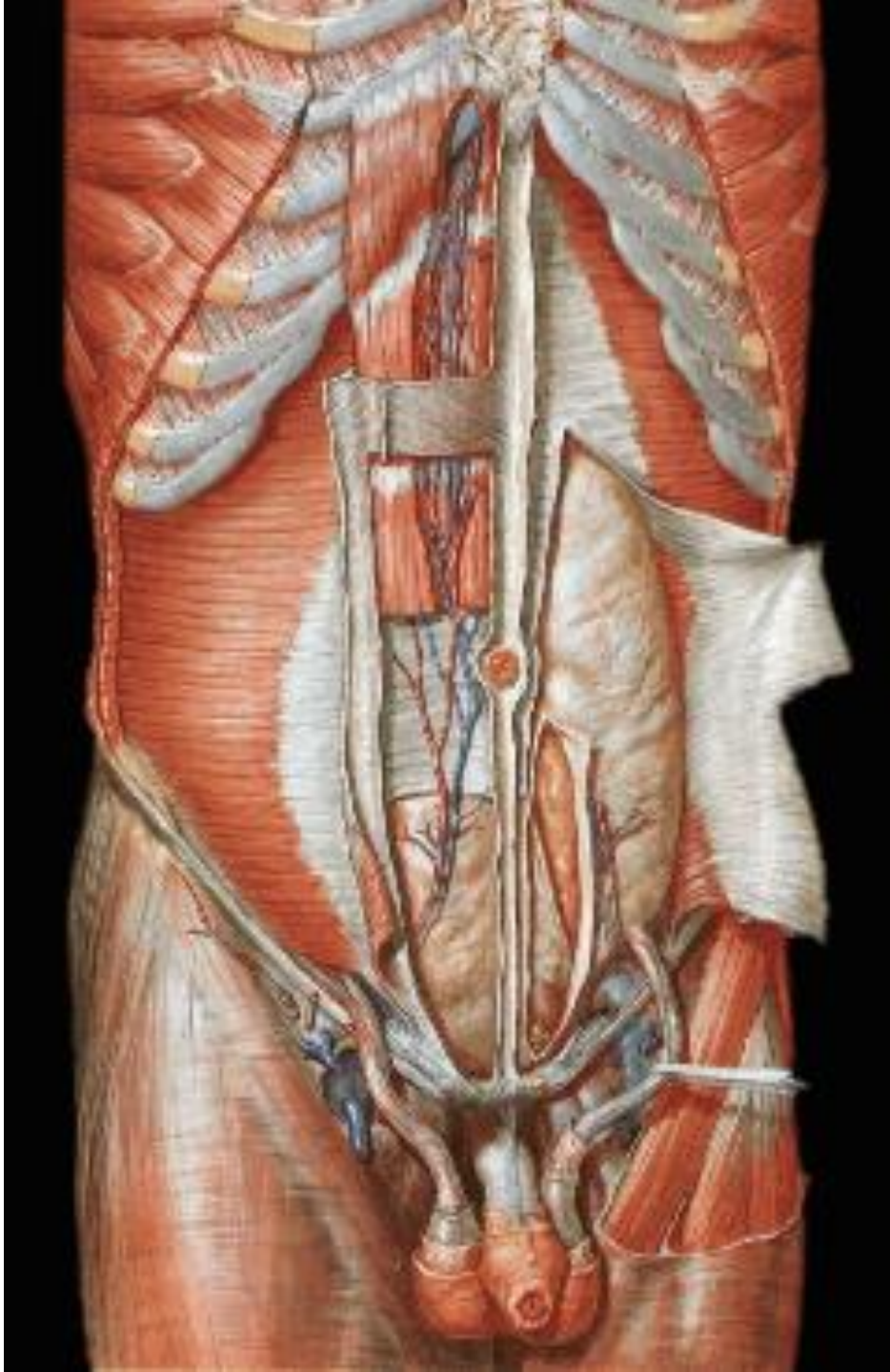
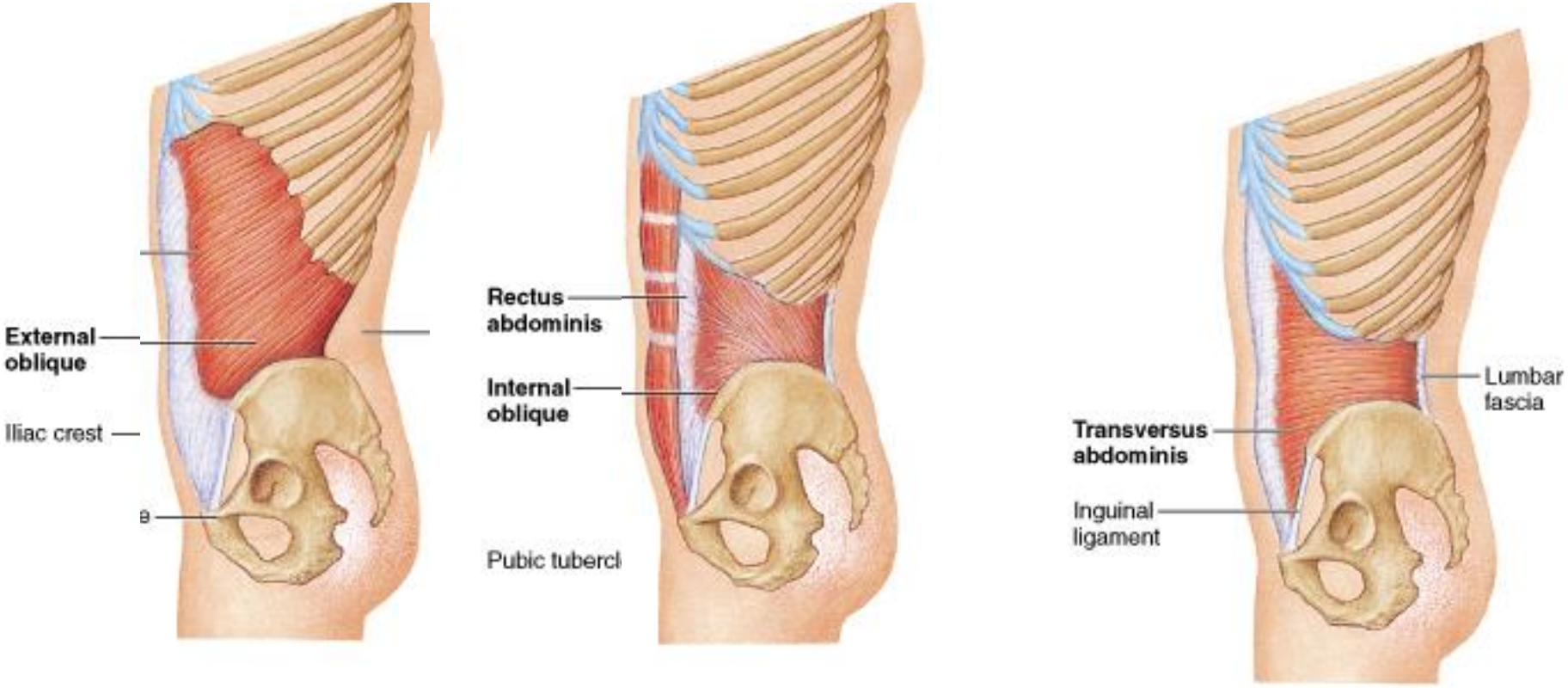
Rectus abdominis (tendinous intersection)
Crest of ilium
Attachment of external oblique (cut) to iliac crest
Internal oblique
Inguinal ligament
(A)
(C)

# Transversus Abdominis





# Muscles of abdominal wall--details

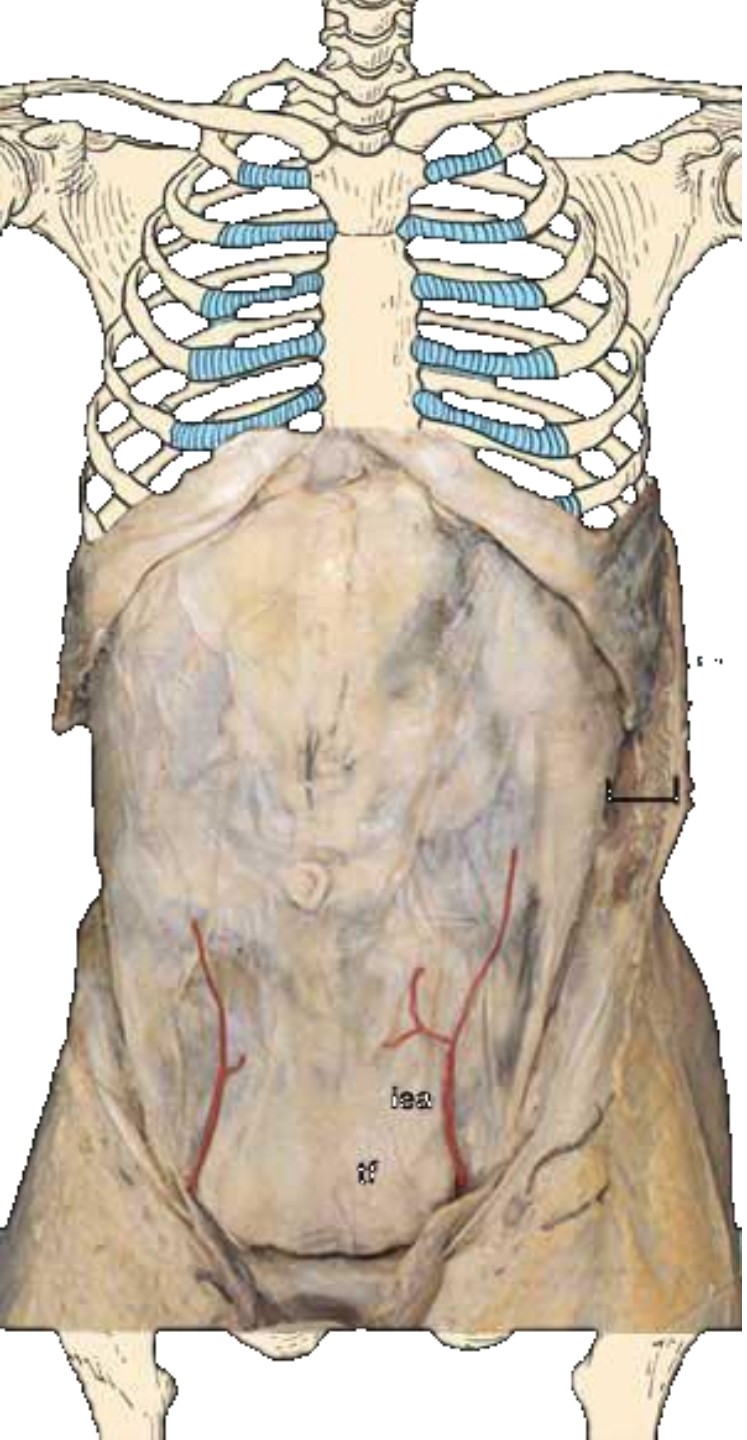


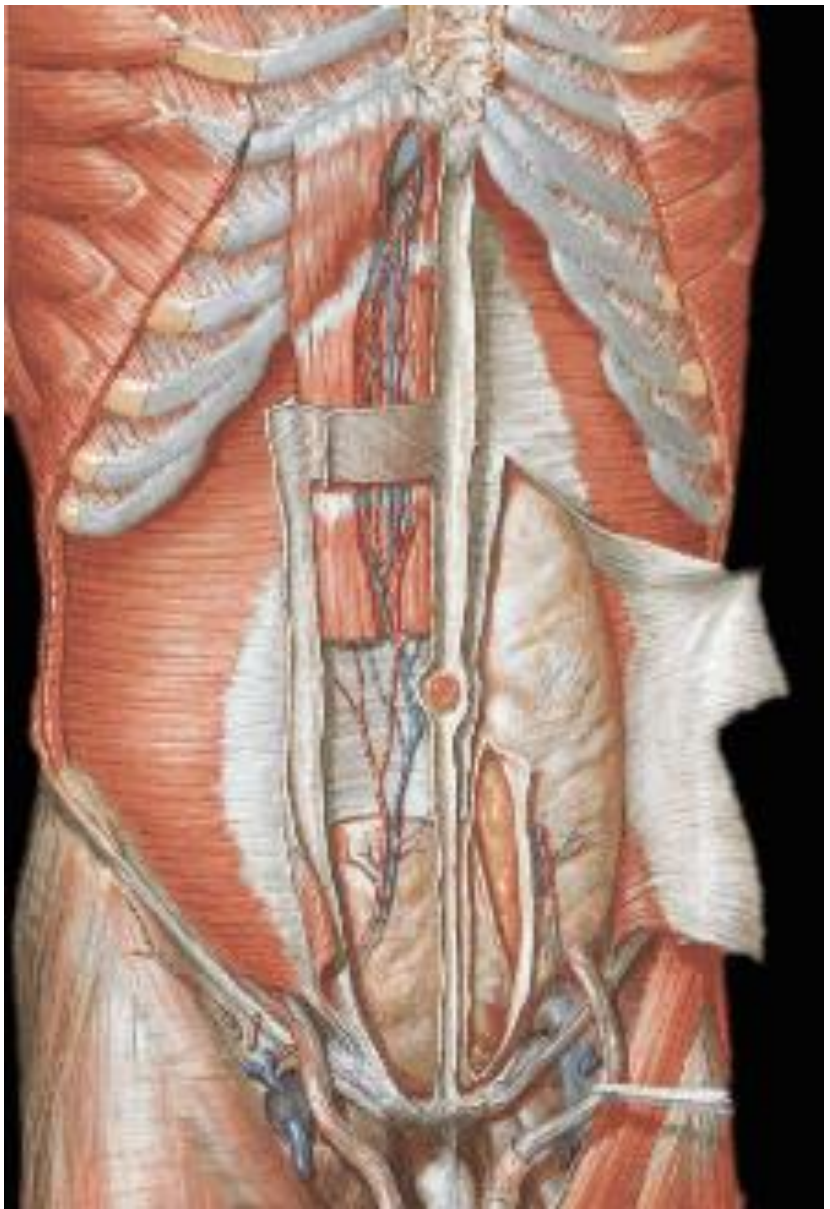

(c)



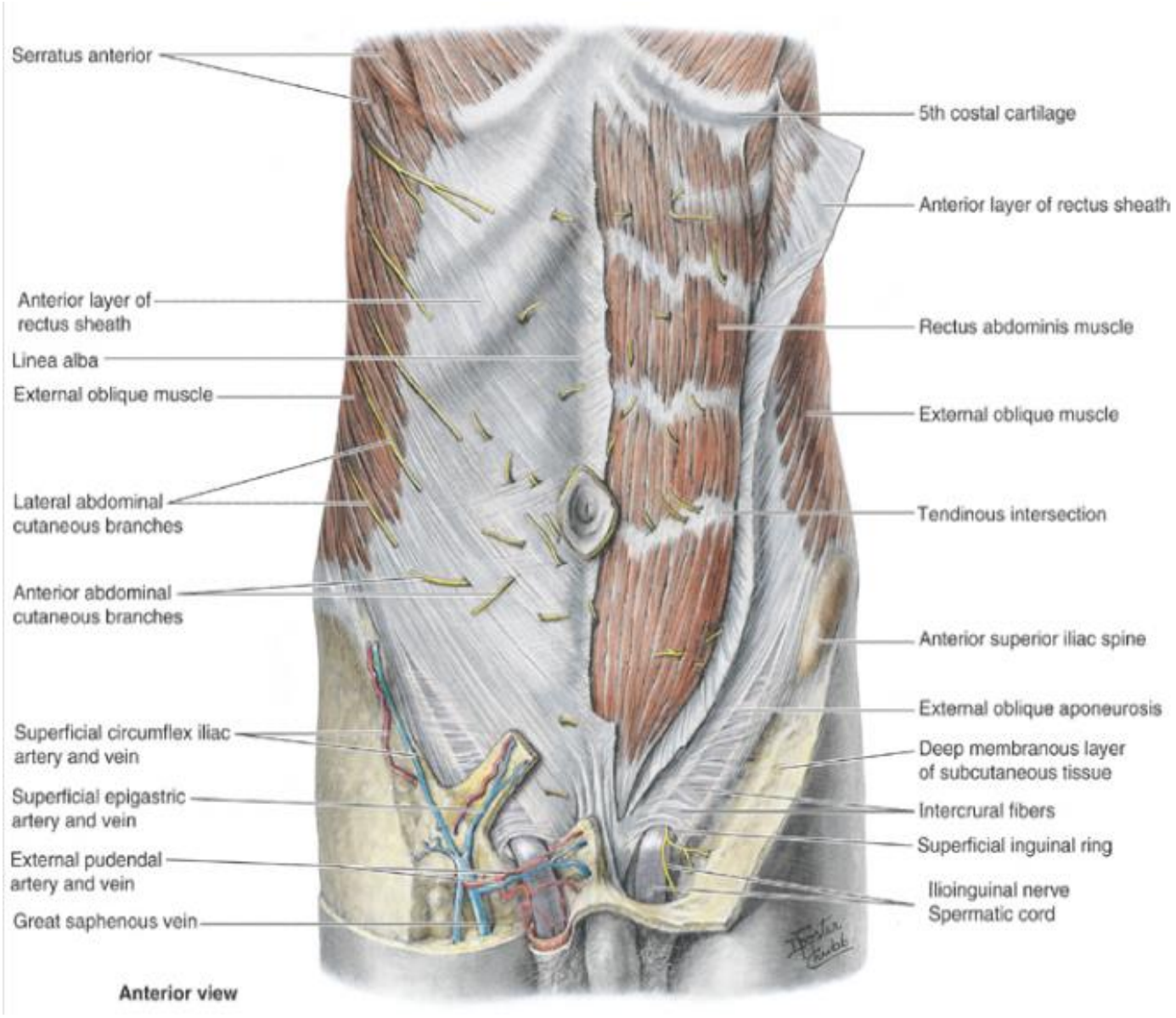
Please see Fi.

# Transversalis Fascia





# Rectus sheath



# Rectus Abdominis Muscle

**Origin:**

The symphysis pubis and pubic crest, pubic tubercle.

**Insertion:**

$5^{th}$, $6^{th}$, $7^{th}$ costal cartilage and xiphoid process.

**Nerve Supply:**

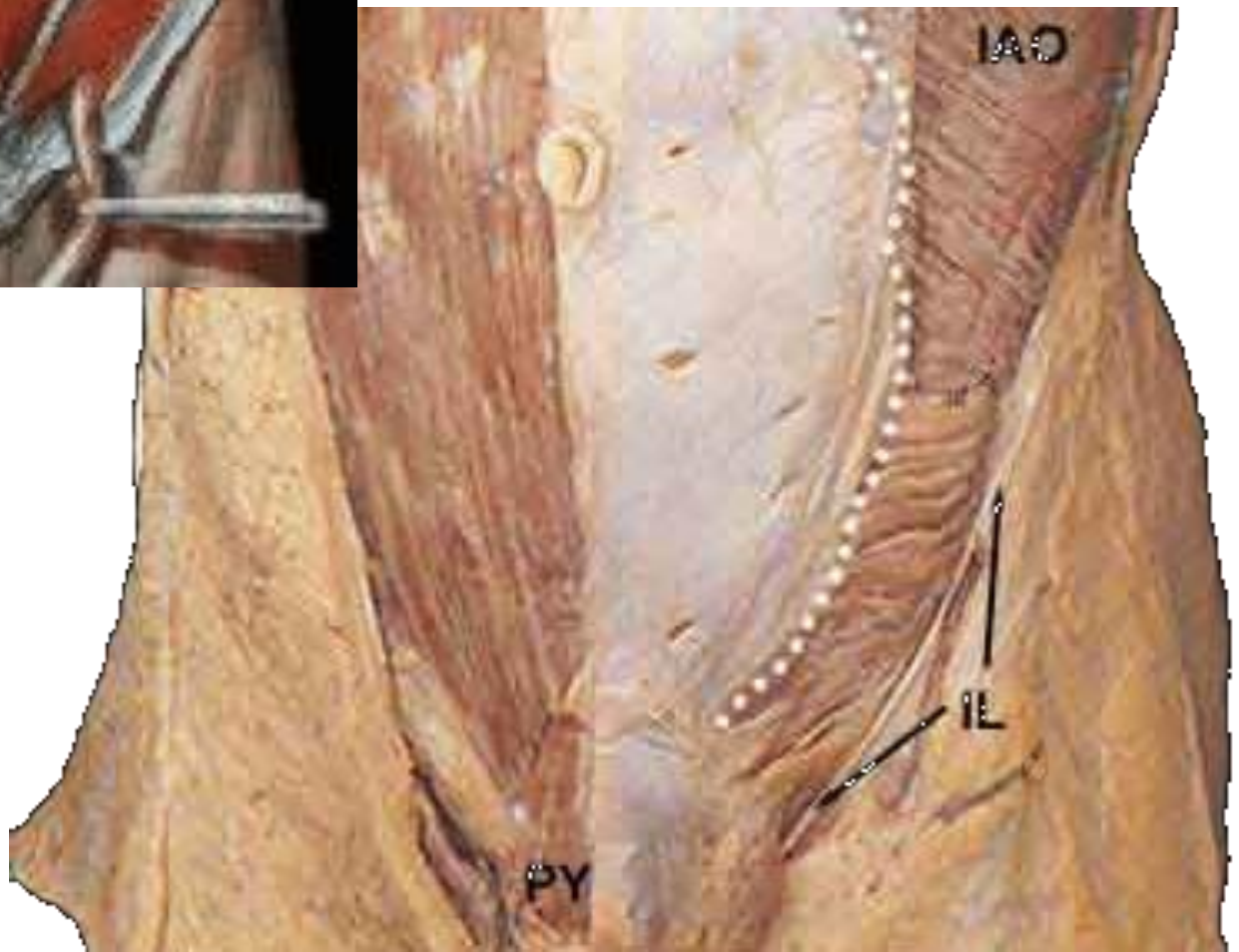
Intercostal nerves anterior rami of T7 T 12.

**Action:**

١. Increase the intra-abdominal pressure.

٢. Flexion of the trunk.

# PYRAMIDALIS



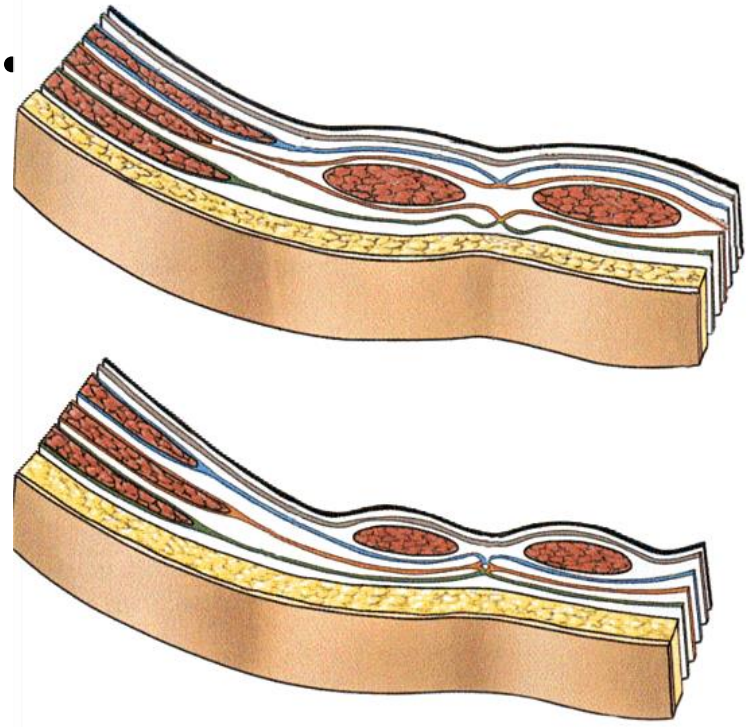
# Rectus sheath

- **Anterior layer** composed of external oblique aponeurosis as well as part of the internal oblique aponeurosis
- **Posterior layer** composed of portion of internal oblique aponeurosis and transverse abdominal aponeurosis
- **Arcuate line** – limit of aponeurotic post rectus sheath, only transversalis fascia covers the posterior Rectus below this level

# Sheath of rectus abdominis

## Anterior layer

- Formed by fusion of aponeurosis of obliquus externus abdominis and anterior leaf of aponeurosis of obliquus internus abdominis



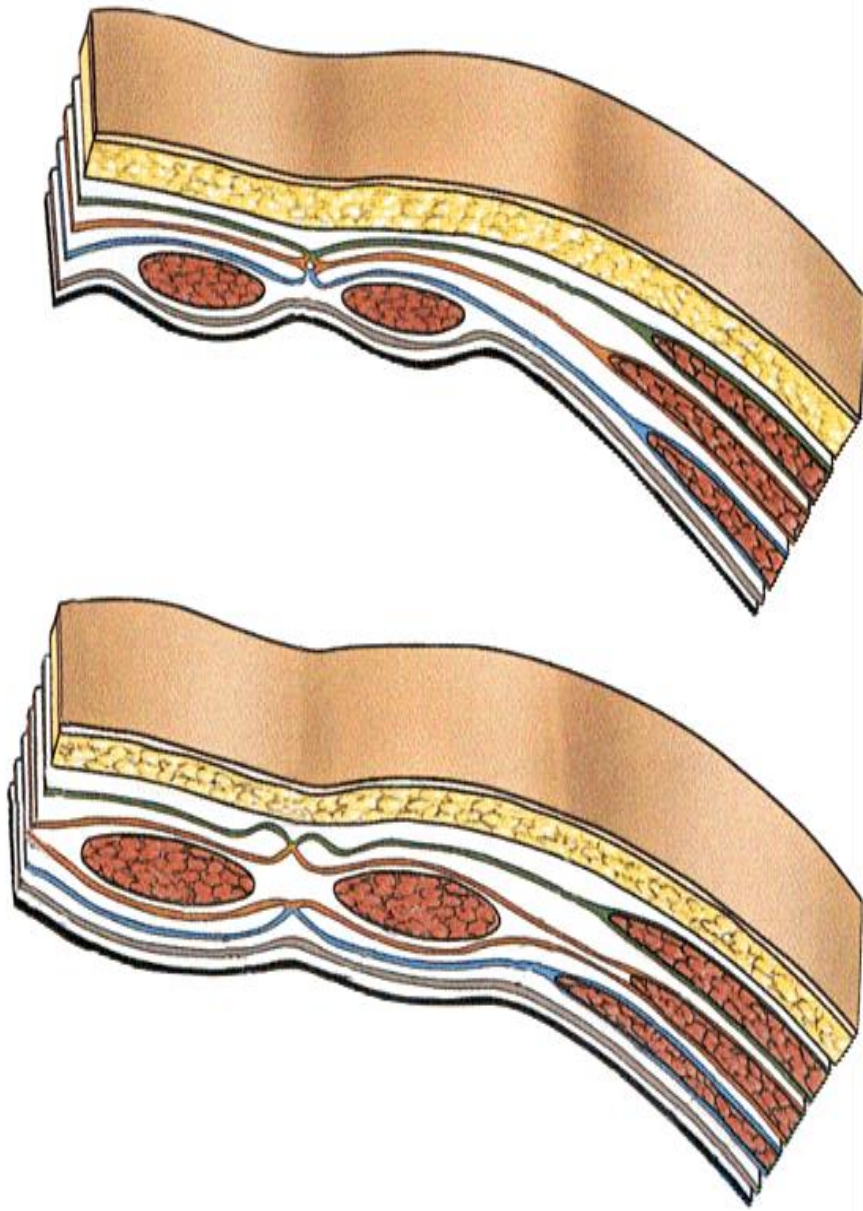
# Sheath of rectus abdominis

## Posterior laye

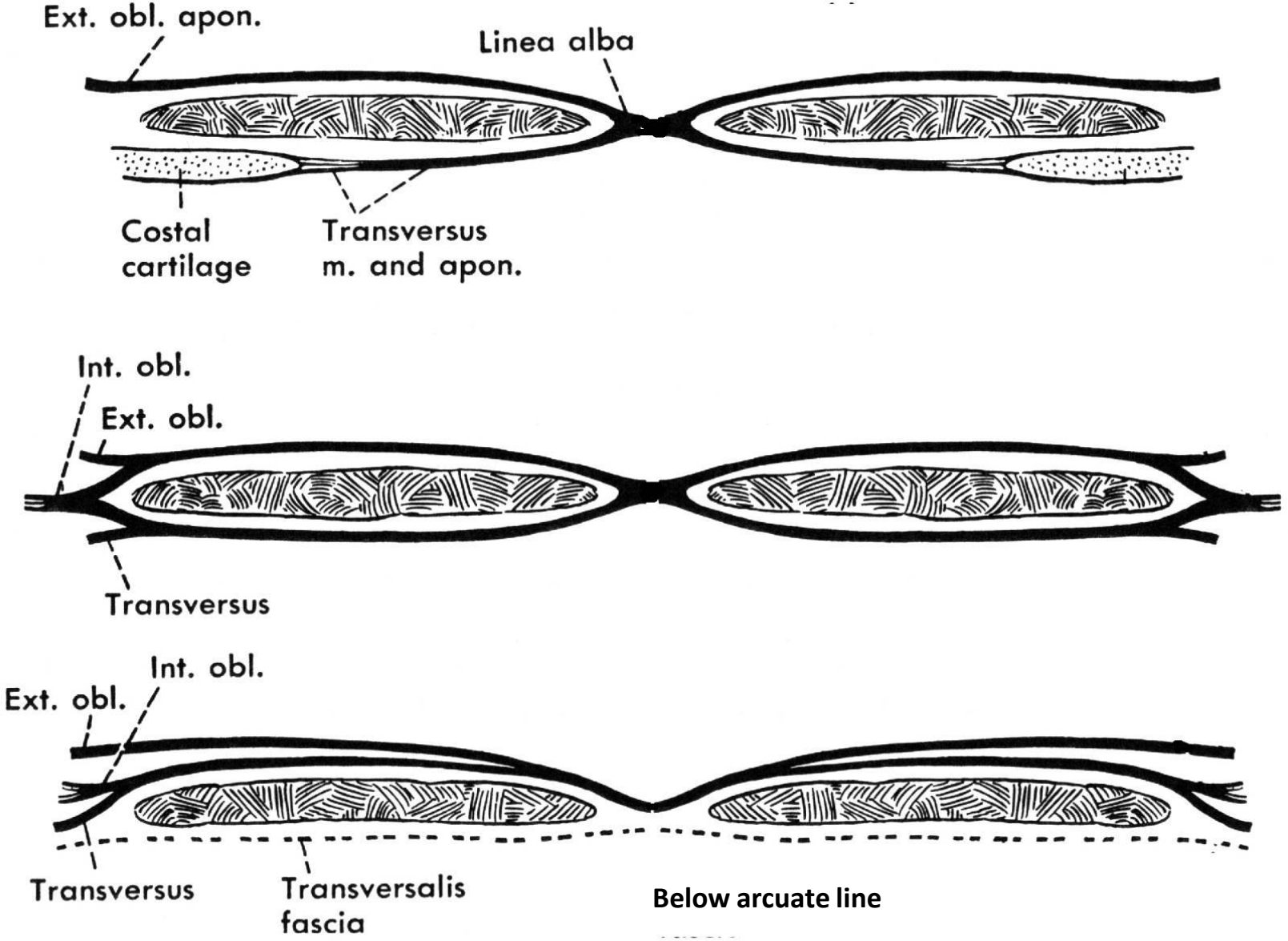
Formed by fusion of posterion leaf of aponeurosis of obliquus internus abdominis and aponeurosis of transversus abdominis

Absent in about 4-5cm below the umbilicus, where aponeuroses of all three muscles form anterior layer the lower free border named **arcuate line**

Below this line rectus abdominis in contact with transverse fascia



# Formation of rectus sheath



# Posterior abdominal wall

**The posterior abdominal wall is mainly composed:**

① Five lumbar vertebrae and associated IV discs.

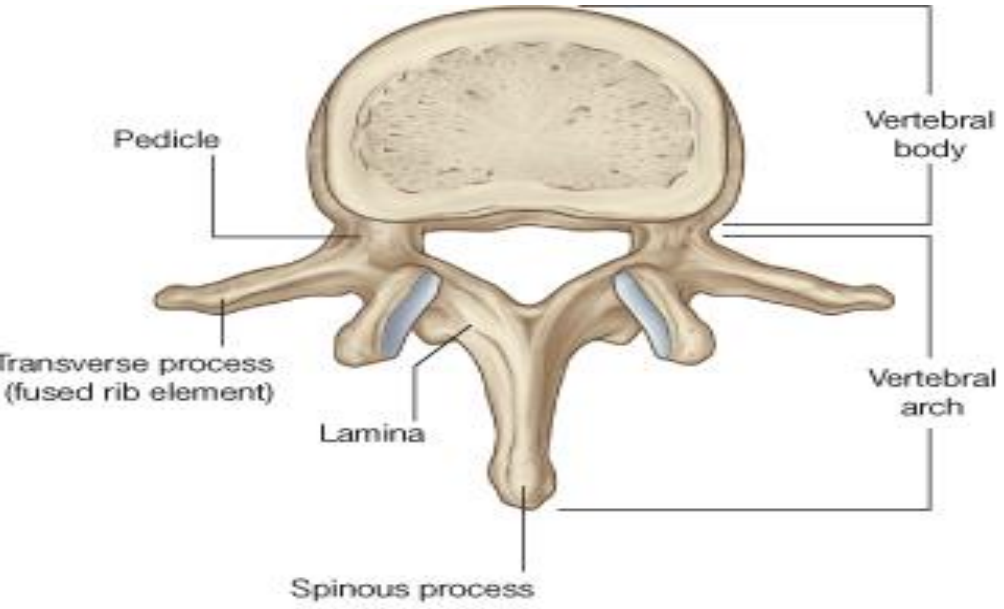
② Post abdominal wall muscles – psoas, quadratus lumborum, iliacus, transverse, abdominal wall oblique muscles.

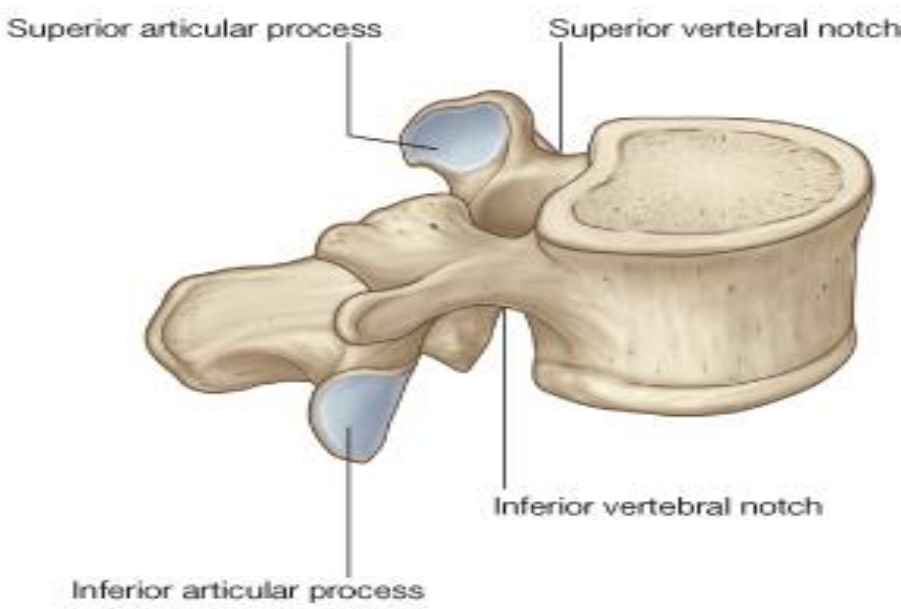
③ Lumbar plexus, composed of the ventral rami of lumbar spinal nerves.

④ Fascia including thoracolumbar fascia.

⑤ Diaphragm contributing to the superior part of the posterior wall

⑥ Fat, nerves, vessels (IVC, aorta) and lymph nodes.



# Fascia of the posterior abdominal wall

The fascia lies between the parital peritoneum and the muscles: it is customizing to name the fascia according to the structure it covers.

- the psoas fascia or psoas sheath. ☆
- the quadratus lumborum fascia. ☆
- the thoracolumbar fascia. ☆

# Muscles of the posterior abdominal wall:

**The main paired muscles in the posterior abdominal wall are:-**

- Psoas major
- Iliacus
- Quadratus lumborum

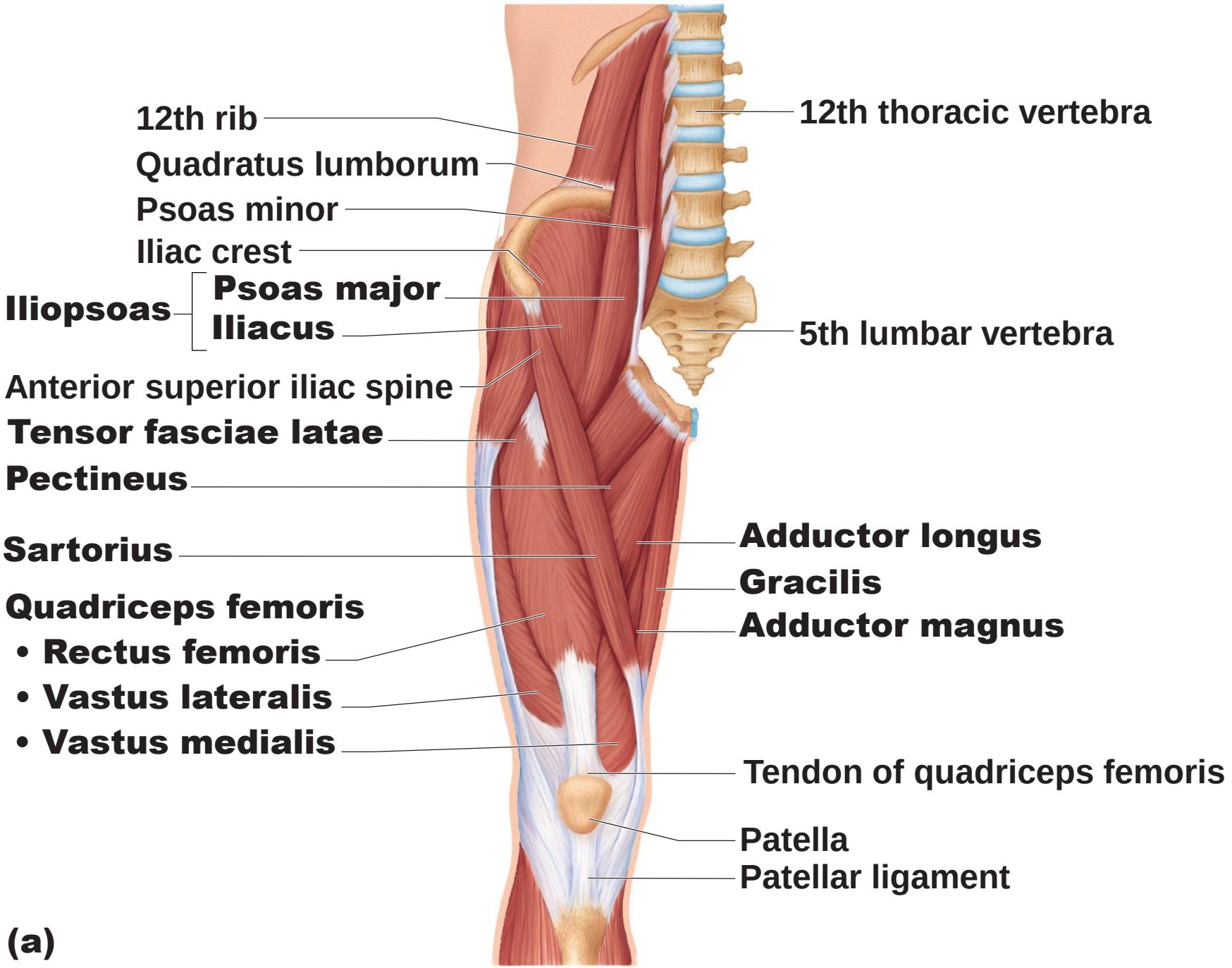
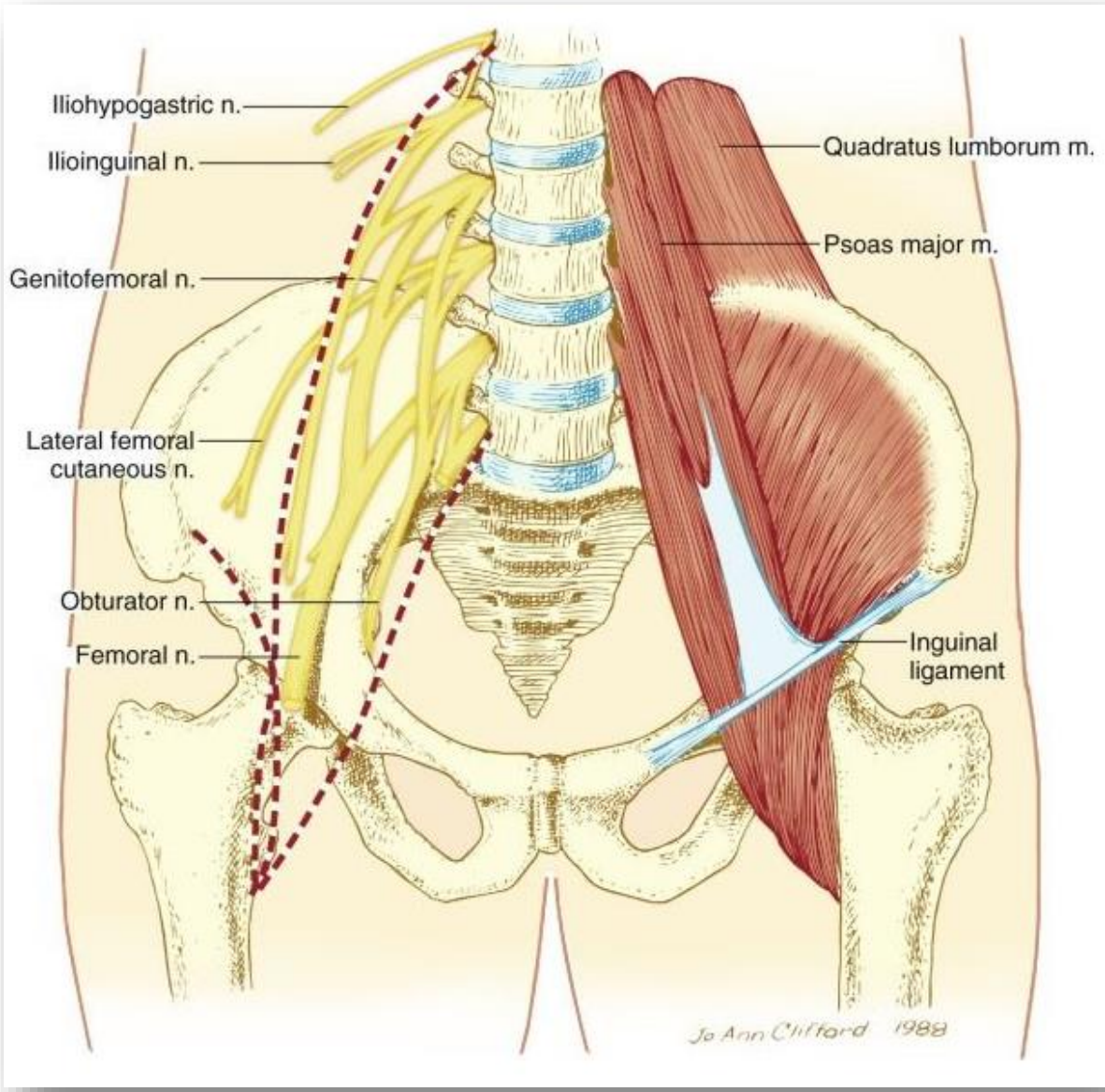
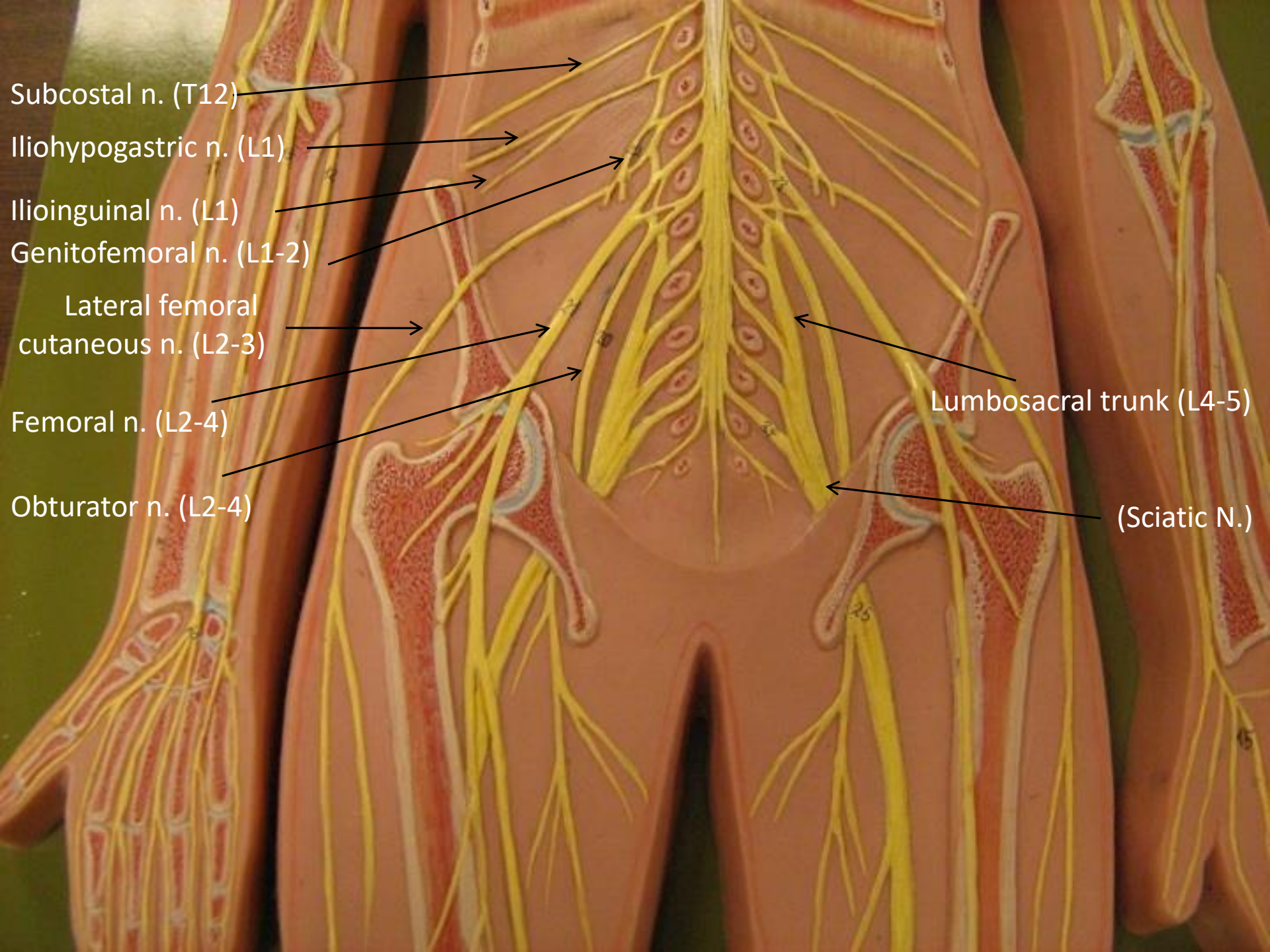


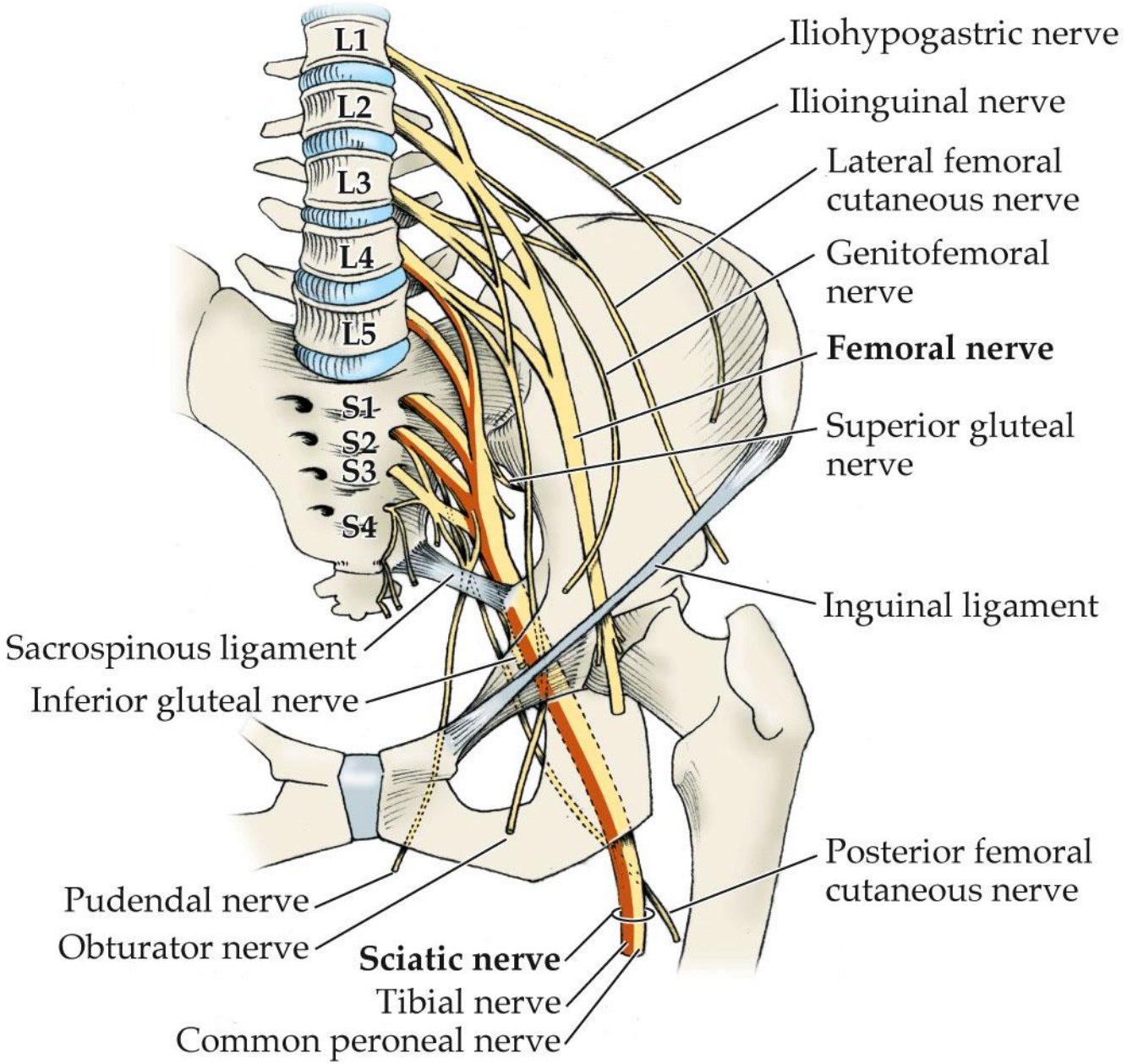

Figure 10.19a

# Anatomy of Lumbar Plexus

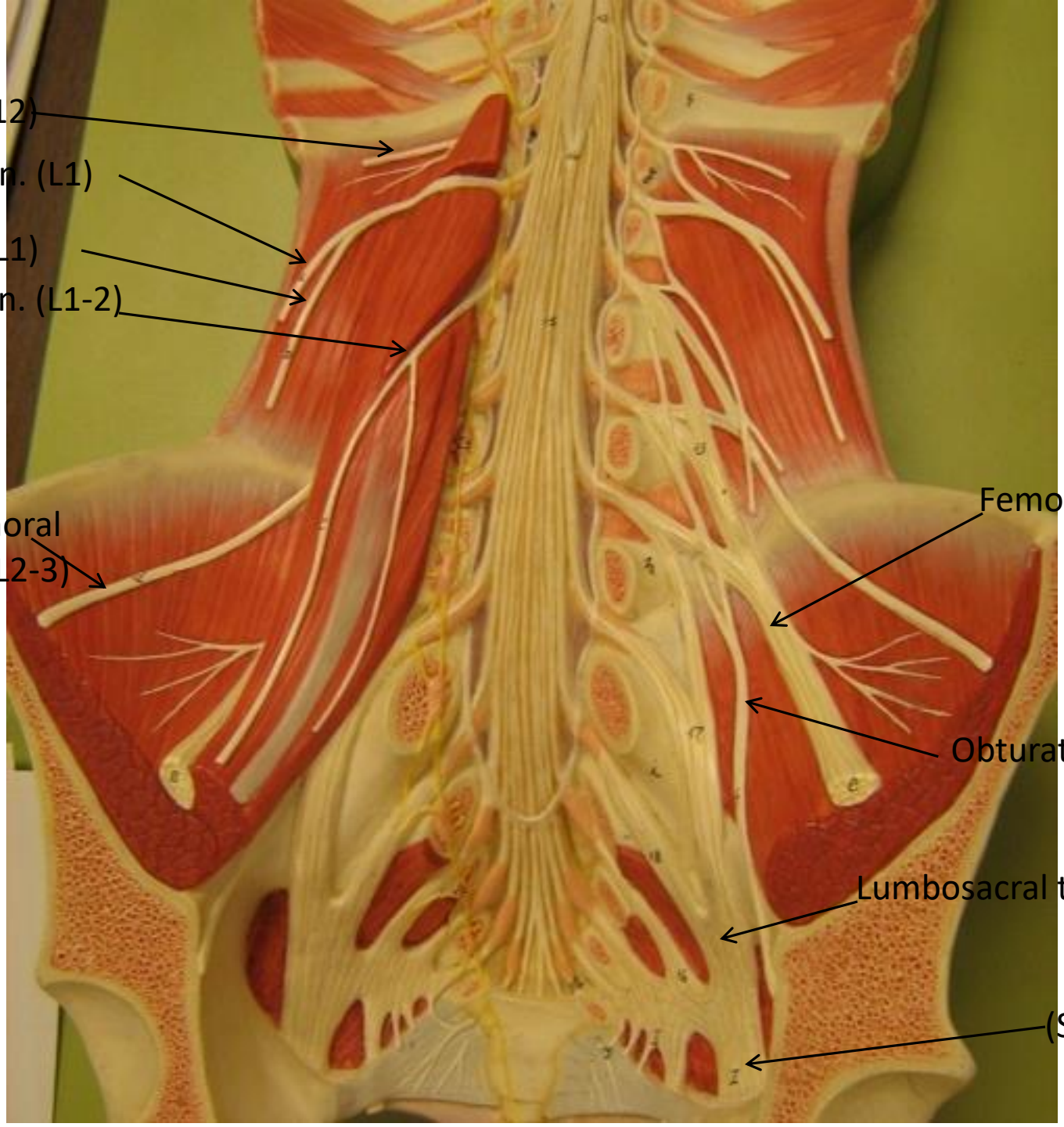
- The lumbar plexus is formed by the anterior rami of the *first four lumbar nerves*; it frequently includes a branch from T12 and occasionally from L5.
- The plexus lies between the psoas major and quadratus lumborum muscles in the so-called *psoas compartment*.




Subcostal n. (T12)
Iliohypogastric n. (L1)
Ilioinguinal n. (L1)
Genitofemoral n. (L1-2)
Lateral femoral cutaneous n. (L2-3)
Femoral n. (L2-4)
Obturator n. (L2-4)
Lumbosacral trunk (L4-5)
(Sciatic N.)




(After Kahle W, Leonhardt H, Platzer W. 1993. Color Atlas/Text of Human Anatomy, Vol. 3: Nervous System and Sensory Organs, 4th Ed. Thieme, New York.)


Subcostal n. (T12)
Iliohypogastric n. (L1)
Ilioinguinal n. (L1)
Genitofemoral n. (L1-2)
Lateral femoral cutaneous n. (L2-3)
Femoral n. (L2-4)
Obturator n. (L2-4)
Lumbosacral trunk (L4-5)
(Sciatic N.)

# Muscles of the Lx & abdomen

| Name | Origin | Insertion | Action | Innervation |
|---|---|---|---|---|
| Psoas minor | Sides of T12 & L1 vertebrae & T12L1 disc | Long tendon lying on psoas major | Weak flexor of lumbar spine | L1 nerve |
| Psoas major | T12-L5 vertebral bodies, transverse processes & discs | Lesser trochanter of the femur | Flexion of Lx spine and hip flexor | L1-3/4 nerves |
| Iliacus | Posterior 2/3 of iliac fossa | Lesser trochanter of femur | Trunk flexion & hip flexion | Femoral nerve L2-3 |

# Psoas Major Muscle

**Origin:**

The transverse processes and sides of vertebral bodies and their intevertebral discs from T12 till L5 vertebrae.

**Insertion:**

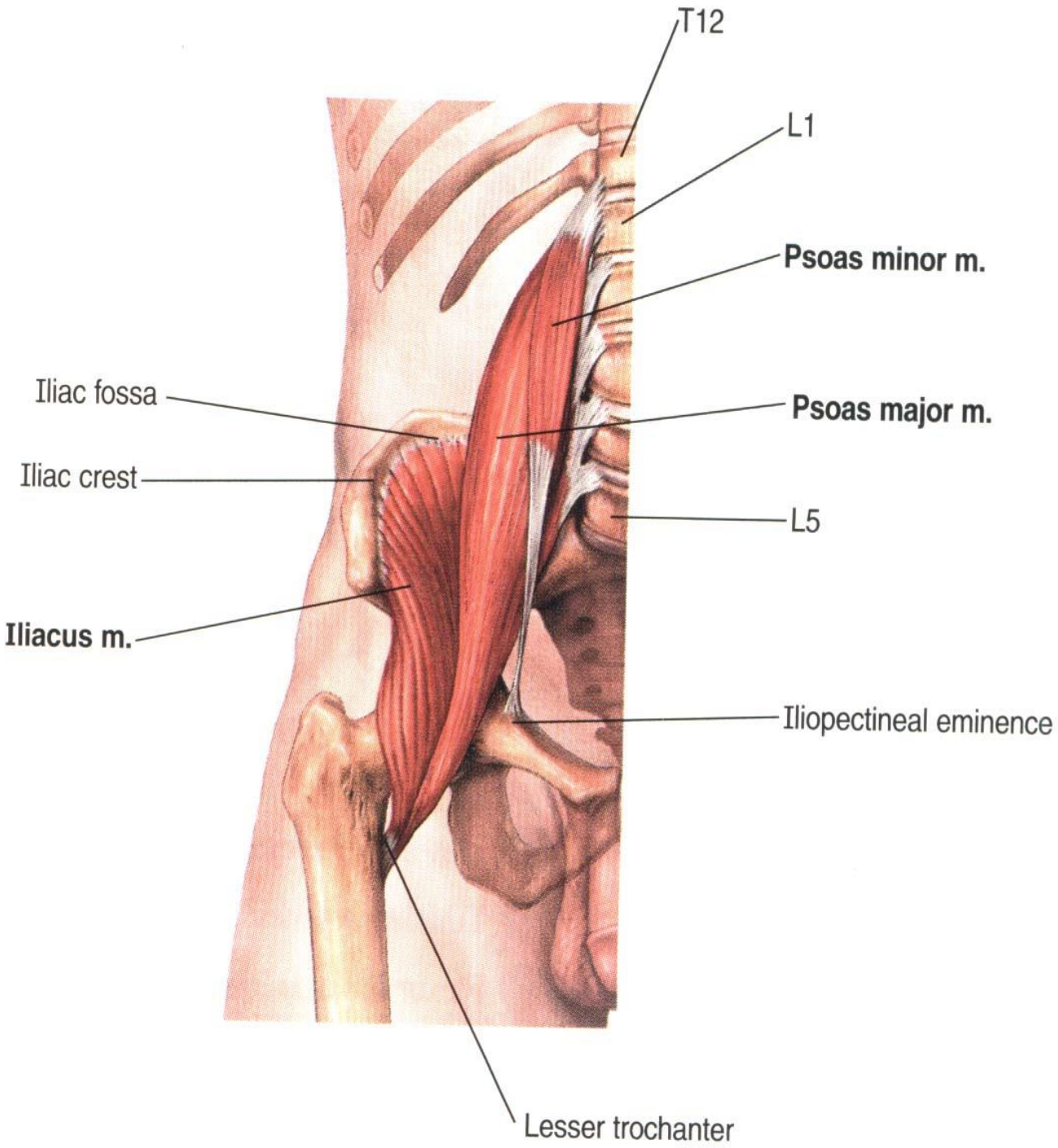
Lesser trochanter of the femur.

**Nerve Supply:**

Lumbar spinal nerves (lumbar plexus < anterior rami of L1to L3).

**Action:**

Flexion of the hip joint.

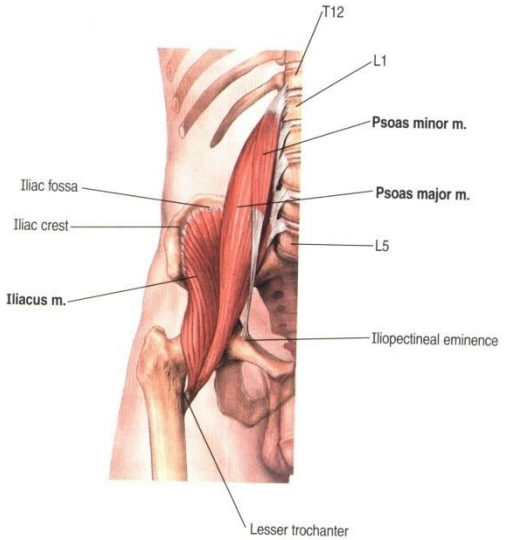

T12
L1
Psoas minor m.
Iliac fossa
Psoas major m.
Iliac crest
L5
Iliacus m.
Iliopectineal eminence
Lesser trochanter

# Psoas minor

- Sometimes absent
- Origin: lateral surface of bodies of T12and L1 vertebrae and the intervertebral disc
- Insertion : pectineal line of the pelvic brim and the iliopubic eminence .

Inervation : anterior rami of L1

action :Weak flexion



# Quadratus Lumborum Muscle

**Origin:**

The ilio-lumar ligament, iliac crest and transverse processes of the lower lumbar vertebrae.

**Insertion:**

Last rib,the inferior border and transverse processes of upper lumbar vertebrae. L1-L4

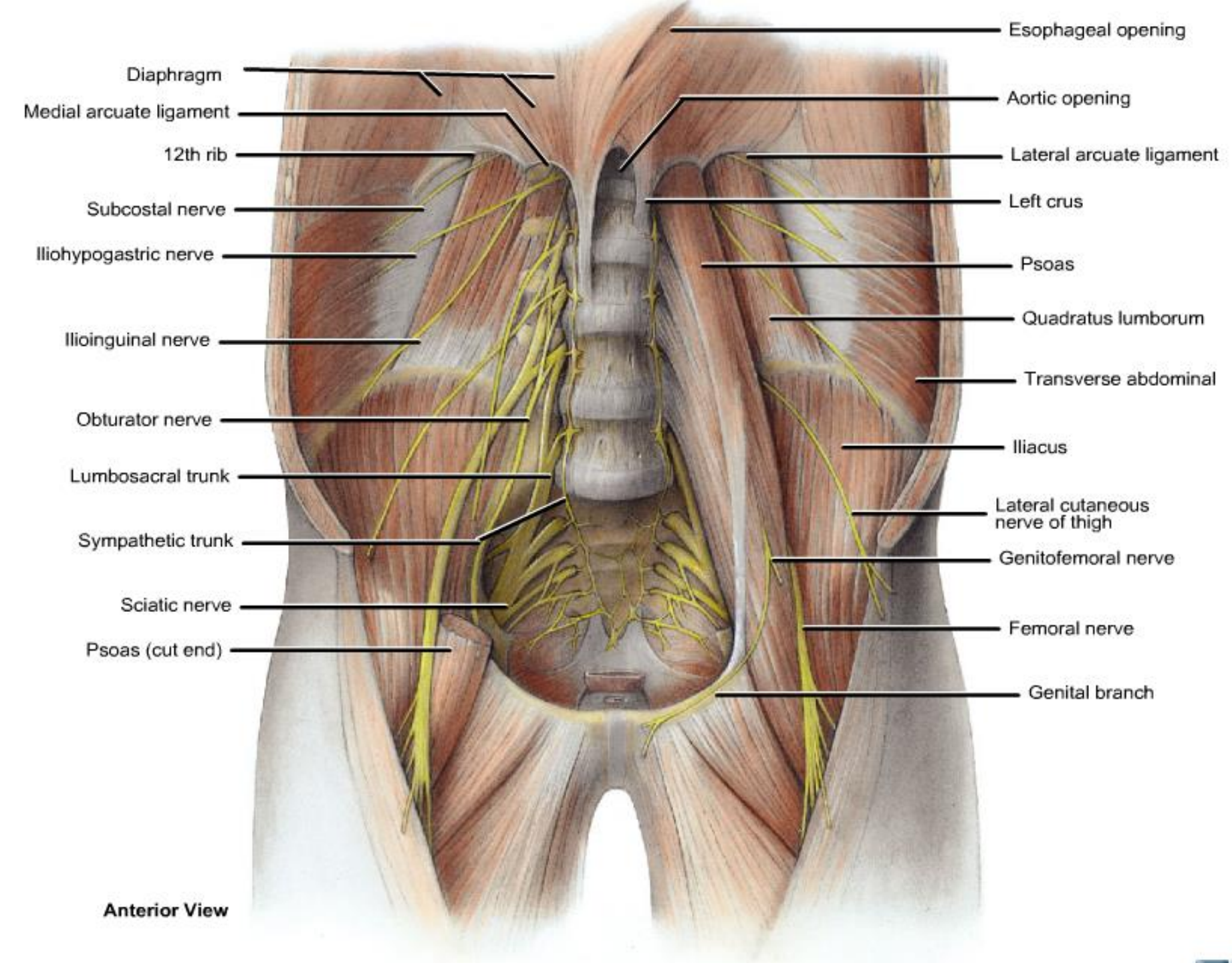
**Nerve Supply:**

Lumbar spinal nerves (lumbar plexus anterior rami of T12 and L1 to L4 ).

**Action:**

١. Lateral flexion of the vertebral column.

٢. Fixation of the last rib during expiration.


Esophageal opening
Diaphragm
Aortic opening
Medial arcuate ligament
12th rib
Lateral arcuate ligament
Subcostal nerve
Left crus
Iliohypogastric nerve
Psoas
Quadratus lumborum
Ilioinguinal nerve
Transverse abdominal
Obturator nerve
Iliacus
Lumbosacral trunk
Lateral cutaneous nerve of thigh
Sympathetic trunk
Genitofemoral nerve
Sciatic nerve
Femoral nerve
Psoas (cut end)
Genital branch
Anterior View

# Iliacus

**Origin:**

anterior sacro –iliac and iliolumbar ligaments , and upper lateral surface of sacrum

- upper 2/3 of Iliac fossa

**Insertion:**

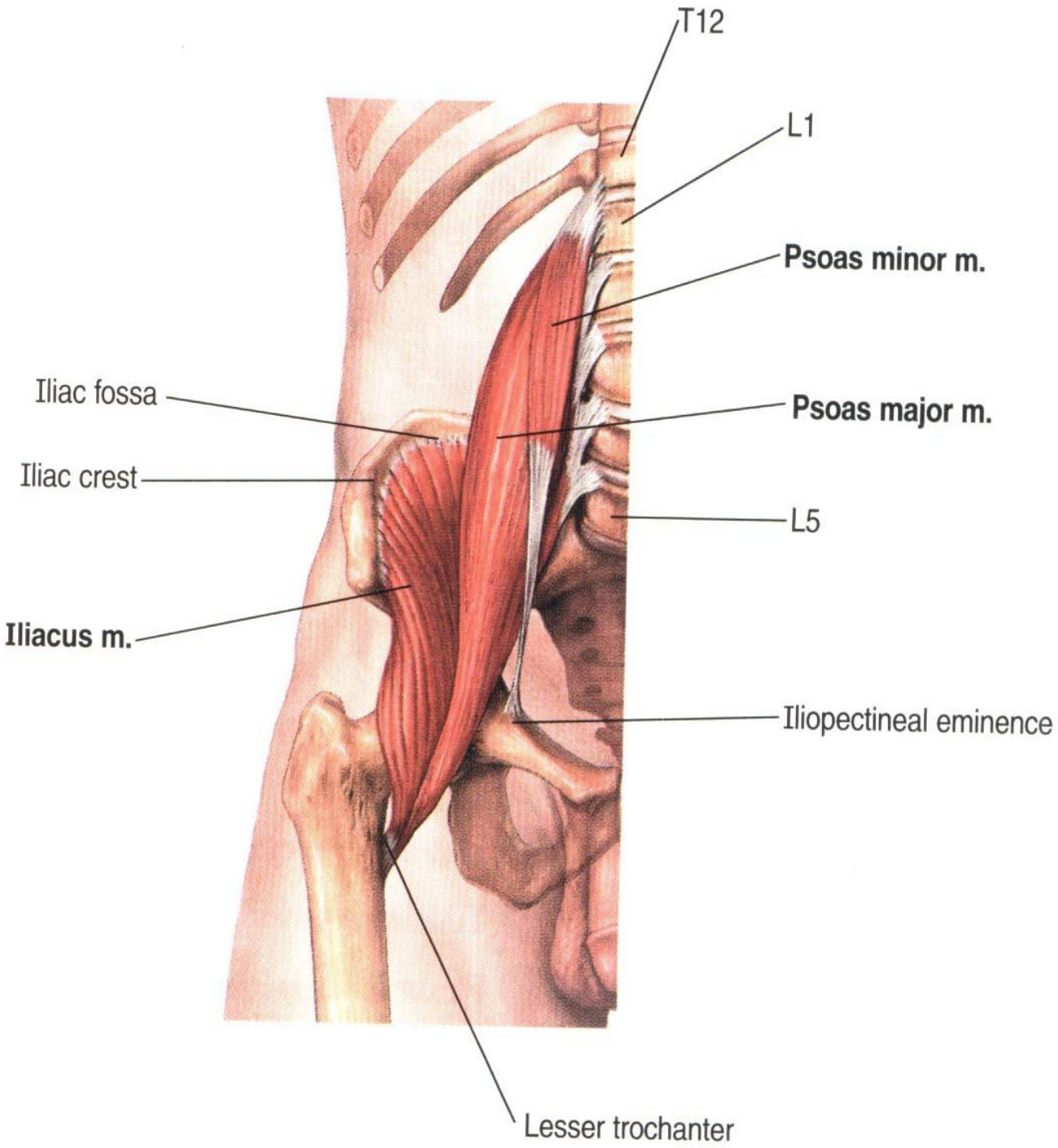
Lesser trochanter of the femur.

**Nerve Supply:**

Femoral nerve( L2-L4).

**Action:**

Flexion of the hip joint.


T12
L1
Psoas minor m.
Iliac fossa
Psoas major m.
Iliac crest
L5
Iliacus m.
Iliopectineal eminence
Lesser trochanter

# Muscles of the Lx & abdomen

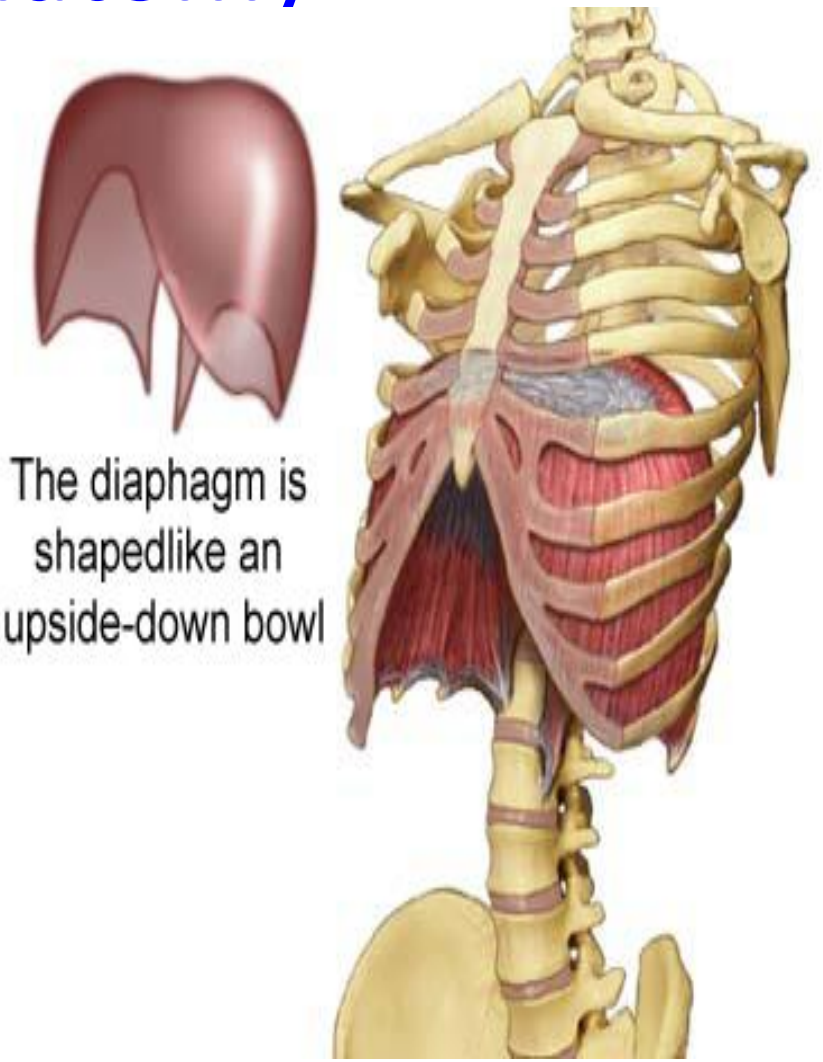
| Name | Origin | Insertion | Action | Innervation |
|---|---|---|---|---|
| Quadratuslumborum | Iliac crest | Inferior surface of 12th rib | Ipsilateral lateral flexion, trunk extension | Subcostal nerve & T12-L3-4 nerves |
| Multifidus | Back of sacrum, Lx vertebrae, transverse processes of Tx | Spines of all vertebrae from L5 to axis | Rotation, extension & lateral flexion | Adjacent spinal nerves |
| Transversusabdominis | Lateral 1/3 of inguinal ligament & anterior 2/3 of iliac crest | Aponeurotic sheath into linea alba & conjoint tendon into pubic crest | Increasing intra-abdominal pressure & acting as a muscular corset | Anterior primary rami of T7-12 & L1 |

# Clinical Anatomy

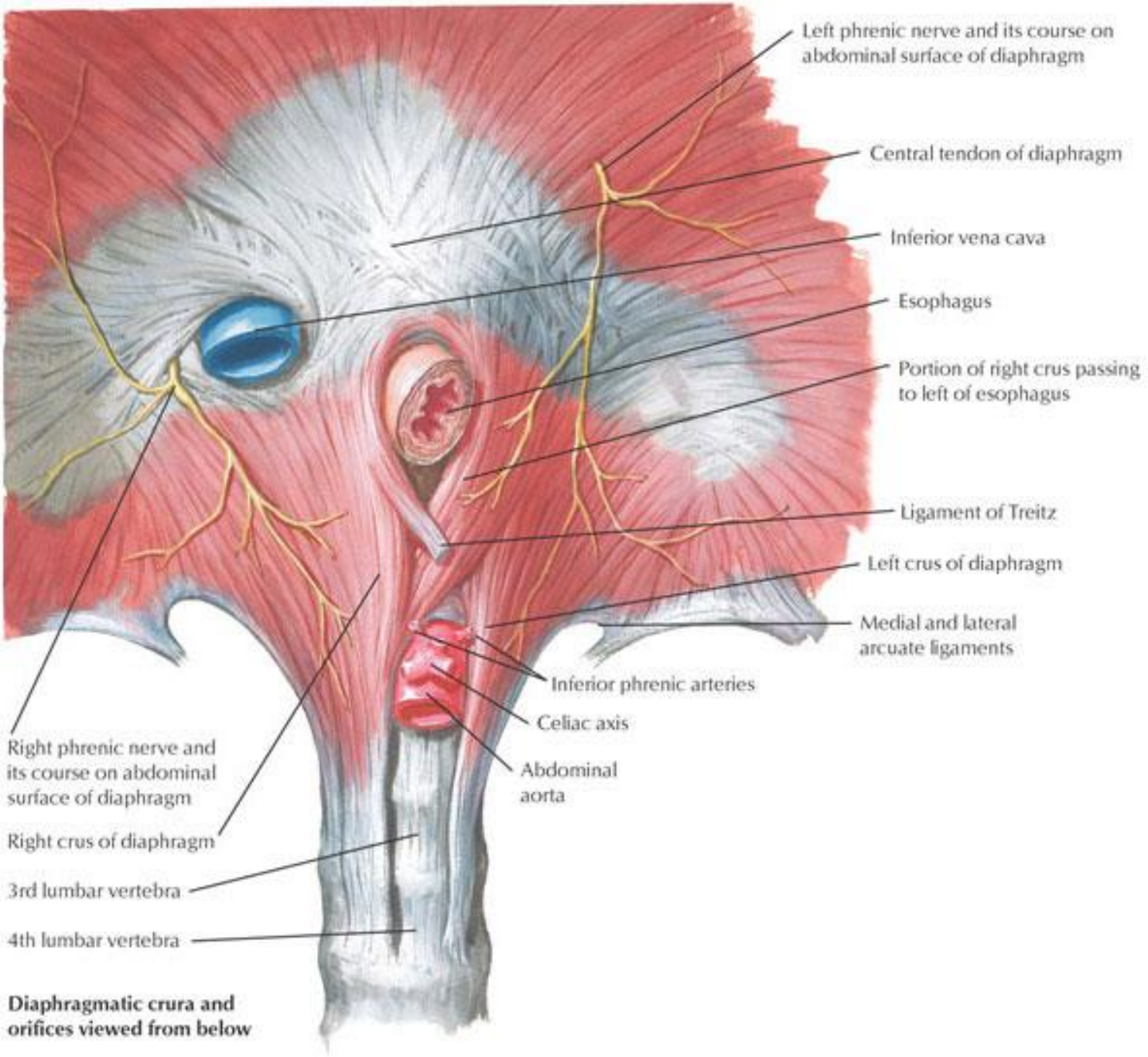
## Muscles of Inspiration:

***Diaphragm: –***

- **Separates thoracic and abdominal activities**
- **Innervation: phrenic nerve**
- **Inhalation – diaphragm contracts enlarging the thoracic cavity and reducing intra-thoracic pressure (air drawn into lungs)**
- **Exhalation – diaphragm relaxes and air is exhaled by elastic recoil of the lungs**



a




**Diaphragmatic crura and orifices viewed from below**

b

Portion of right crus pa

Portion of right crus pas

F. Netter M.D.

# Diaphragm

**Origin:**

١. Sternal head: from xiphoid process.

٢. Costal head: lower six ribs and costal cartilage.

٣. Vertebral head: right and left crura from the first, second and third lumbar vertebrae and arcuate ligaments.

**Insertion:**

Central tendon of the diaphragm.

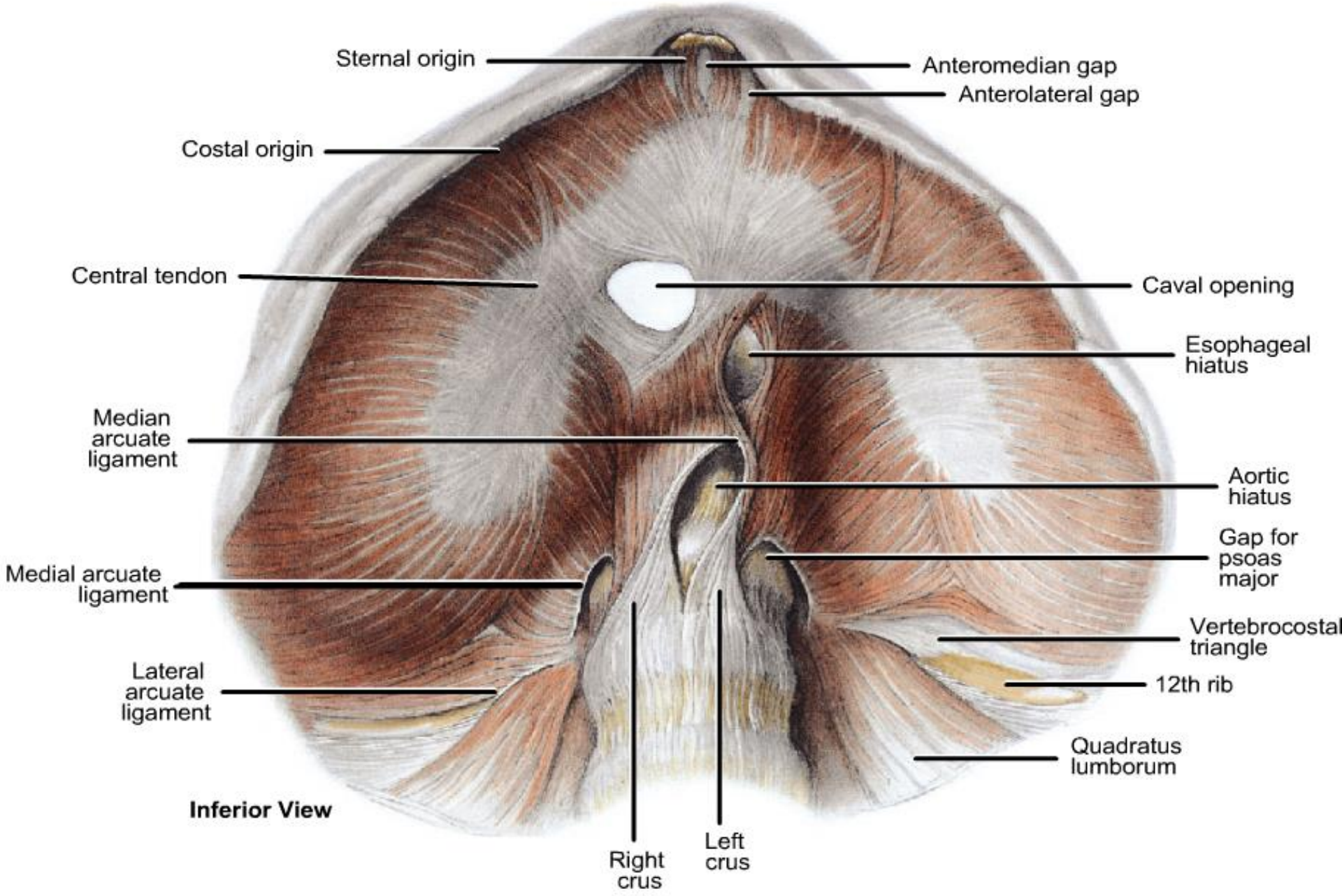
**Nerve Supply:**

Motor: phrenic nerve.

Sensory: phrenic and Intercostal nerves.

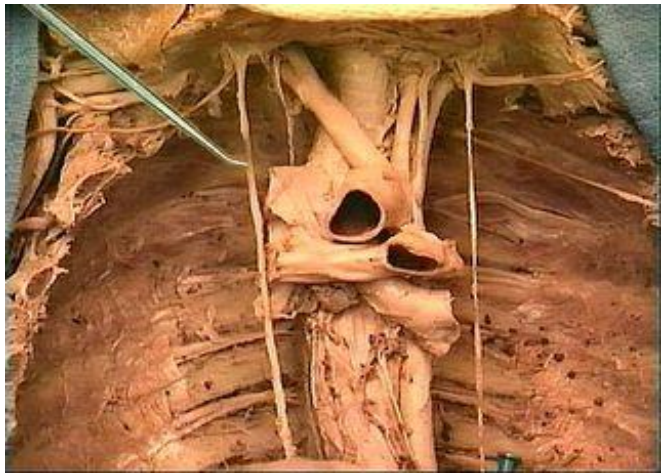
**Action:**

Increase the vertebral diameter of the thoracic cavity (muscle of inspiration).


Sternal origin
Anteromedian gap
Anterolateral gap
Costal origin
Central tendon
Caval opening
Esophageal hiatus
Median arcuate ligament
Aortic hiatus
Gap for psoas major
Medial arcuate ligament
Vertebrocostal triangle
Lateral arcuate ligament
12th rib
Quadratus lumborum
Inferior View
Right crus
Left crus

# Phrenic Nerve Anatomy

- Originates from C3-C5
  - Primarily C4 –
- Motor innervation to diaphragm
- Sensory fibers
  - Pleura –
  - Pericardium –
  - Abdominal components –



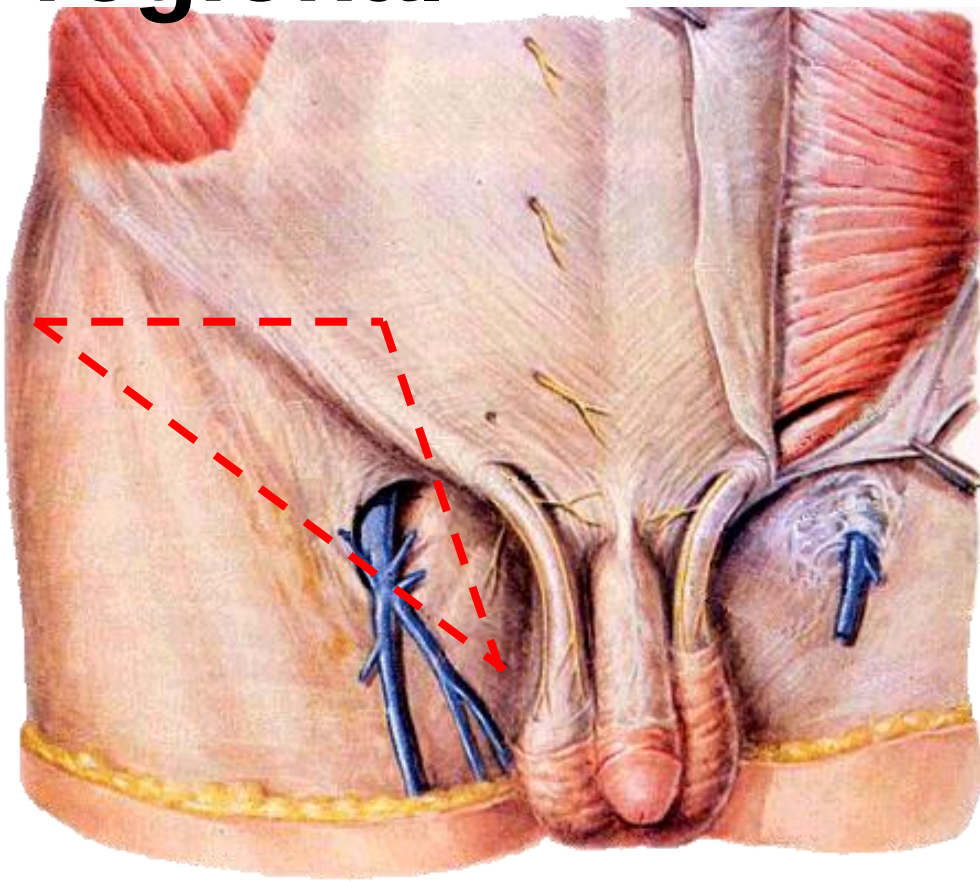
# Phrenic Nerve Anatomy
# Accessory Phrenic Nerve

- Occurs in 15-25% of people
- A branch of C5 which would otherwise pass to subclavius
- Begins lateral to the phrenic nerve in the neck
- Obliquely traverses scalenus anterior
- Joins the phrenic nerve at the root of the neck
- Also supplies diaphragm with efferent fibers

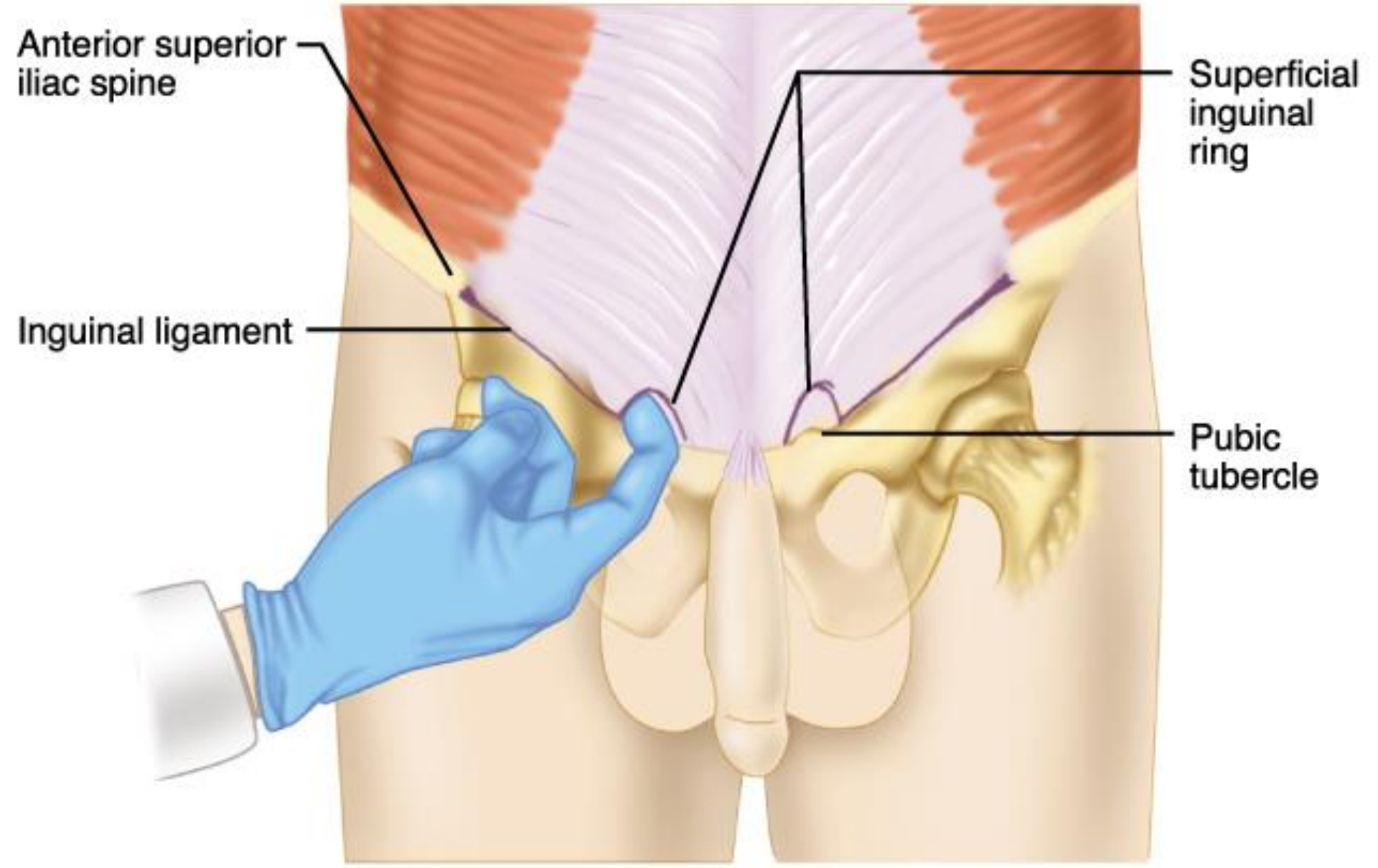
# Inguinal regional

## Boundarie

- Inguinal ligament
- Lateral margin of rectus abdominis
- A horizontal line stretching from anterior iliac spine to lateral margin of rectus abdominis



Boundaries

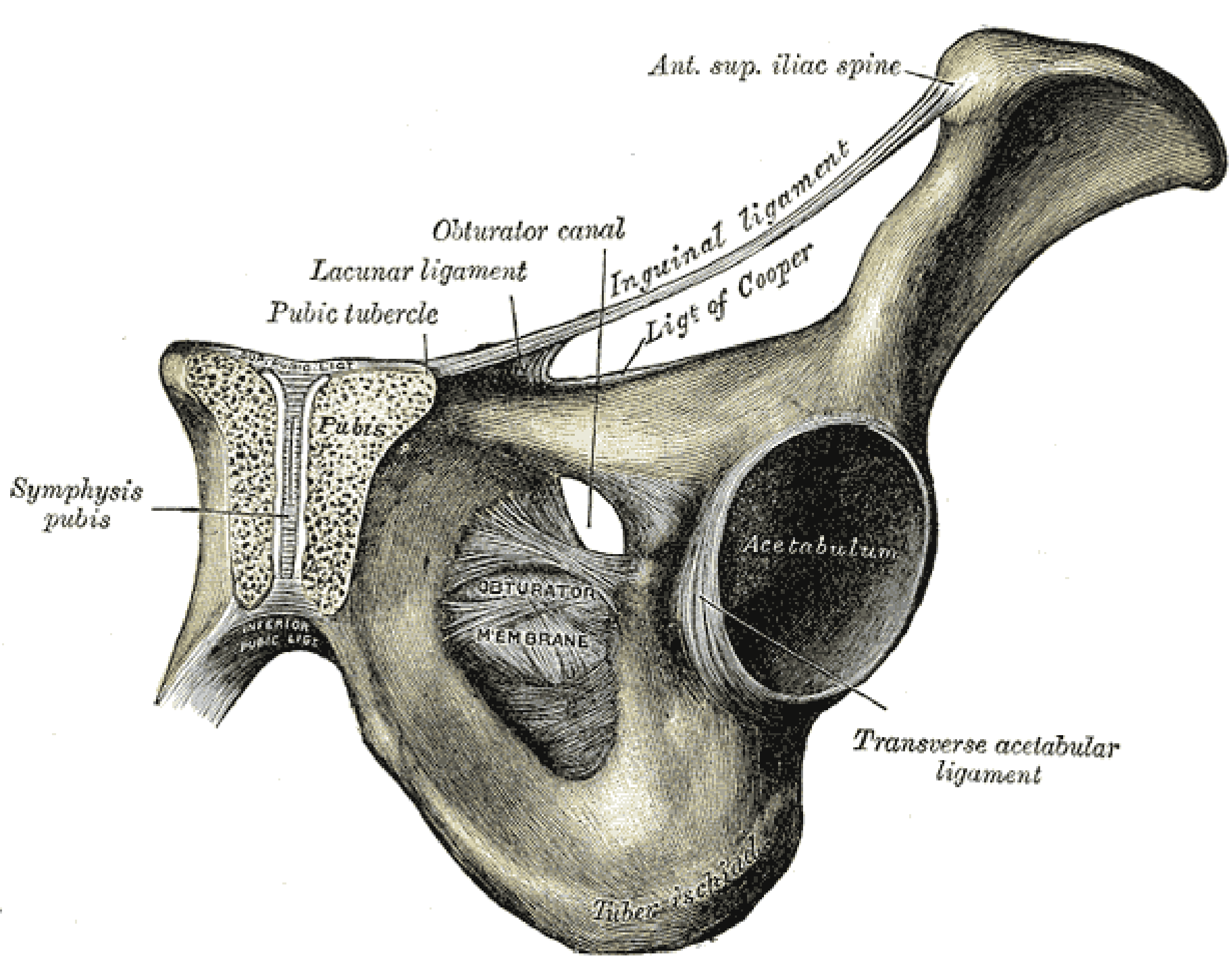


# Inguinal Ligament

- Inguinal ligament:

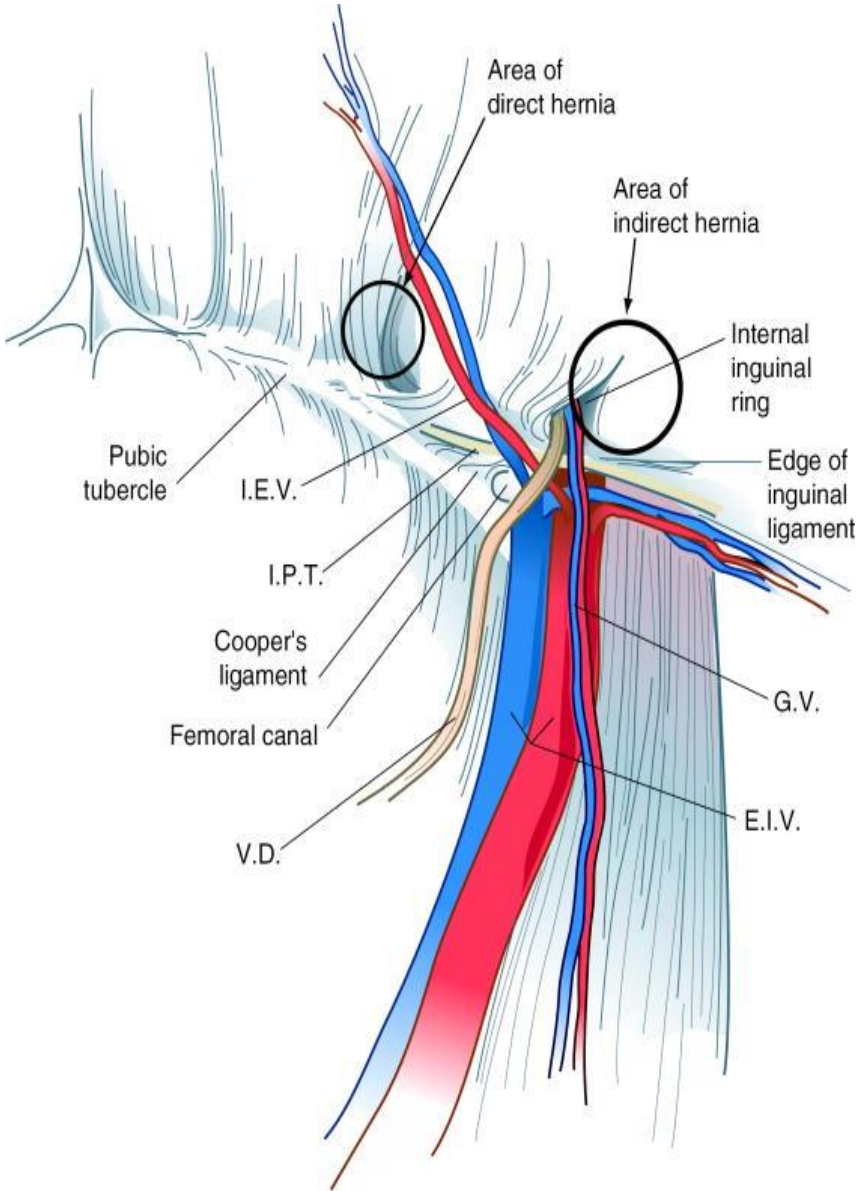
Thickened lower border of external oblique aponeurosis.

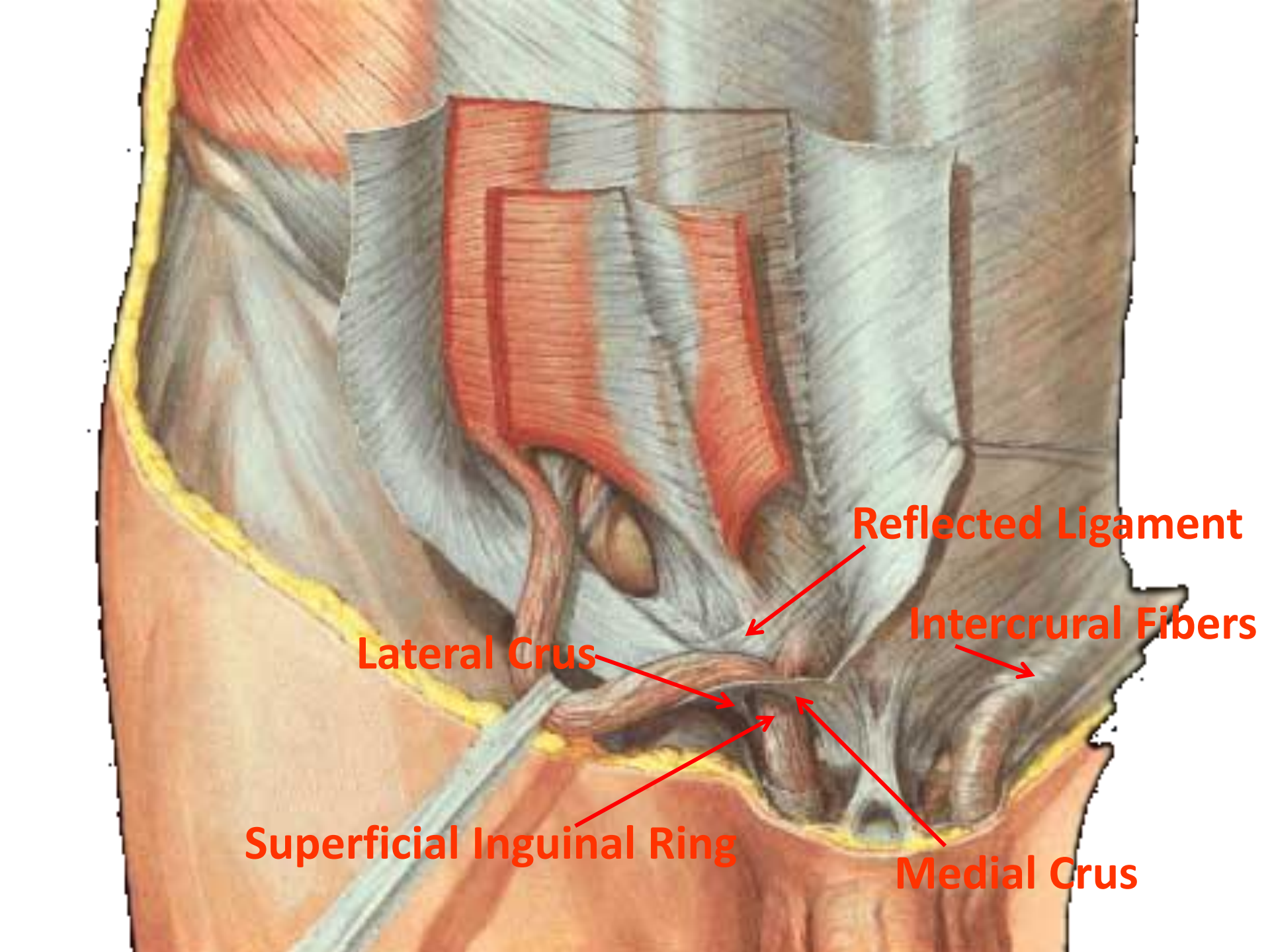
From anterior superior iliac spine to pubic tubercle.

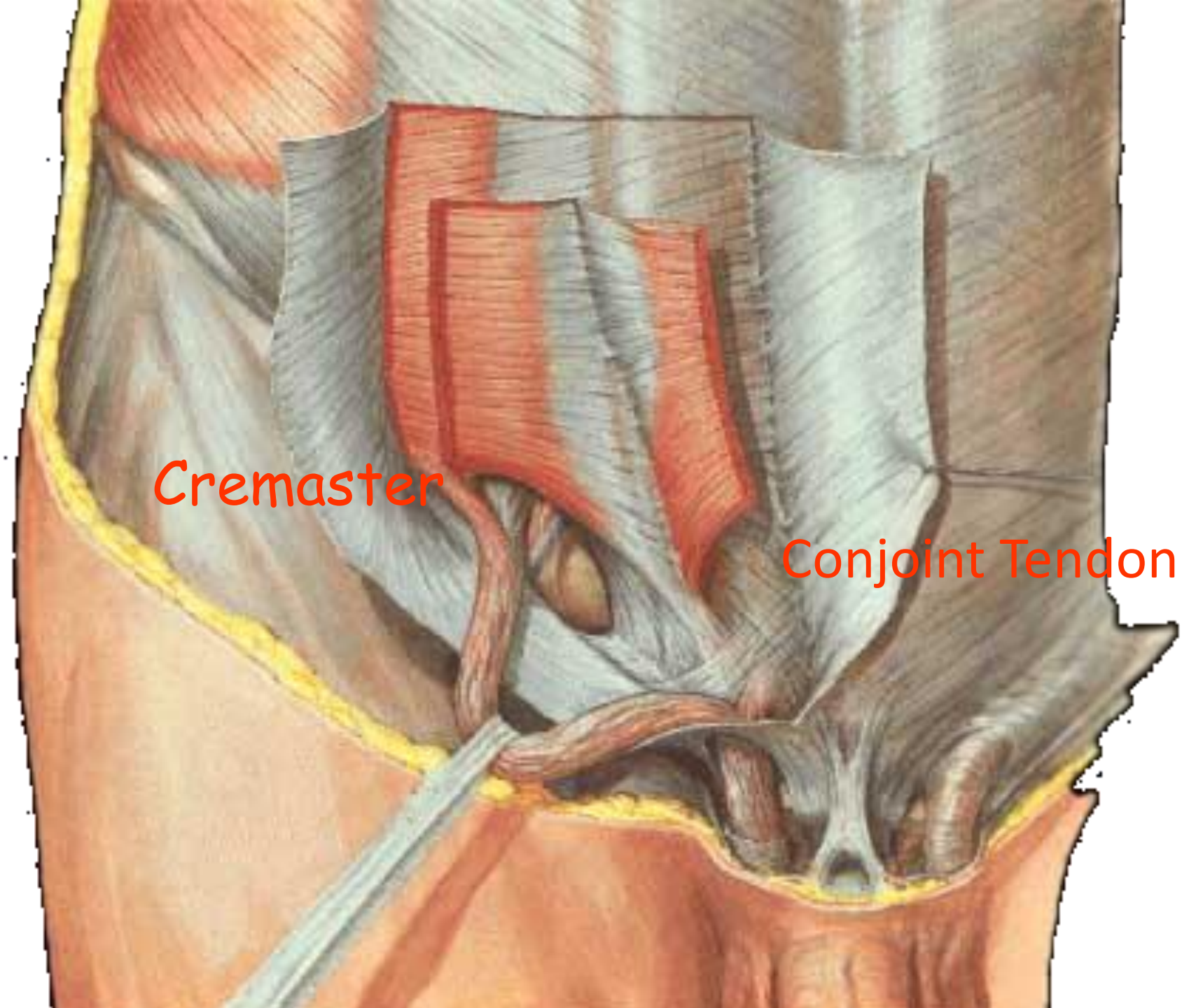

Ant. sup. iliac spine
Inguinal ligament
Obturator canal
Lacunar ligament
Pubic tubercle
Lig^t of Cooper
Pubis
Symphysis pubis
Acetabulum
OBTURATOR MEMBRANE
Transverse acetabular ligament
Tuber ischiadicum

# The *Hesselbach triangle*

- *The **inferior epigastric vessels** serve as its superolateral border, the **rectus sheath*** as medial border, and the ***inguinal ligament*** as the inferior border. Direct hernias occur within the Hesselbach triangle, whereas indirect inguinal hernias arise lateral to the triangle




Reflected Ligament
Intercrural Fibers
Lateral Crus
Superficial Inguinal Ring
Medial Crus


Cremaster
Conjoint Tendon

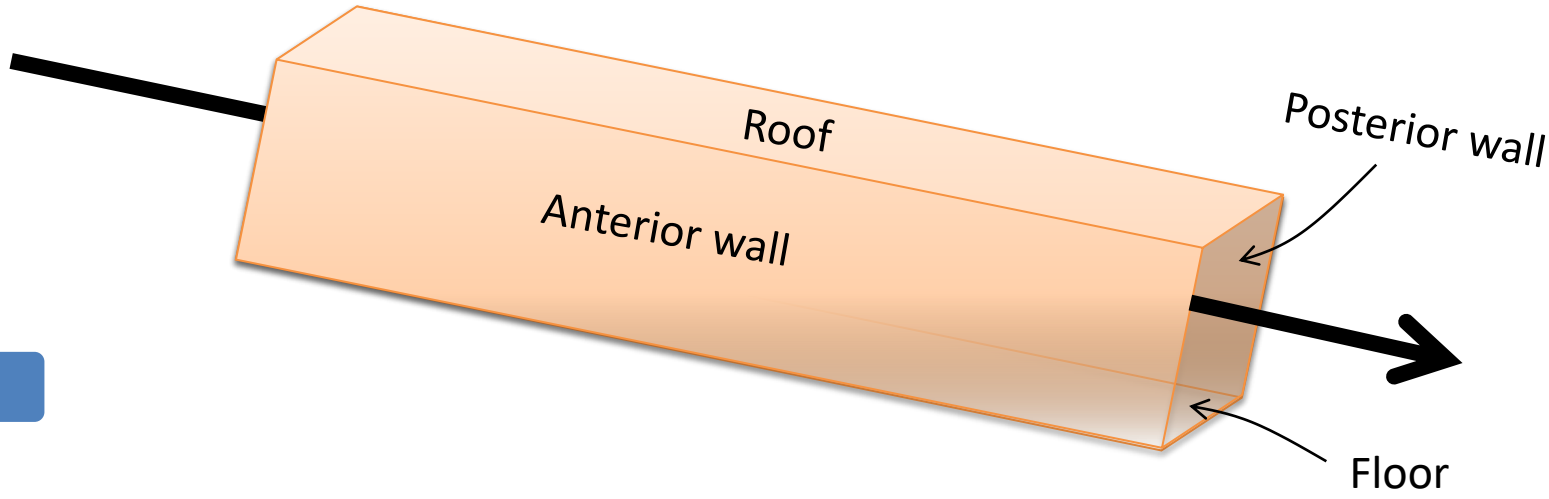
# Inguinal Canal

- Roof
  - internal oblique abdominis –
  - transversus abdominis –
- Floor
  - inguinal ligament –
  - lacunar ligament –
- anterior wall
  - external abdominal oblique aponeurosis –
  - internal abdominal oblique aponeurosis –
- posterior wall
  - transversalis fascia –
  - conjoint tendon (falx inguinalis) –

# BOUNDARIES OF INGUINAL CANAL

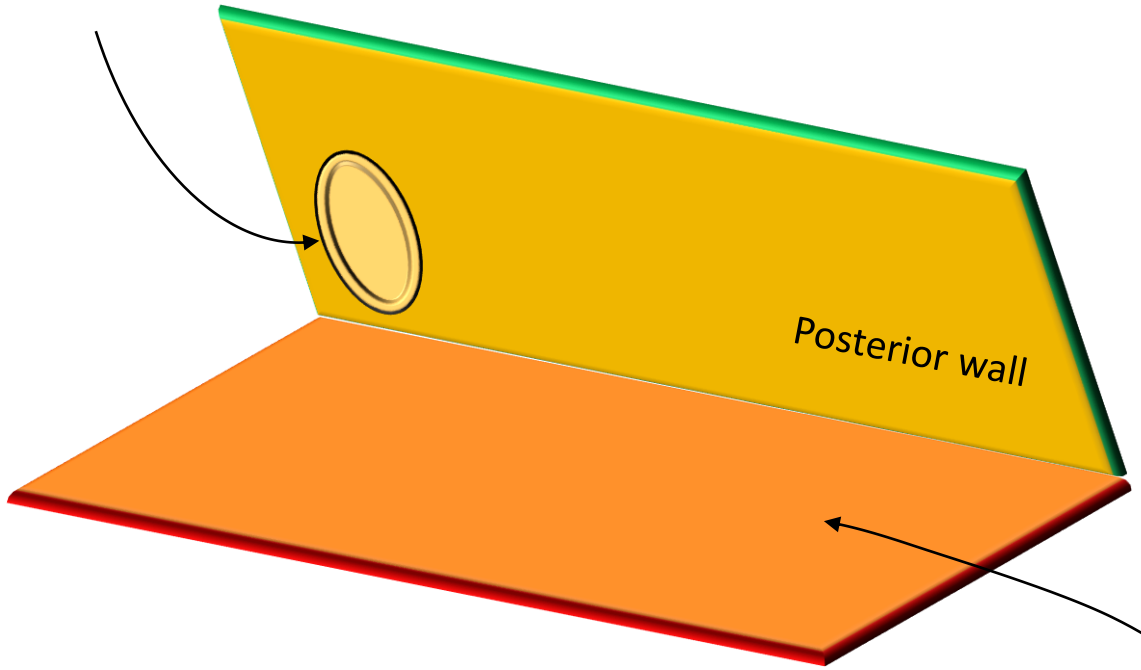
- FLOOR: Inguinal ligament
- ANTERIOR WALL: External Oblique
- POSTERIOR WALL: Transversalis fascia
- MEDIAL-POSTERIOR WALL: Internal oblique and transversalis (when they fuse become conjoint tendon.)

# A Box?



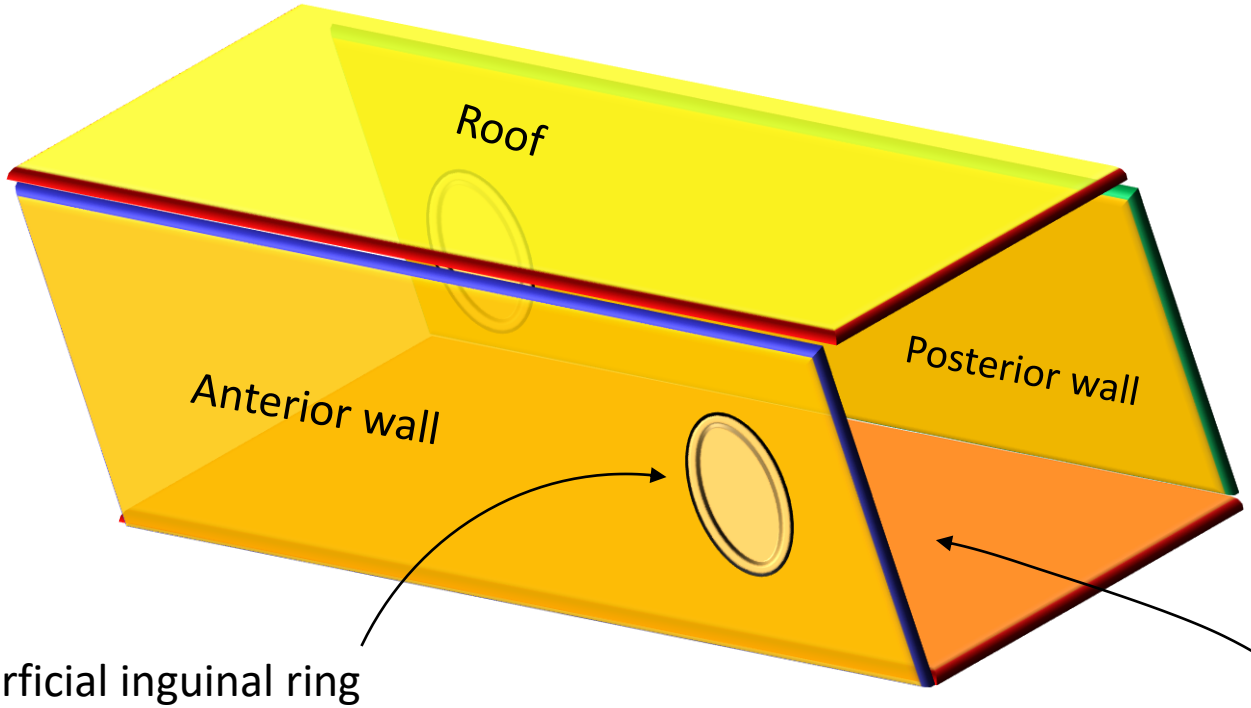

Imagine the right side inguinal canal viewed from the front as a box with anterior & posterior walls, a roof & floor. The arrow indicates that structures can run through it from lateral to medial – e.g. in males it transmits the spermatic cord, and in females, the round ligament of the uterus.

# Inguinal canal



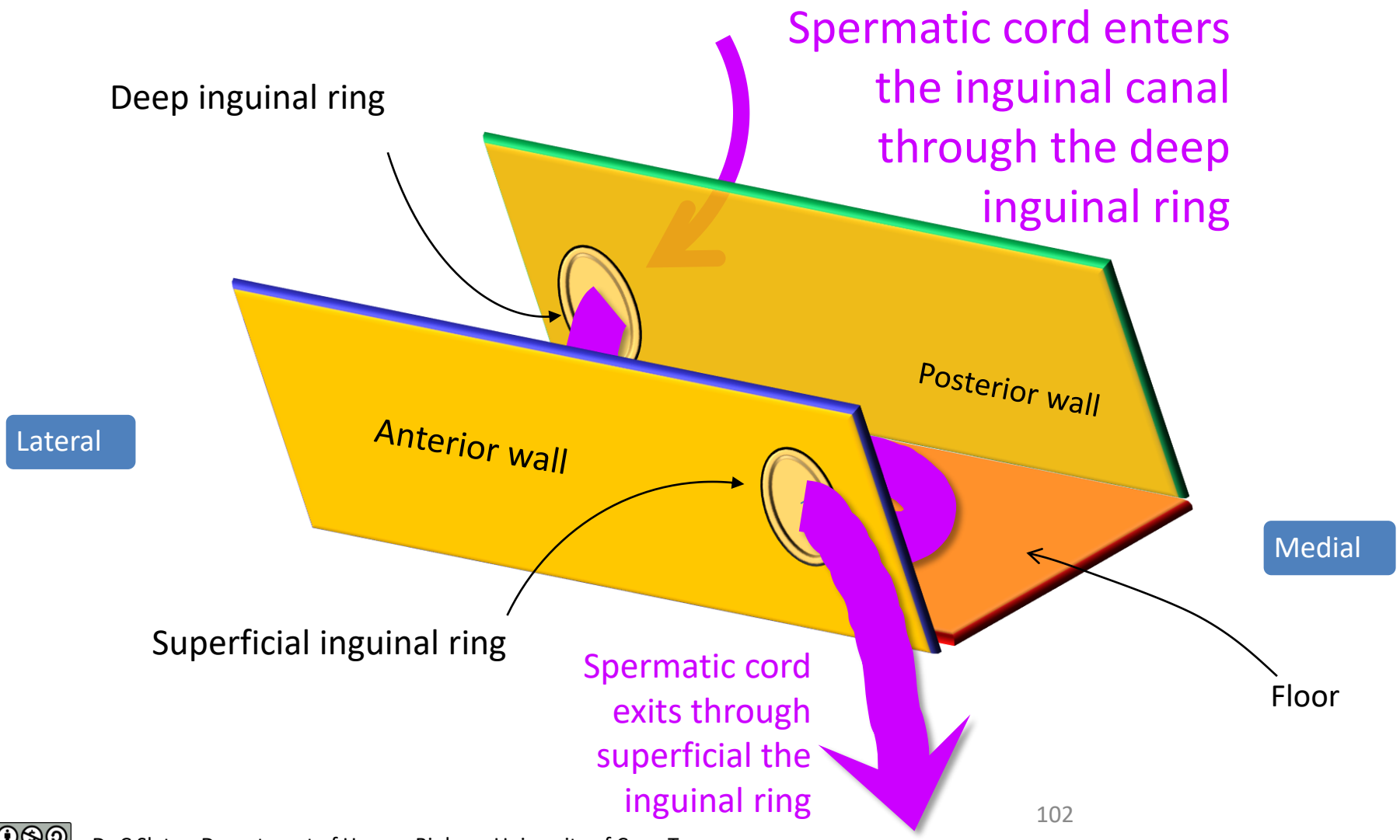

Here are the posterior wall, which has the DEEP inguinal ring situated laterally, and the floor. (Roof and anterior wall removed).

# Inguinal canal



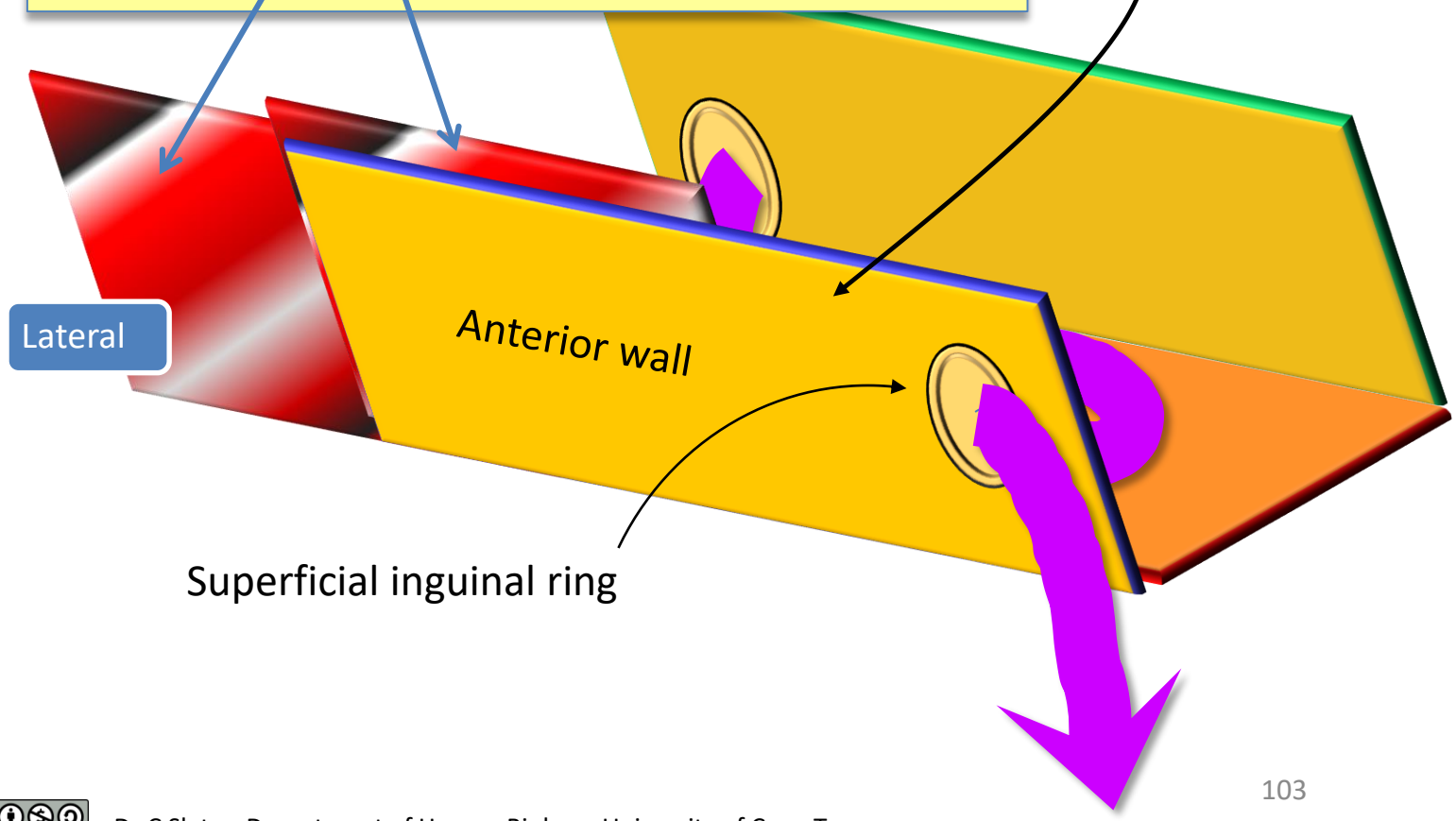

Here are the anterior wall (which has the SUPERFICIAL inguinal ring situated medially), and the roof.

# Inguinal canal



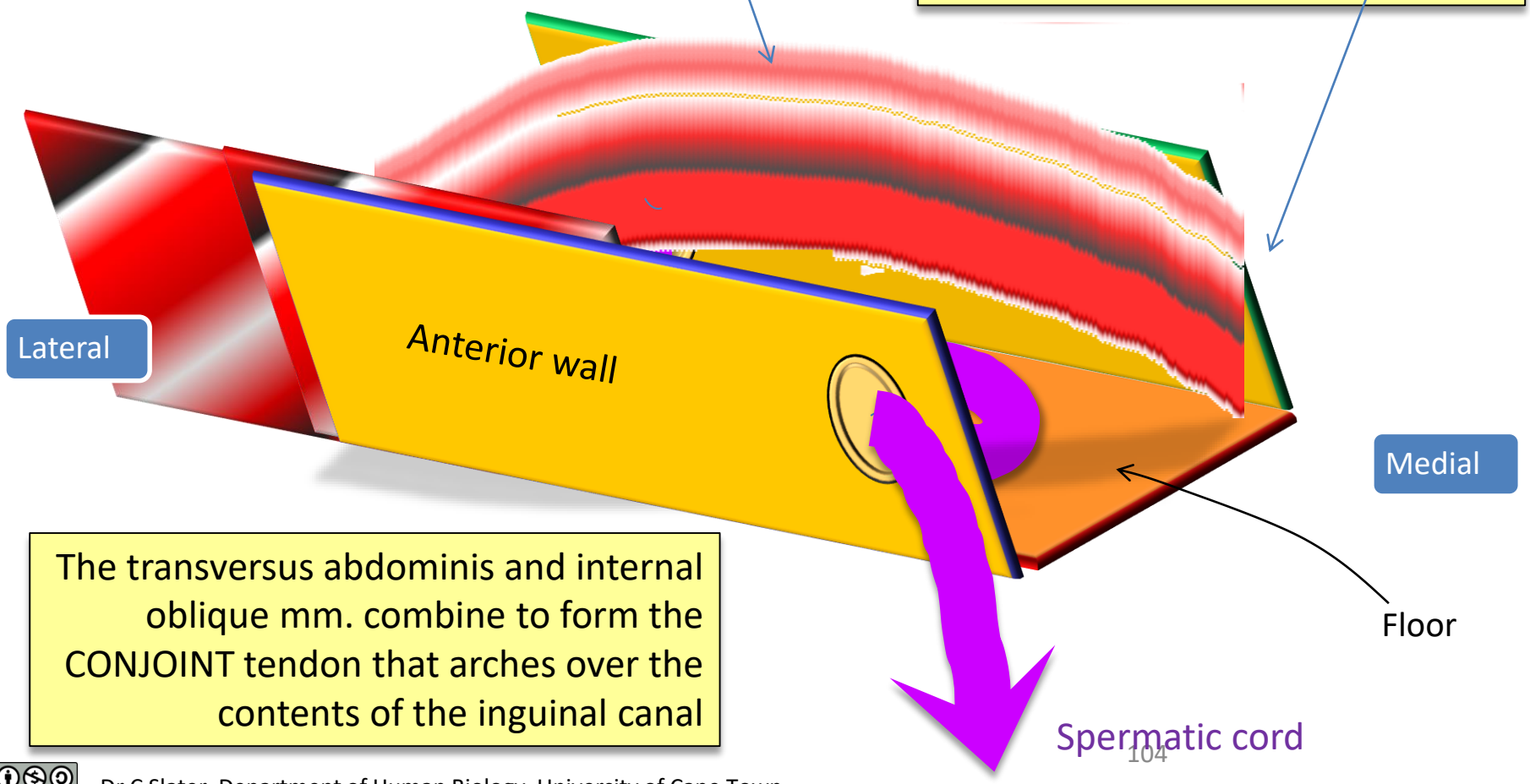
# Inguinal canal

The anterior wall is made up of the **external oblique** muscle throughout, and is reinforced by the **internal oblique m.** laterally.
The **transversus abdominus m.** lies even more laterally as part of the anterior abdominal wall.



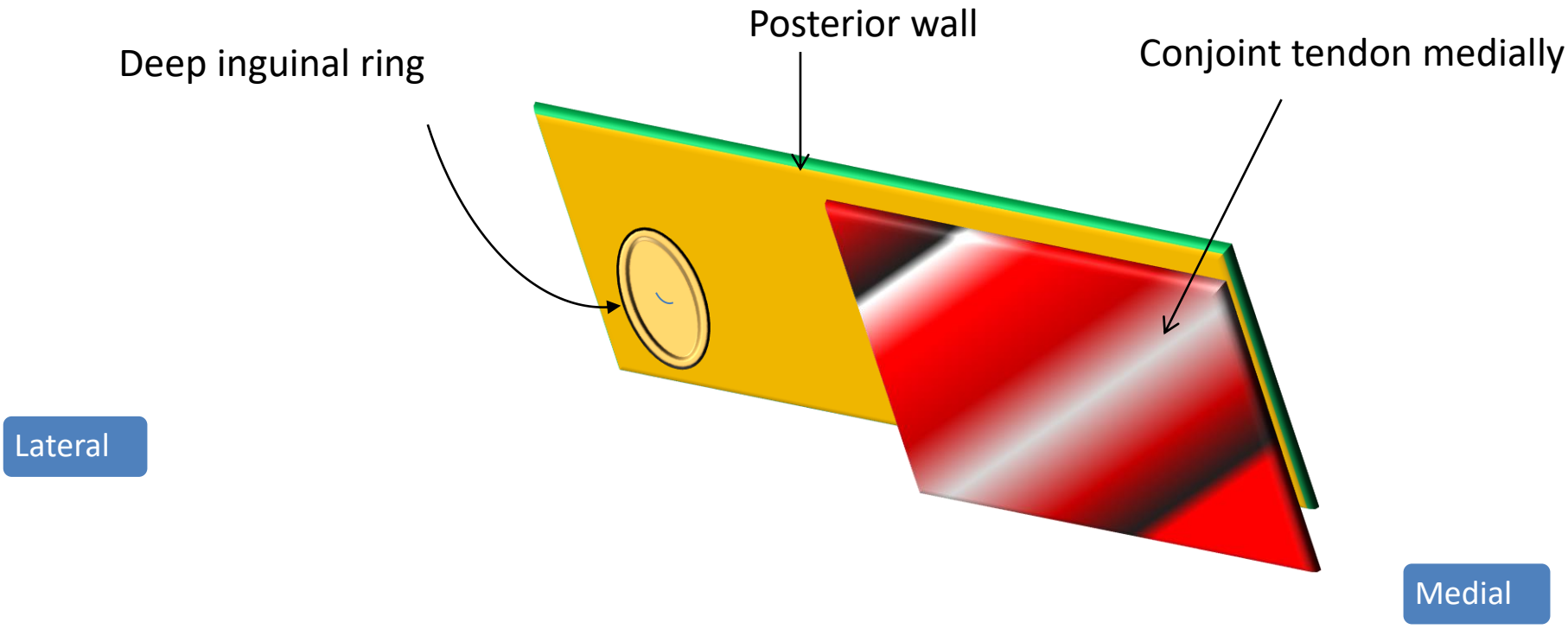
# Inguinal canal

The conjoint tendon attaches to the pubic crest, reinforces the posterior canal wall medially and also forms the ROOF of the canal



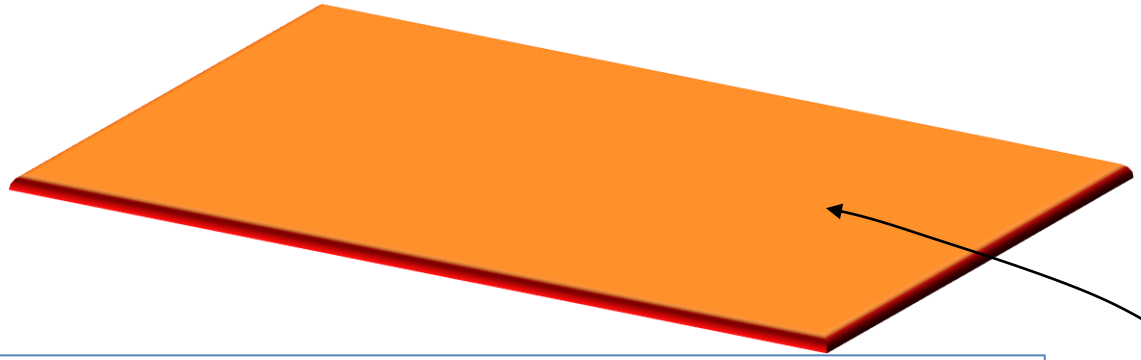

The transversus abdominis and internal oblique mm. combine to form the CONJOINT tendon that arches over the contents of the inguinal canal

# Posterior wall of the inguinal canal



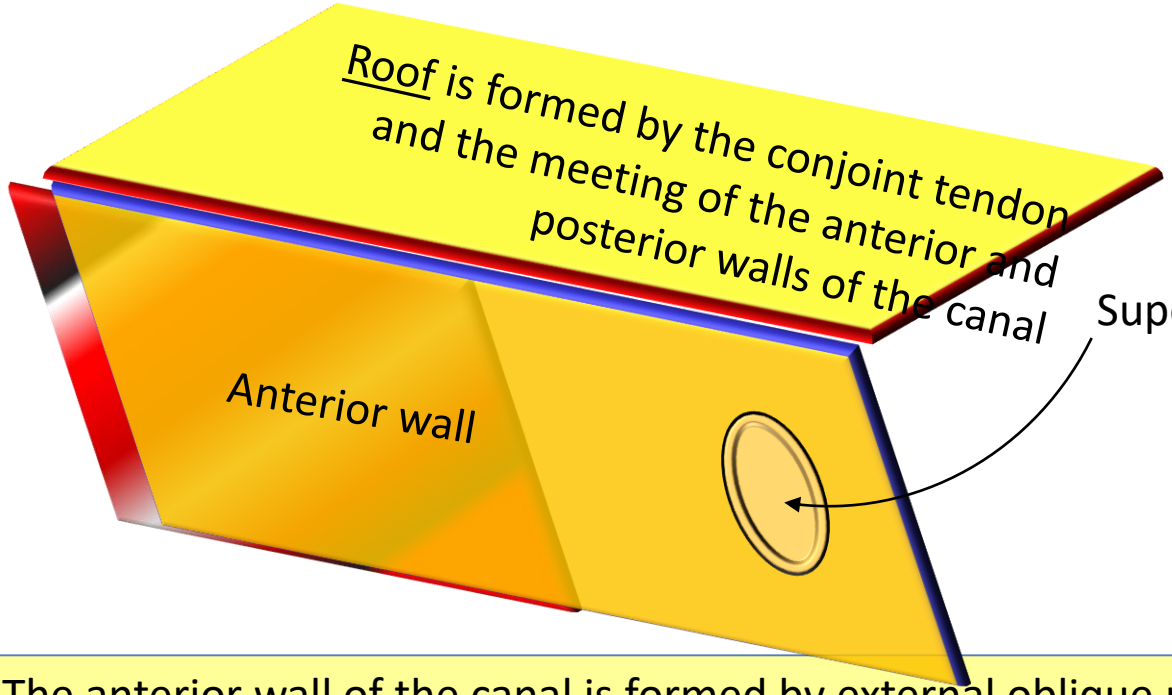

The posterior wall is formed by transversalis fascia (orange) throughout and the conjoint tendon (red) medially. The wall is particularly weak over the deep inguinal ring

# Floor of the inguinal canal




The floor is formed by an incurving of the inguinal ligament, which is part of the external oblique muscle, forming a gutter. (Medially it forms the lacunar ligament which is not illustrated).

# Roof and anterior wall of the inguinal canal




The anterior wall of the canal is formed by external oblique muscle (orange) throughout and by internal oblique muscles (red/black/white) laterally. This wall is weak medially because of the "hole" in the external oblique muscle (= superficial inguinal ring).


Dr C Slater, Department of Human Biology, University of Cape Town

# Inguinal hernias

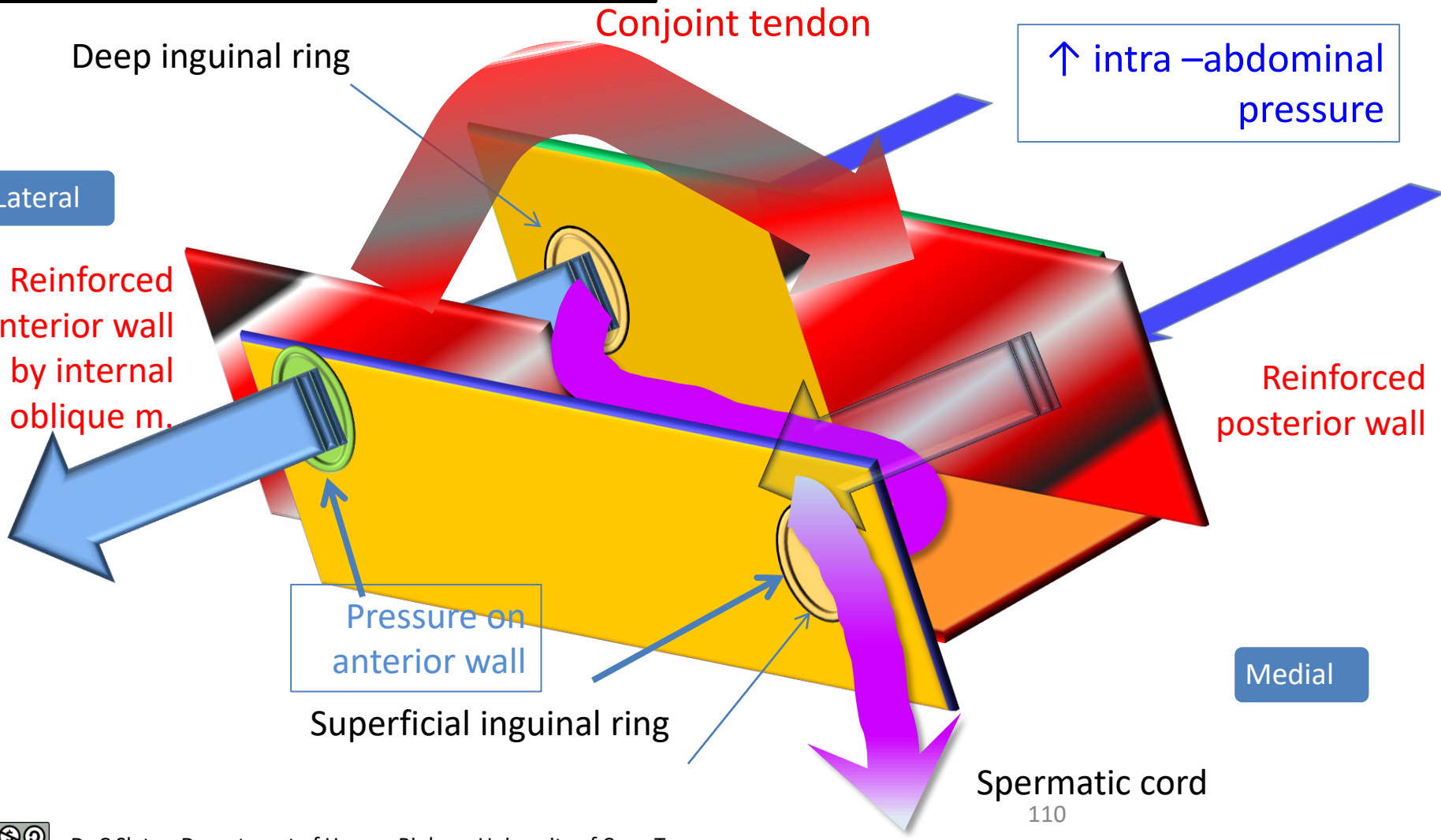
- The posterior wall of the canal is particularly weak laterally because of the deep inguinal ring
- The anterior wall opposite the deep ring is reinforced laterally by the internal oblique m.
- A hernia (e.g. of small bowel) that comes through the deep inguinal ring will have to travel along the inguinal canal as it cannot push into the reinforced layers of muscle in the anterior wall of the canal directly opposite the deep inguinal ring

# Inguinal hernias

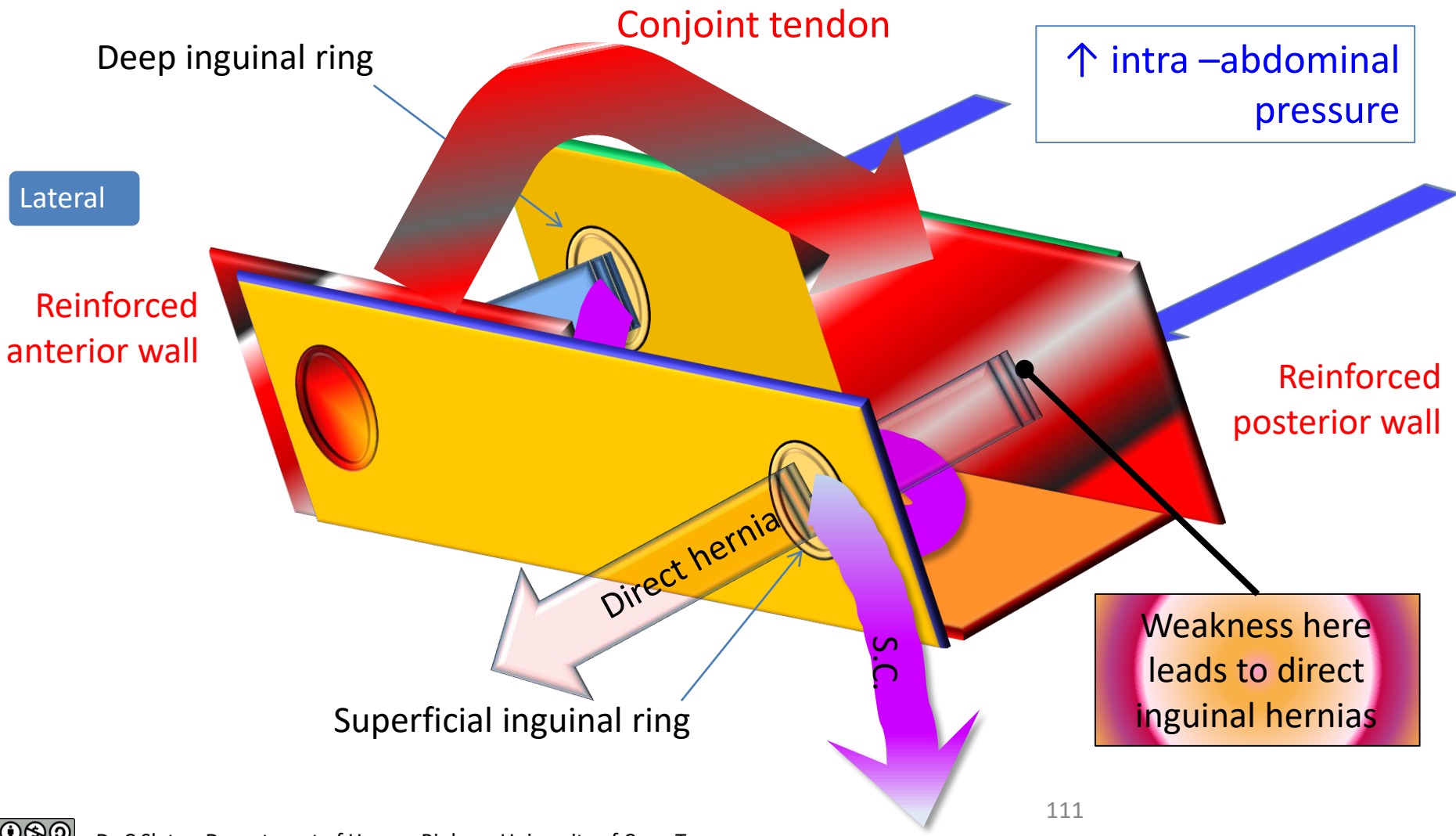
- The anterior wall of the canal is weak medially where the superficial inguinal ring is situated
- The posterior wall, opposite the superficial ring, is reinforced medially by the conjoint tendon that is formed by fibres of the internal oblique and transversus abdominis muscles
- Abdominal contents cannot normally force themselves through the superficial ring directly because of the reinforced posterior wall medially

# Pressures on the inguinal canal

= areas where reinforcement is present



# Pressures in the inguinal canal



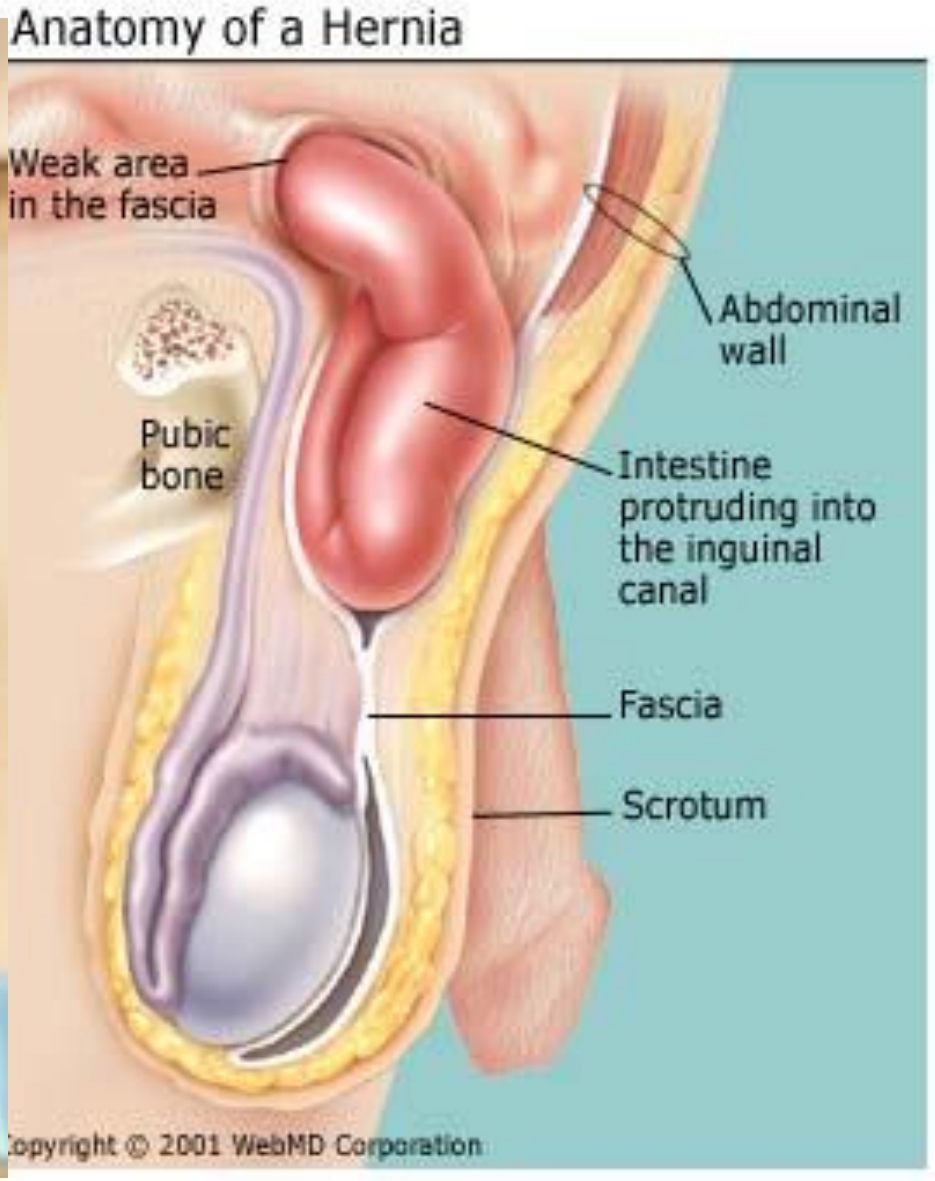
# Indirect inguinal hernias

- Pass through the deep ring
- Travel along the canal
- Exit the superficial ring above and medial to the pubic tubercle (remember the inguinal ligament attaches to the tubercle). Since the incurved inguinal ligament forms the floor of the canal, the contents of the canal could not emerge below or lateral to the pubic tubercle (useful in surgical diagnosis). An example is congenital inguinal hernia.

# Direct inguinal hernias

- If the posterior wall of the canal is weakened medially (e.g. by chronically increased intra-abdominal pressure), it can stretch and bulge out through the superficial ring
- The contents of the hernia do not travel along the length of the canal but push directly on the stretched posterior inguinal canal wall and through the superficial ring.

# Anatomy of a Hernia

# CONTENTS OF CANAL

**3 ARTERIES:**

- Testicular Artery
- Artery to Vas
- Artery to cremaster

**3 NERVES:**

- Genital branch of genitofemoral nerve
- Sympathetic fibres
- Ilioinguinal nerve

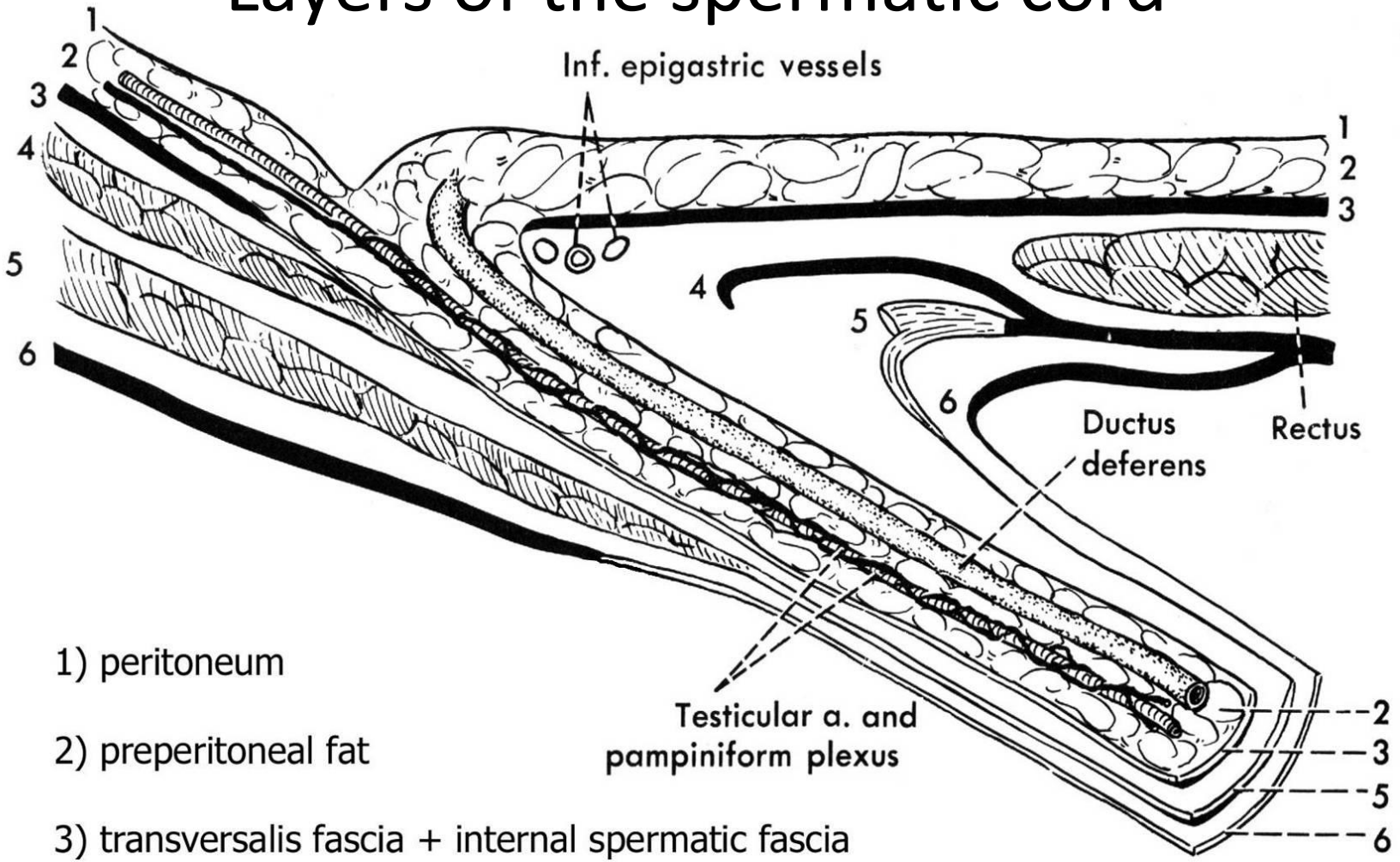
**3 LAYERS OF FASCIA:**

- External spermatic fascia
- Cremasteric fascia
- Internal spermatic fascia.

**3 OTHERS:**

- Vas deferens
- Panpiniform plexus
- Lymphatics

# Layers of the spermatic cord




1) peritoneum

2) preperitoneal fat

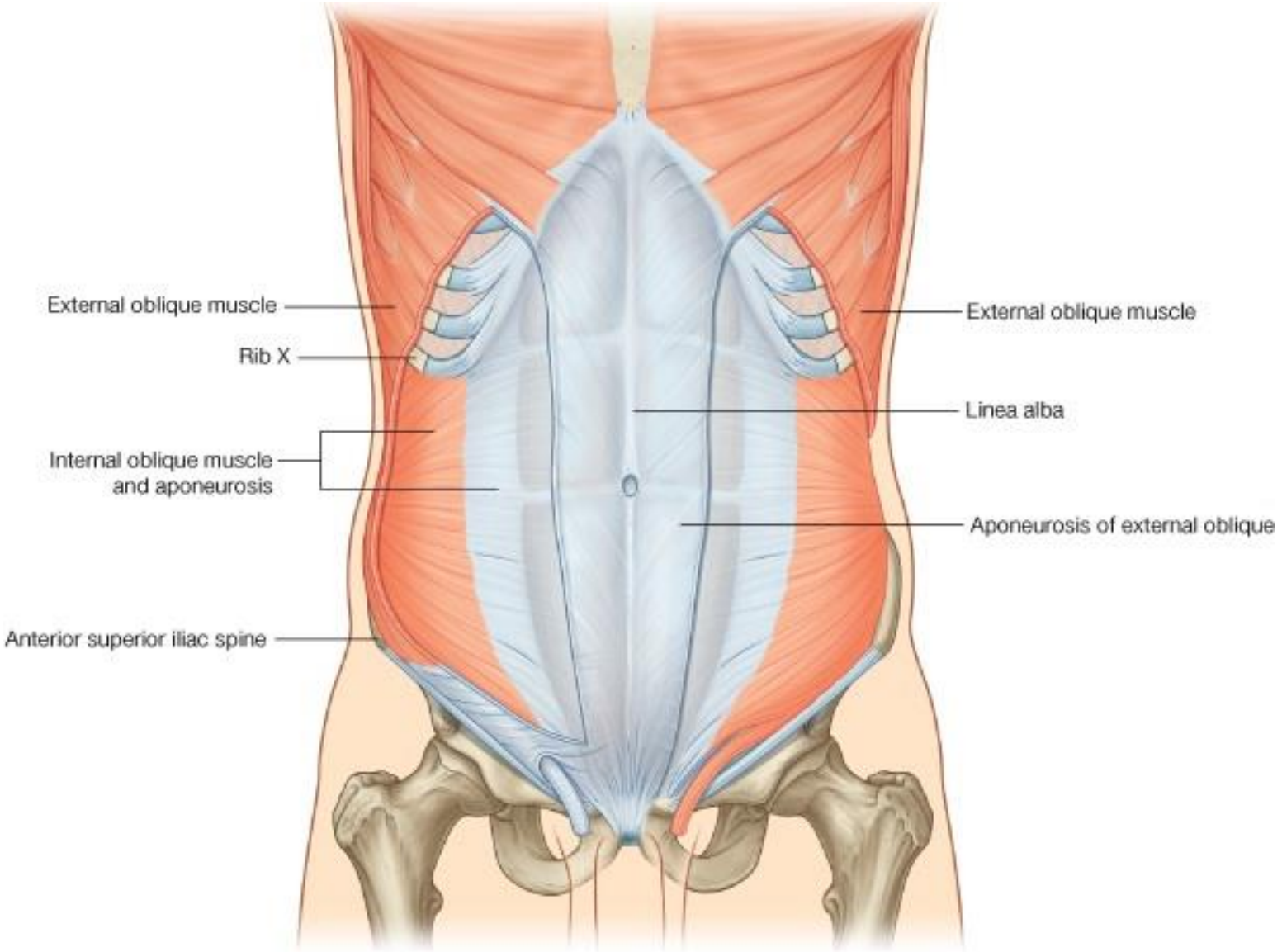
3) transversalis fascia + internal spermatic fascia

4) transversus abdominus muscle + transversus abdominus aponeurosis

5) internal oblique muscle + cremaster muscle

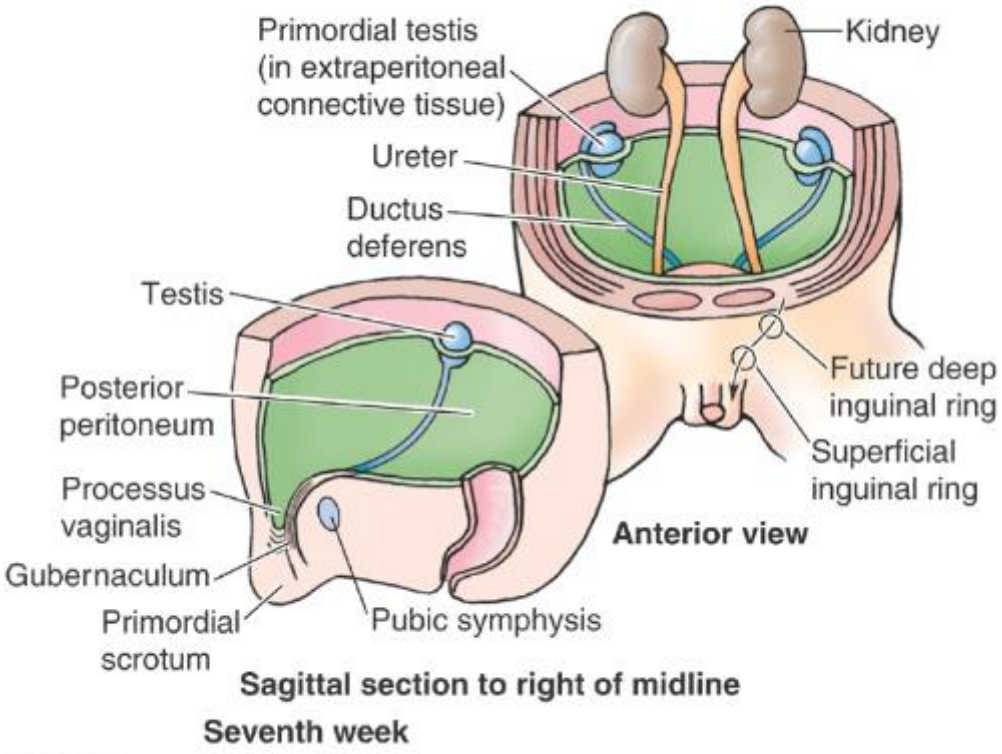
6) external oblique aponerosis + external spermatic fascia

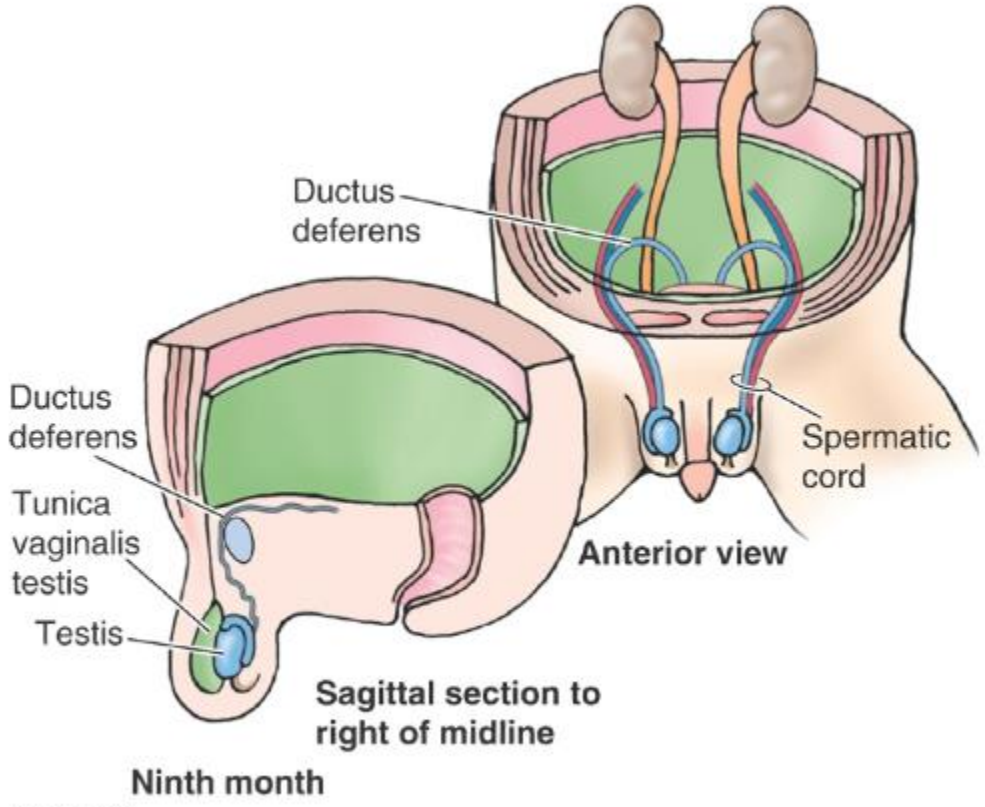
# Cremaster muscle

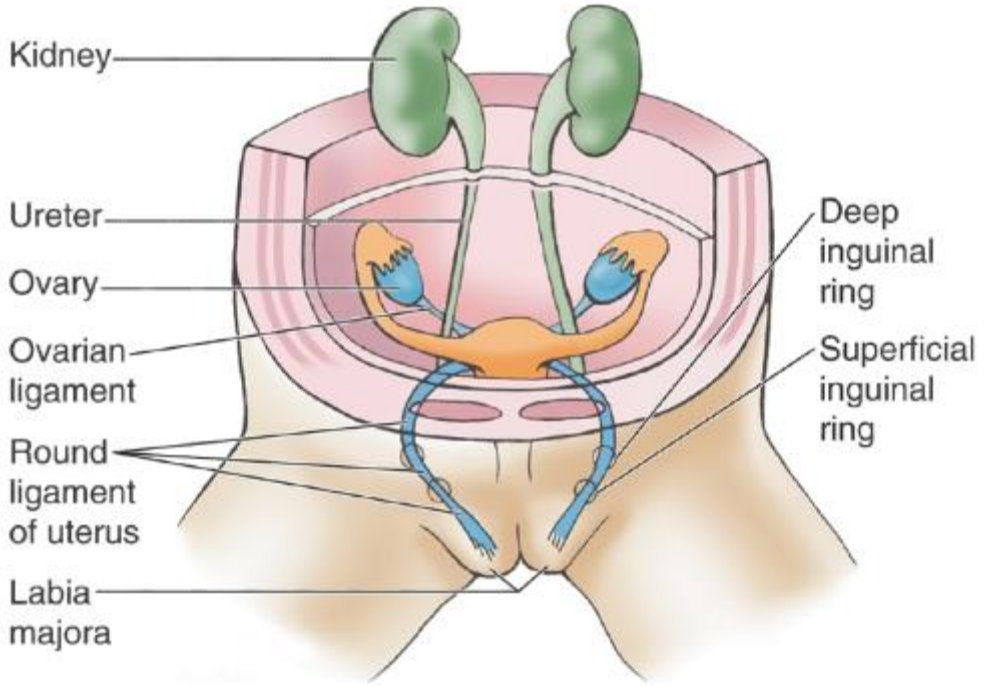


# Contents (male)

- spermatic cord
  - arteries: testicular artery, deferential artery, cremasteric artery
  - nerves: genital branch of the genitofemoral nerve, nerve to cremaster, sympathetic nerves
  - vas deferens
  - pampiniform plexus
  - lymphatic vessels
- ilioinguinal nerve

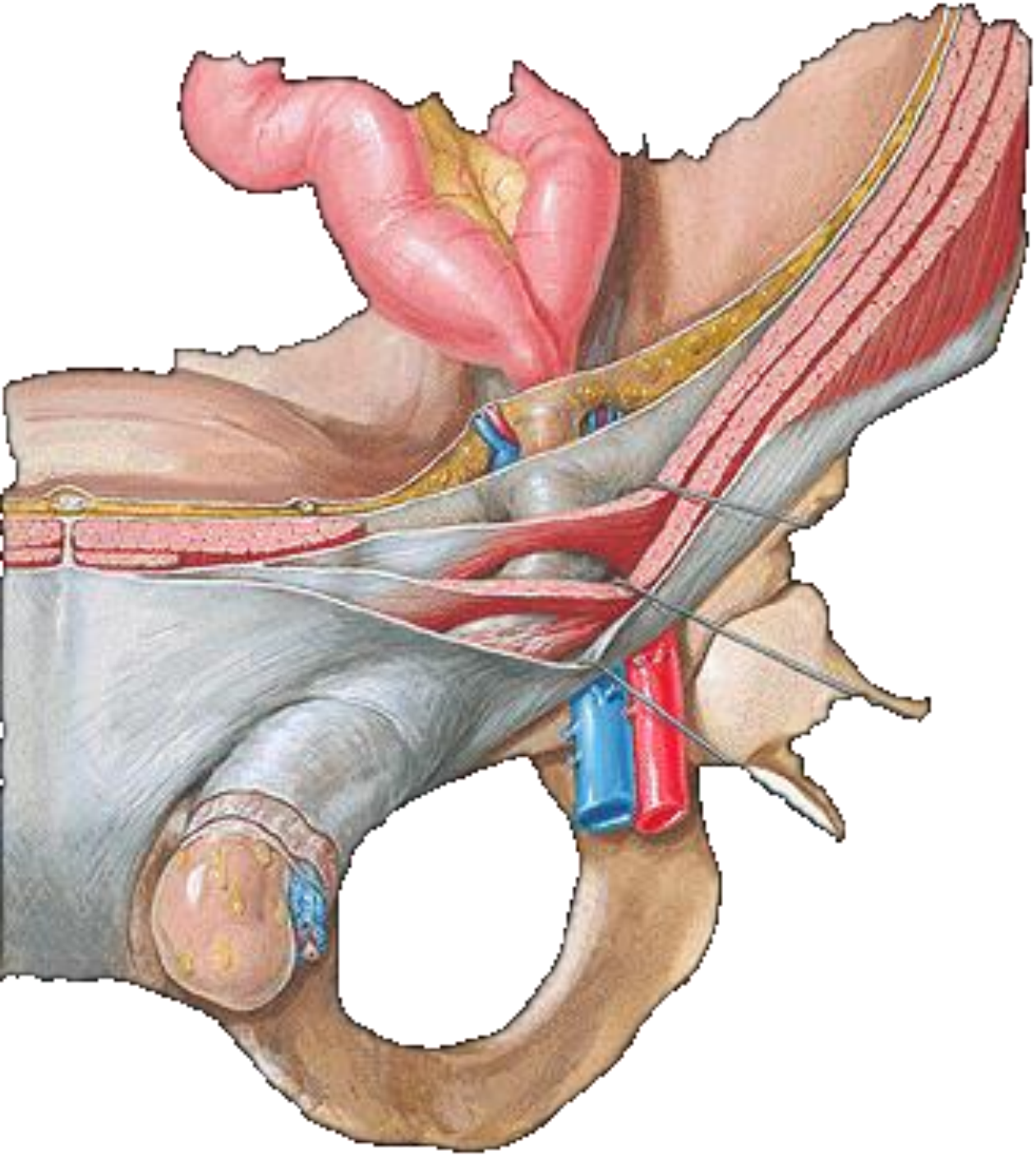

Primordial testis
(in extraperitoneal
connective tissue)
Kidney
Ureter
Ductus
deferens
Testis
Future deep
inguinal ring
Posterior
peritoneum
Superficial
inguinal ring
Processus
vaginalis
Anterior view
Gubernaculum
Primordial
scrotum
Pubic symphysis
Sagittal section to right of midline
Seventh week


Ductus deferens
Ductus deferens
Tunica vaginalis testis
Testis
Spermatic cord
Anterior view
Sagittal section to right of midline
Ninth month
CDA5 ©2008 LWW



# Contents (female)

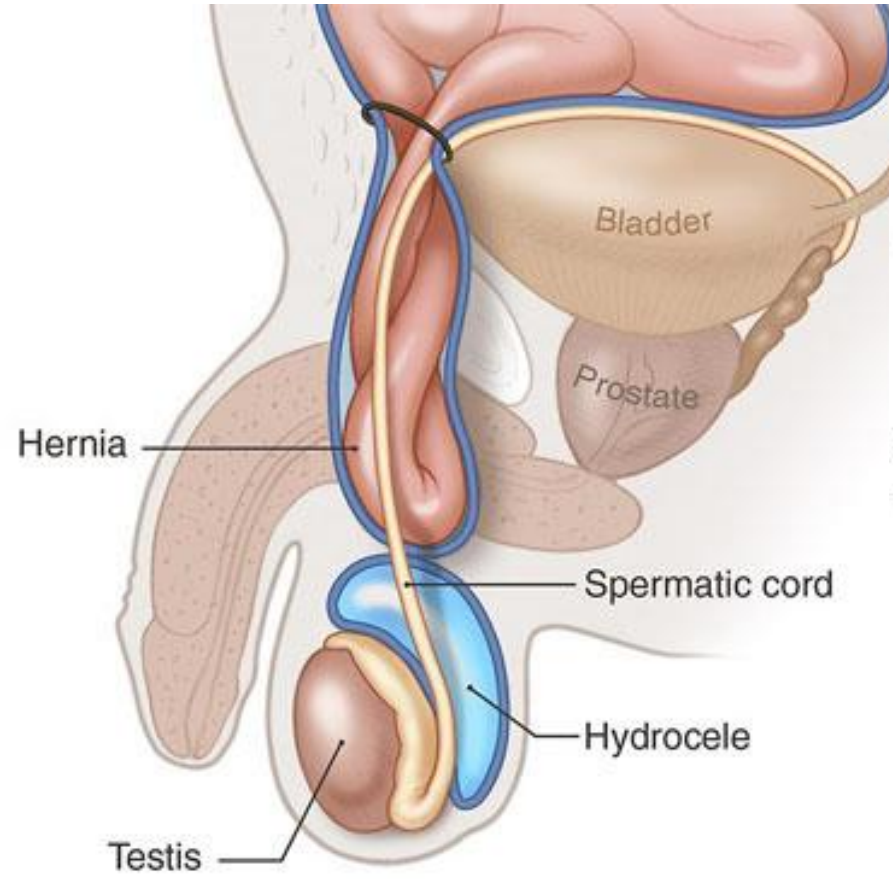
- round ligament of the uterus
- ilioinguinal nerve

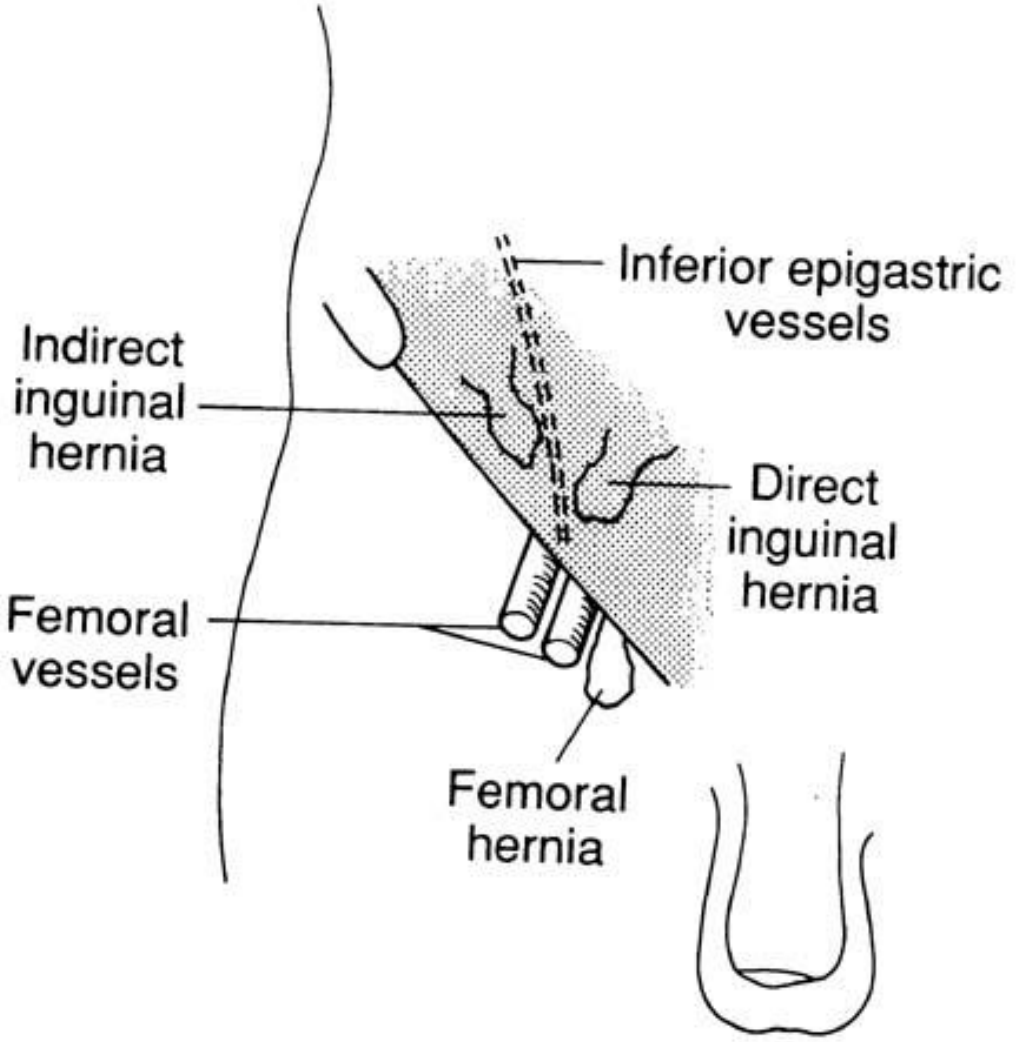


# HERNIA

- Inguinal hernia
  - Indirect –
  - Direct –

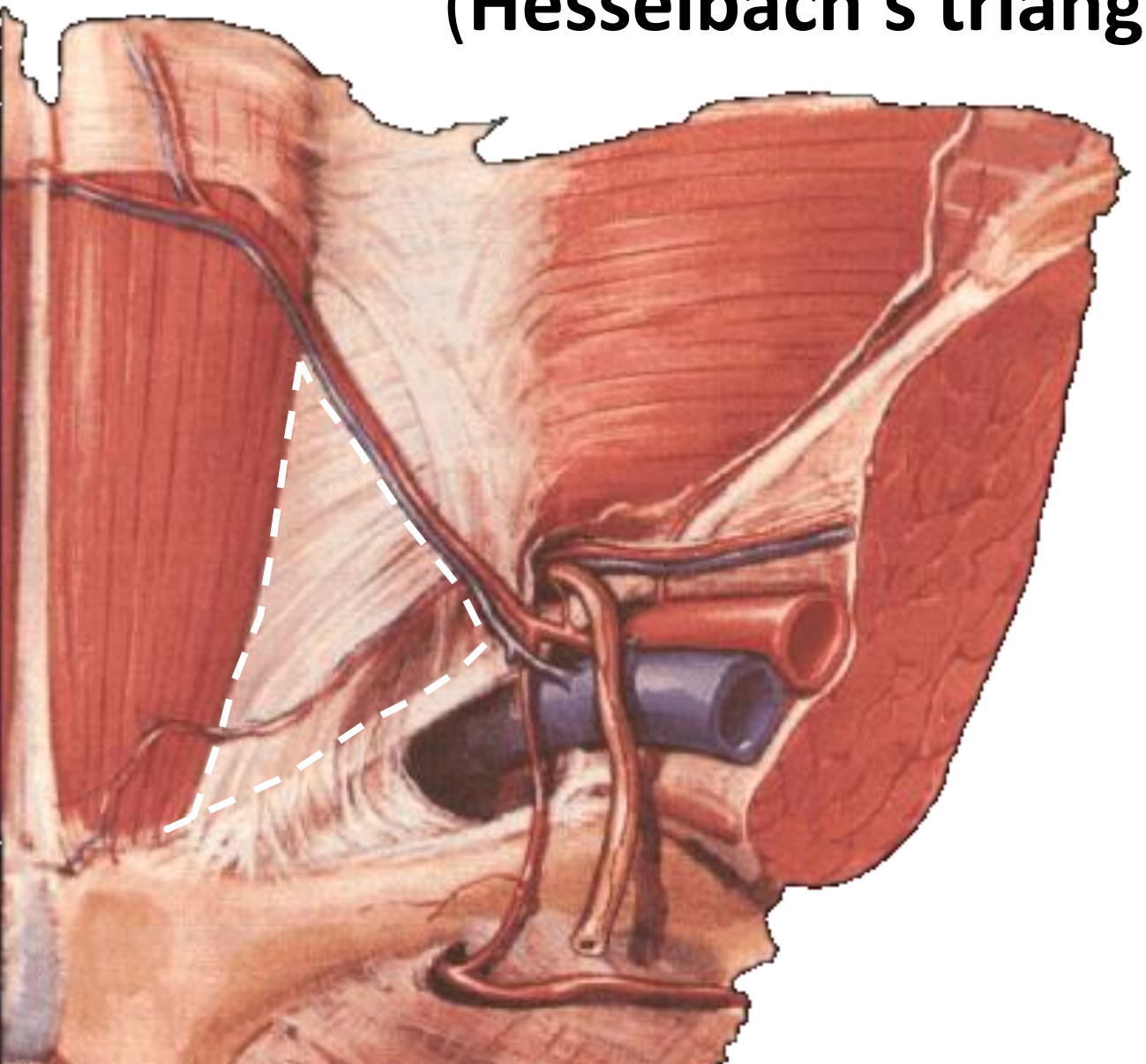
# Anatomy


Bladder
Prostate
Hernia
Spermatic cord
Hydrocele
Testis


Inferior epigastric vessels
Indirect inguinal hernia
Direct inguinal hernia
Femoral vessels
Femoral hernia

# Incarcerated Inguinal Hernia

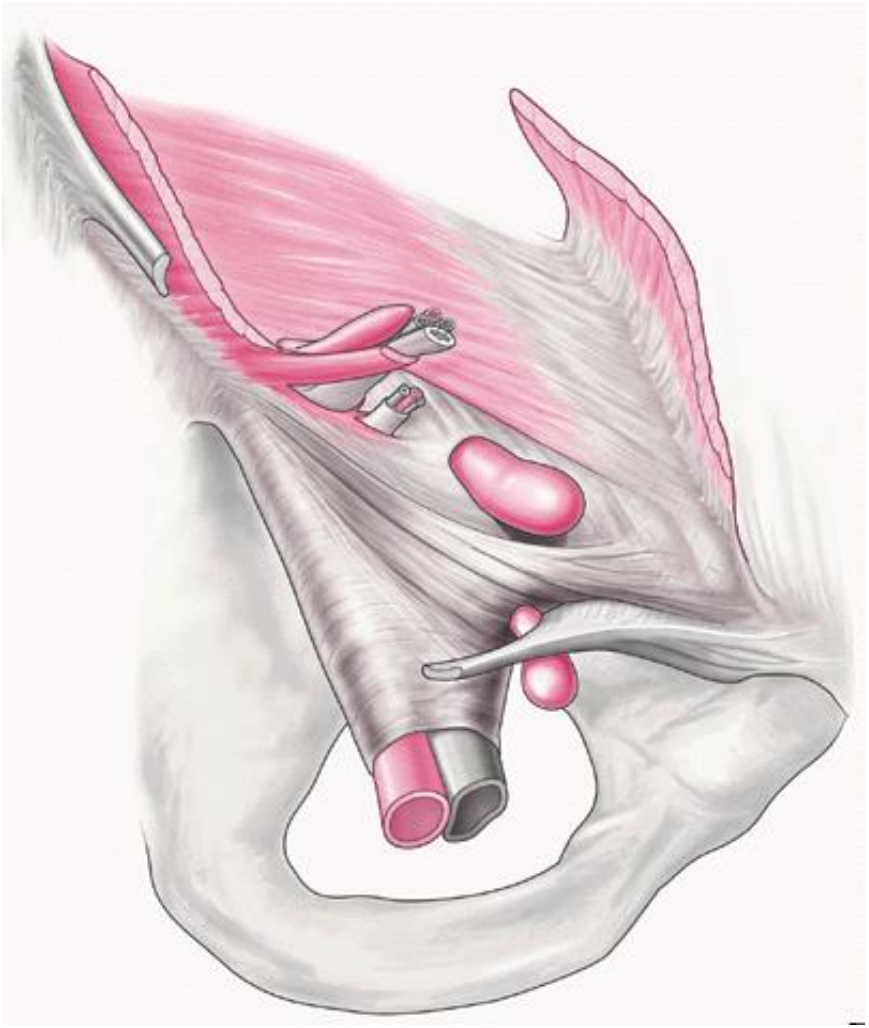
# Inguinal Triangle
# (**Hesselbach's triangle** )

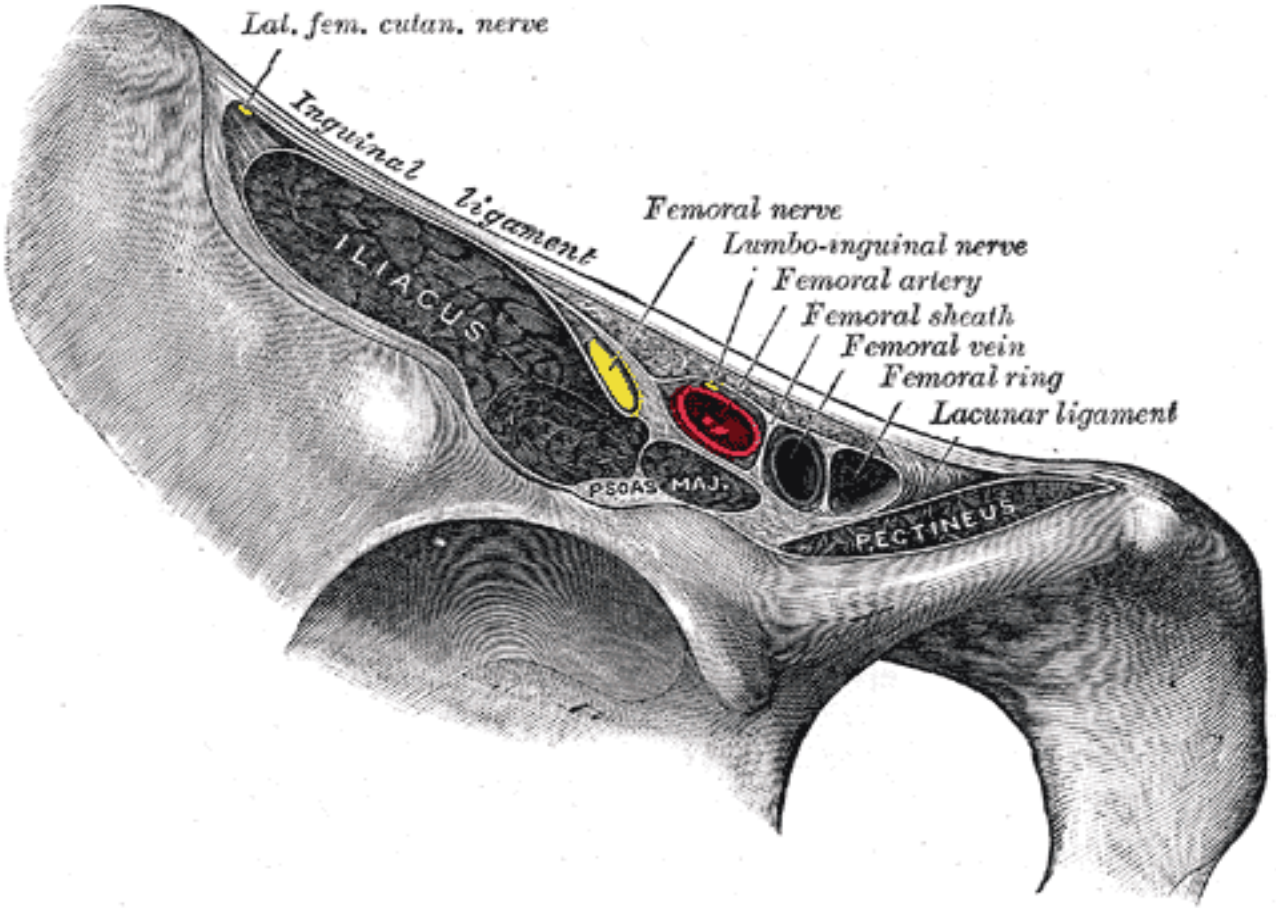


Direct Hernia

# Groin Hernia

- Indirect Inguinal
  - Congenital –
  - Patent processus vaginalis –
- Direct Inguinal
  - Acquired –
  - Inguinal floor defect –
- Femoral
  - Below inguinal ligament –

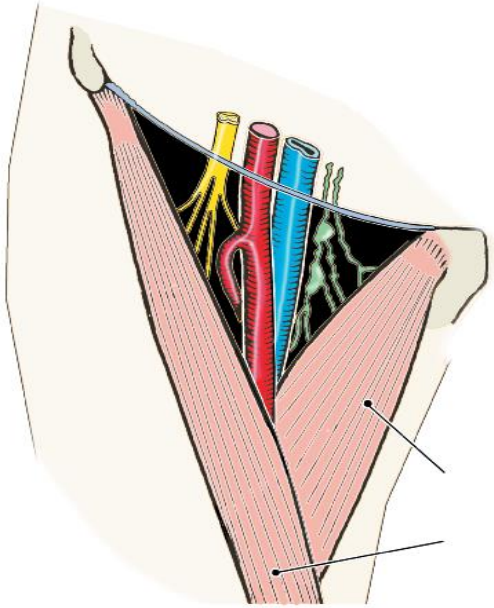





- Through the femoral ring in the triangle of Scarpa
- Femoral ring:
  - Inguinal ligament (ant) –
  - pectineal fascia and ligament of Coopper (post) –
  - lig Gimbernat (internal) –
  - ileo-pectineal ligament (ext) –

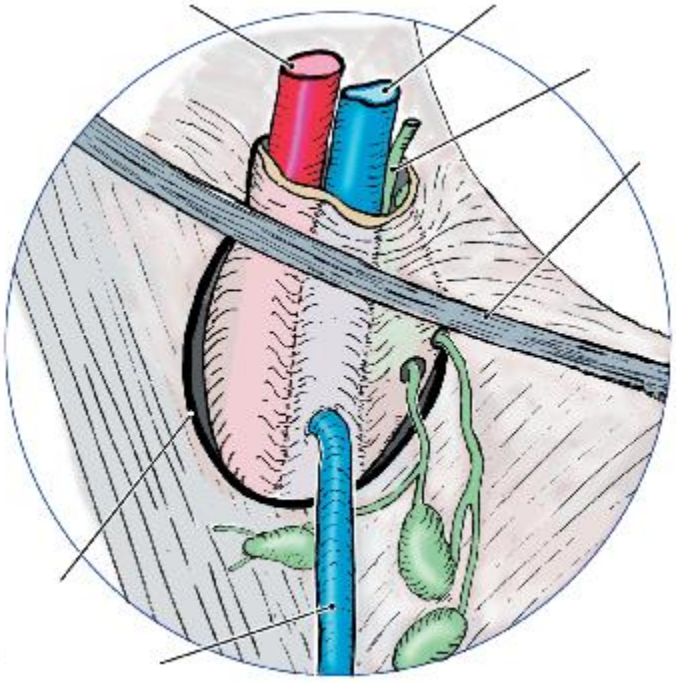
# Anatomy

# Femoral Canal

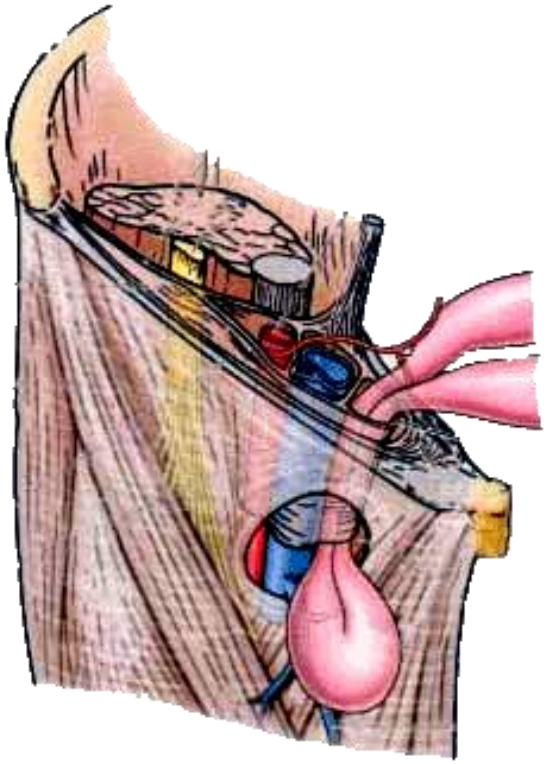


The boundaries of the femoral ring are

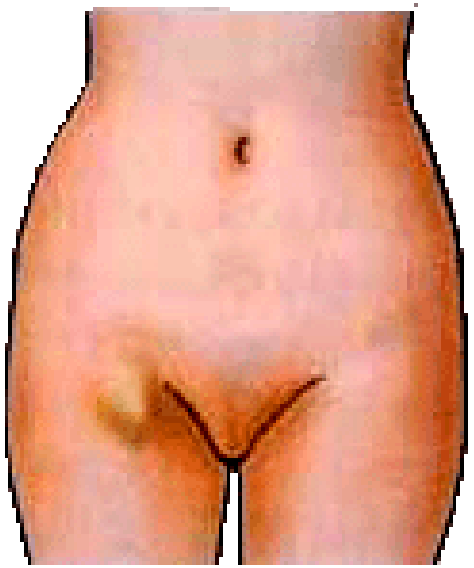
- anteriorly by the inguinal ligament;
- posteriorly by Astley Cooper's (iliopectineal) ligament, the pubic bone and the fascia over the pectineus muscle;
- medially by the concave knife-like edge of Gimbernat's (lacunar) ligament, which is also prolonged along the iliopectineal line, as Astley Cooper's ligament;
- laterally by a thin septum separating it from the femoral vein.
- A femoral hernia occurs through this space and is medial to the femoral vessels



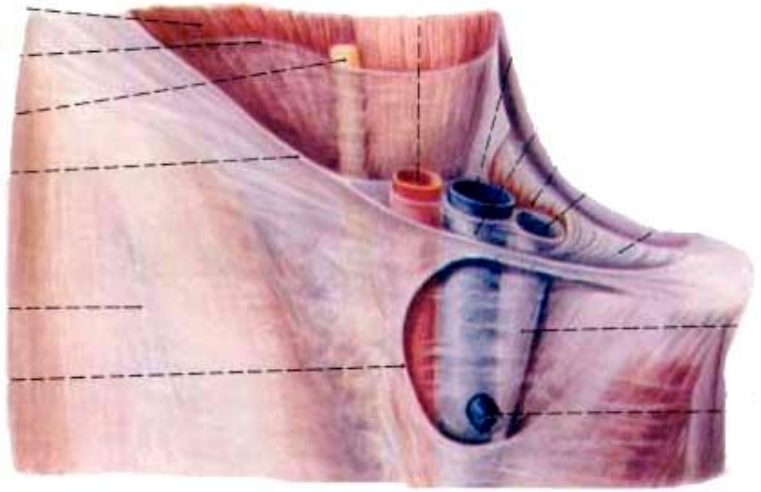
# Femoral hernia

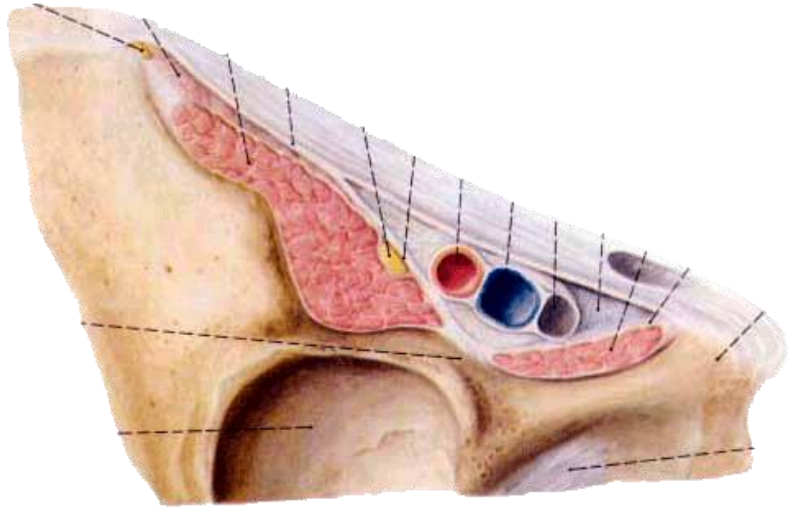


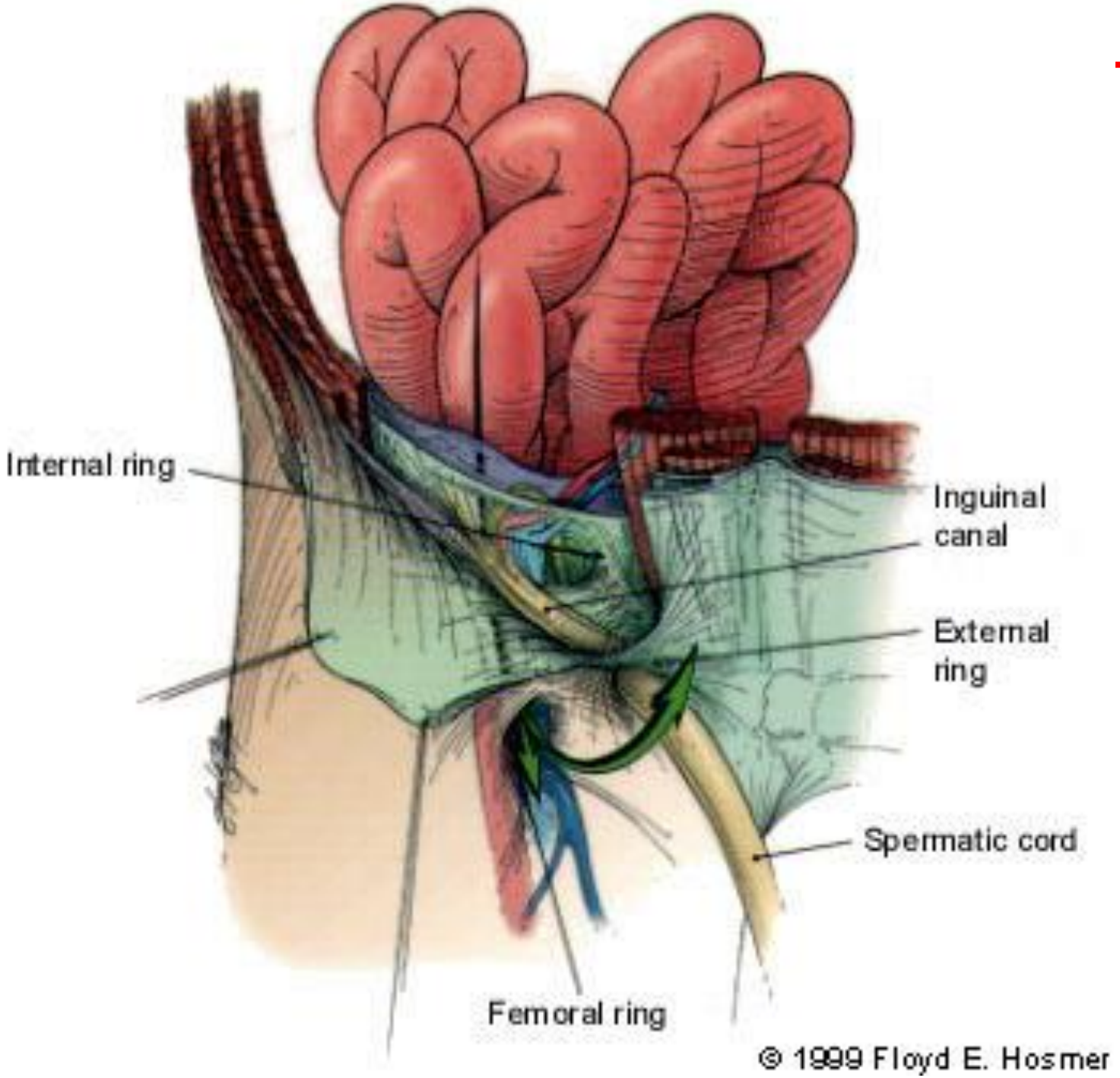
- If a loop of intestine is forced into the femoral ring, it expands to form a swelling in the upper part of the thigh. Such a condition is known as a **femoral hernia** .
- A femoral hernia is more common in women than in men (possibly because their wider pelvis and femoral canal ).

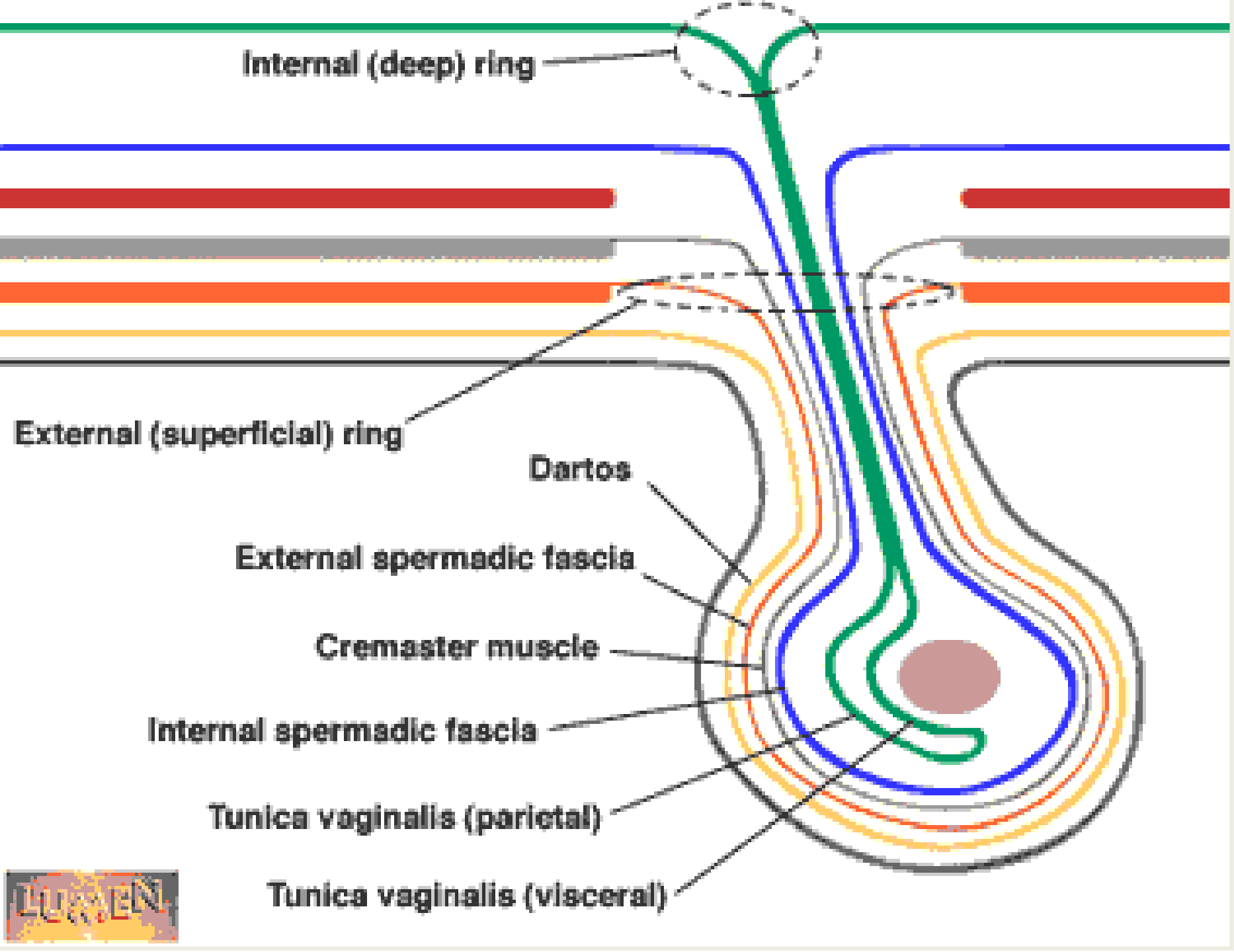


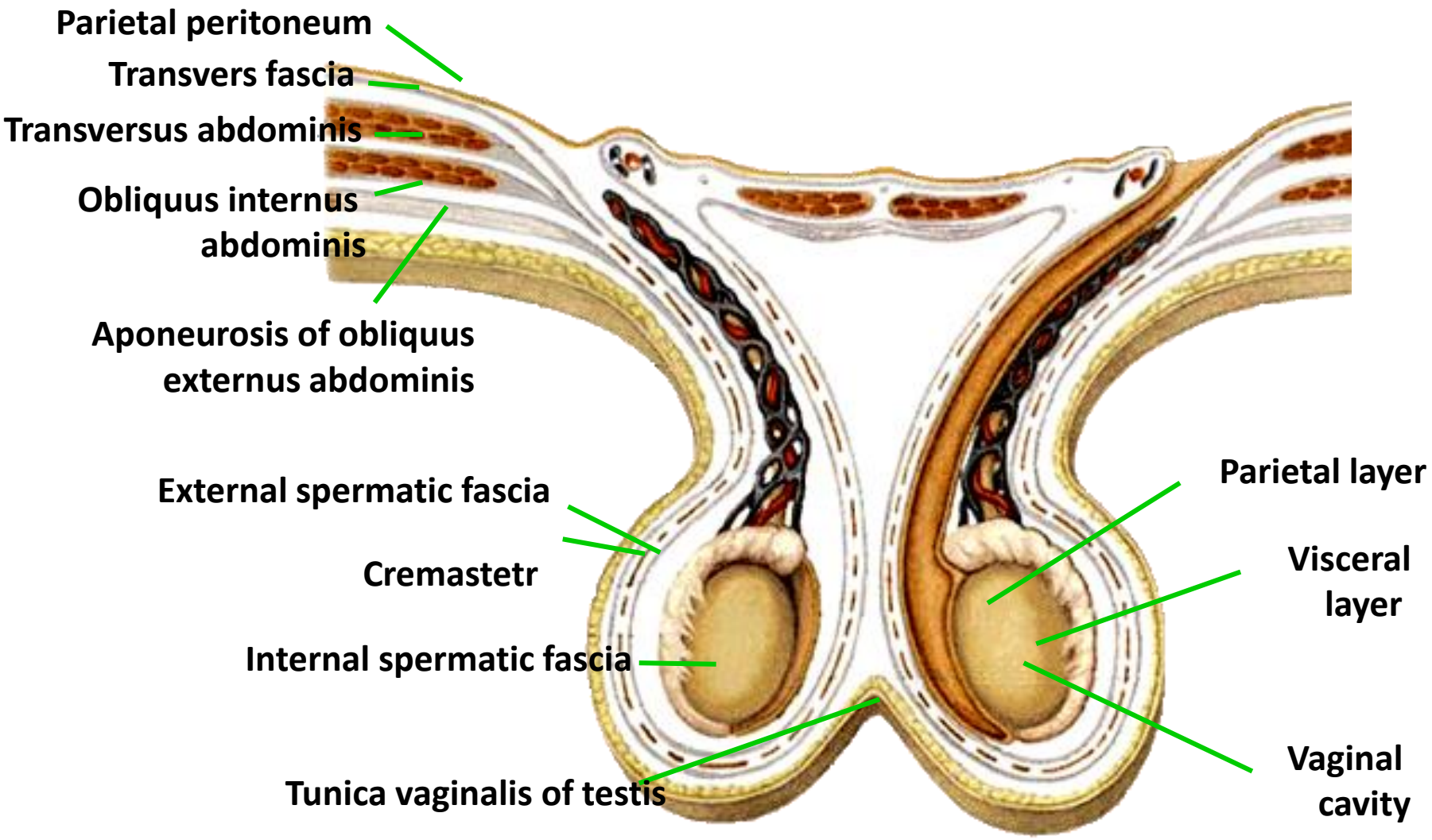
- It is about 1.3cm long , and its upper opening is called the **femoral ring** .
- The **boundaries of the femoral ring** are: the inguinal ligament, anteriorly; the lacunar ligament medially; the pecten of pubis, posteriorly; the femoral vein, laterally. covered by femoral septumsuperiorly.
- The canal contains a little loose fatty tissue, a small lymph node, and some lymph vessels.






Internal ring
Inguinal canal
External ring
Spermatic cord
Femoral ring
© 1999 Floyd E. Hosmer


Internal (deep) ring
External (superficial) ring
Dartos
External spermadic fascia
Cremaster muscle
Internal spermadic fascia
Tunica vaginalis (parietal)
Tunica vaginalis (visceral)


Parietal peritoneum
Transvers fascia
Transversus abdominis
Obliquus internus abdominis
Aponeurosis of obliquus externus abdominis
External spermatic fascia
Cremastetr
Internal spermatic fascia
Tunica vaginalis of testis
Parietal layer
Visceral layer
Vaginal cavity

# Internal structures of the scrotum

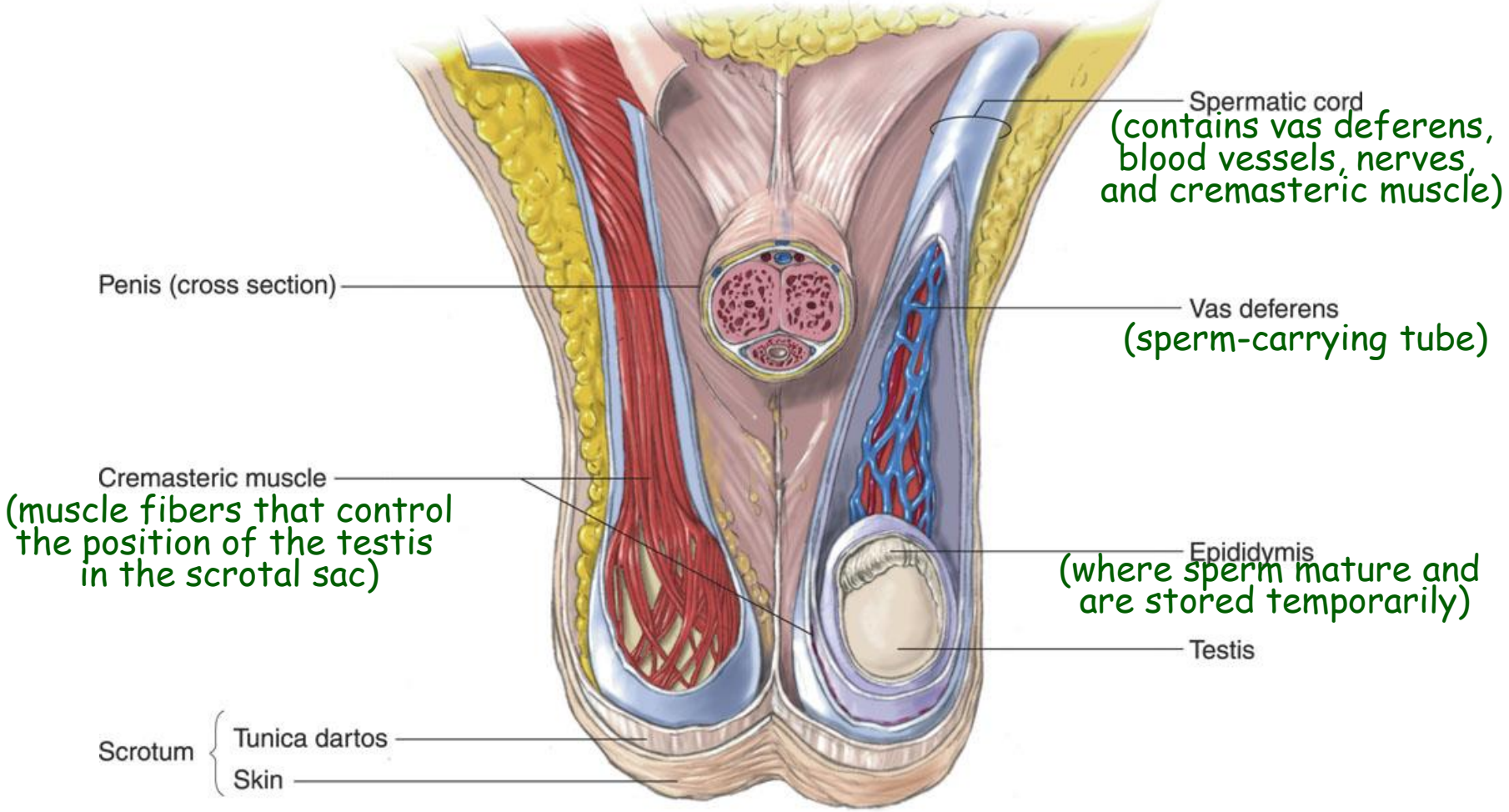
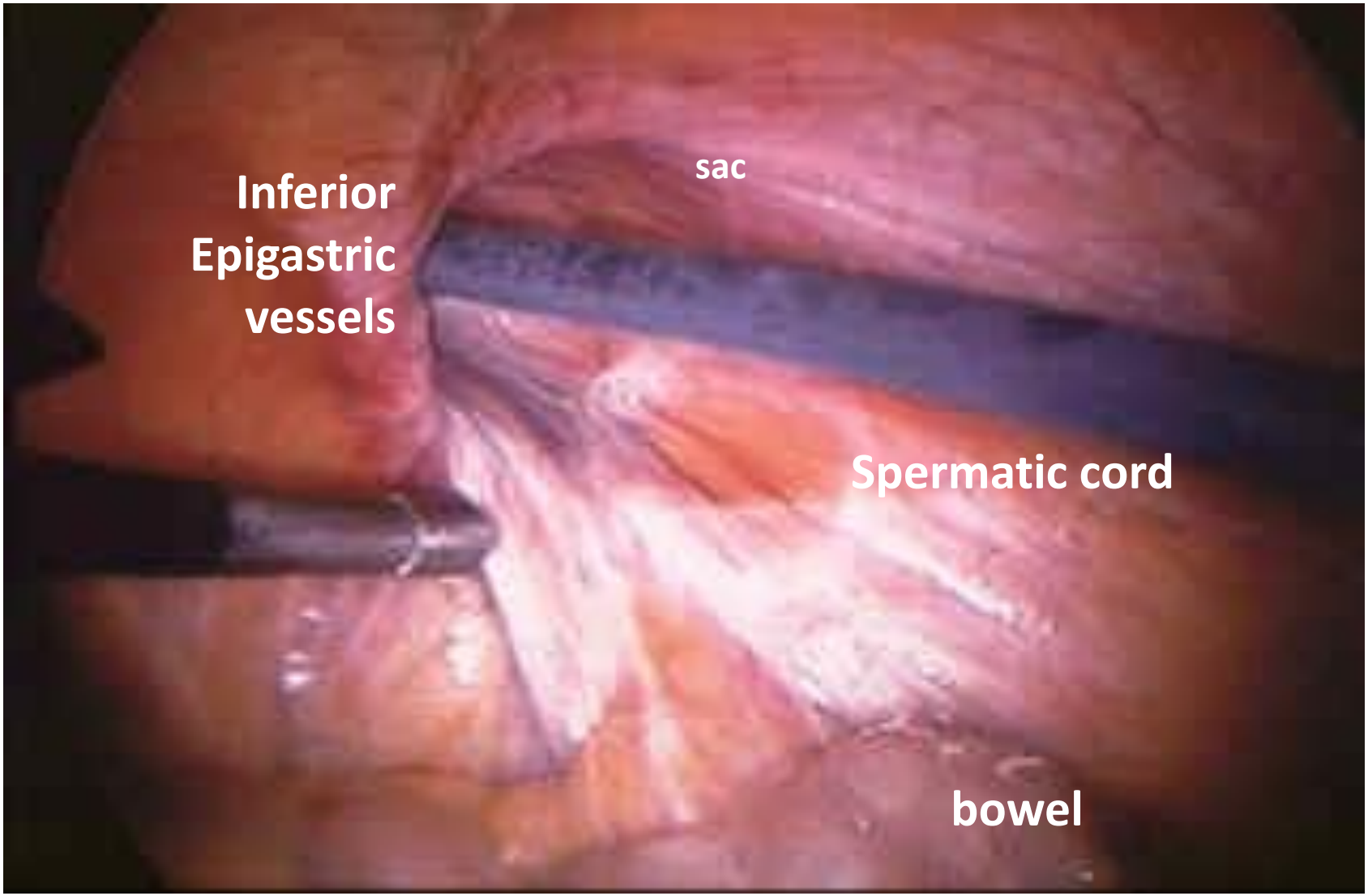
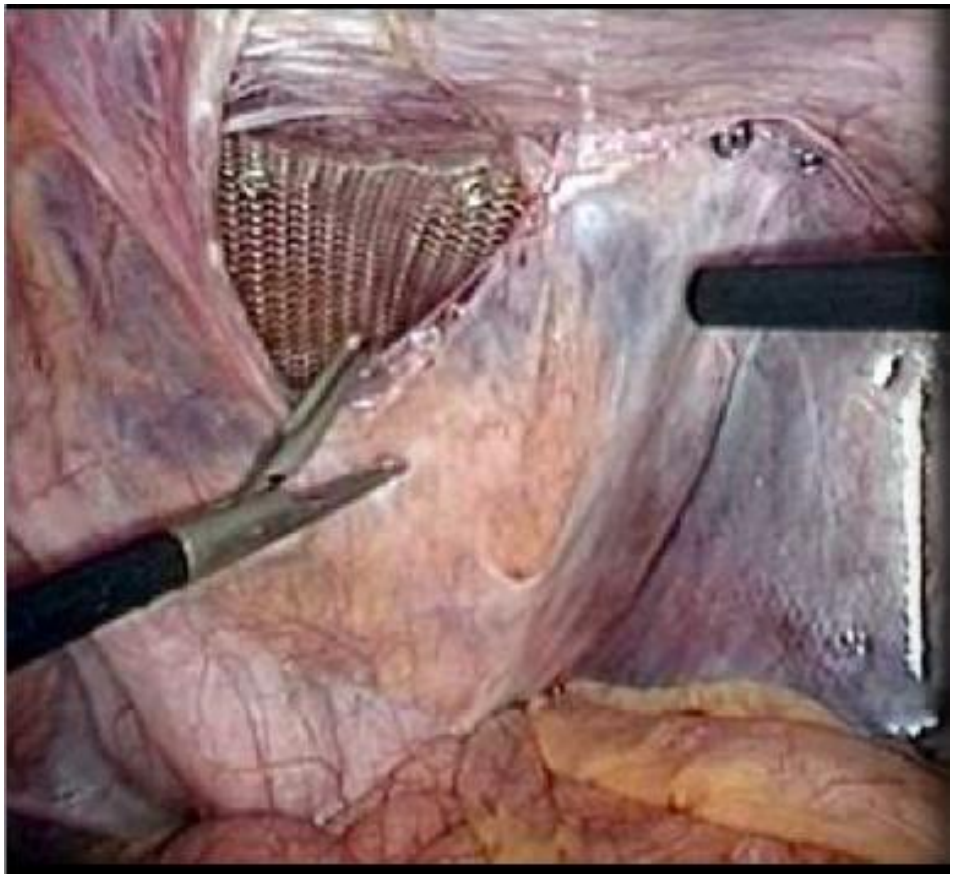


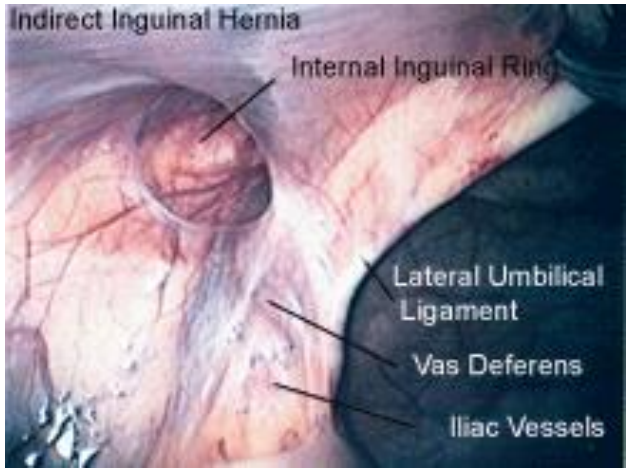

**Fig 5.4** Internal structures of the scrotum. This illustration shows portions of the scrotum cut away to reveal the cremasteric muscle, spermatic cord, vas deferens, and a testis within the scrotal sac.


Q 1


Inferior
Epigastric
vessels
sac
Spermatic cord
bowel

# Laparoscopic mesh repair

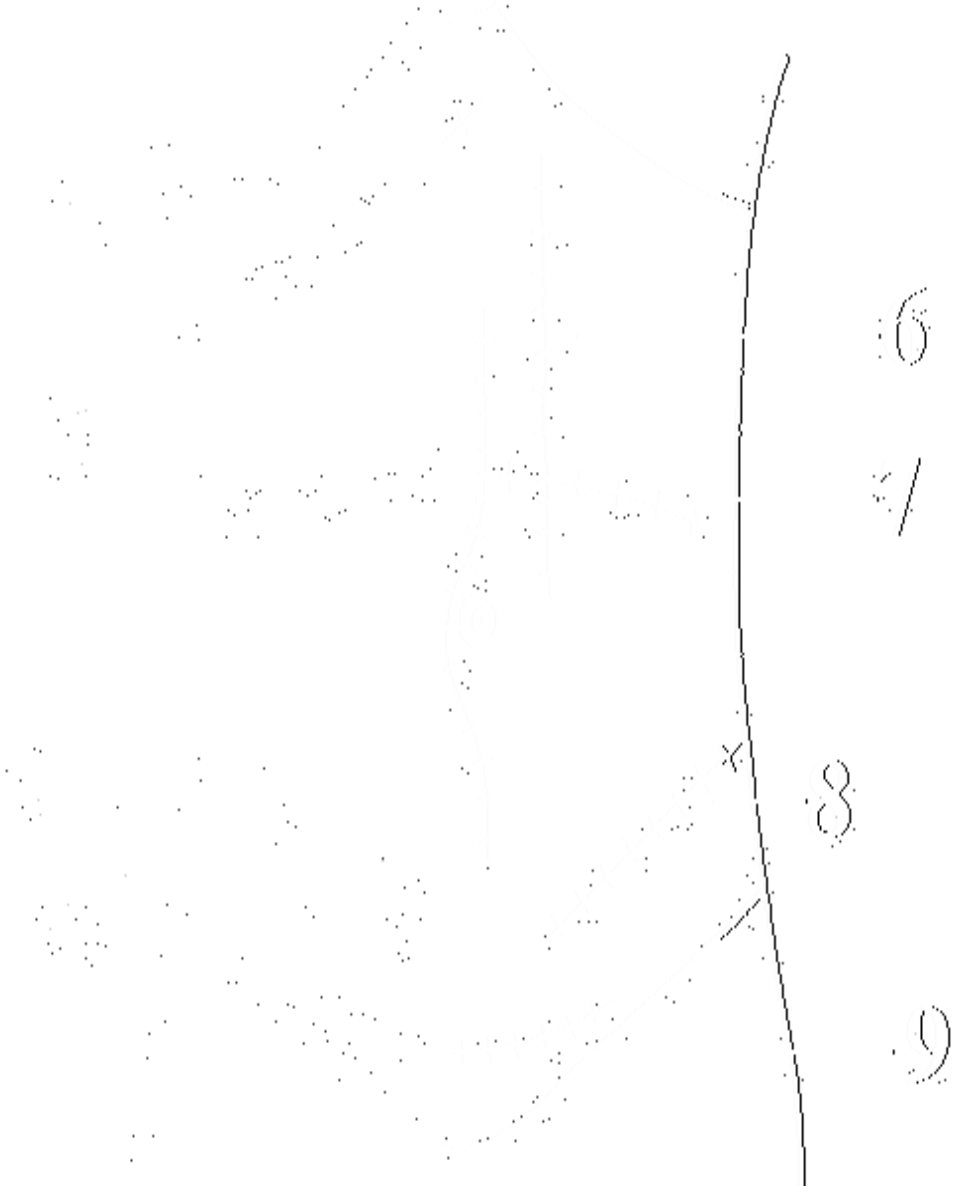





# Steps in Tension-Free Hernioplasty

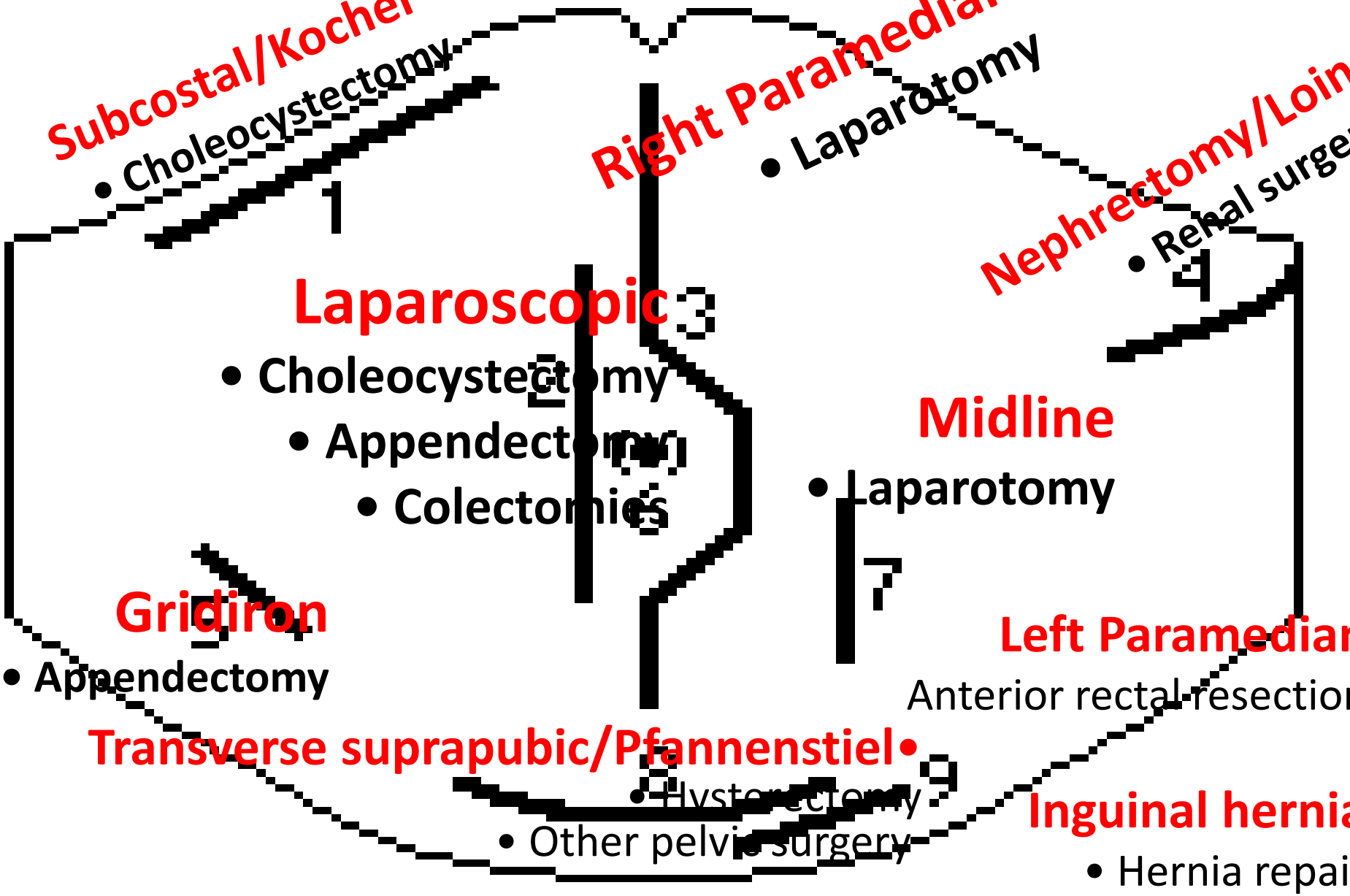
**Completed Tension-free Repair**

# INCISIONS

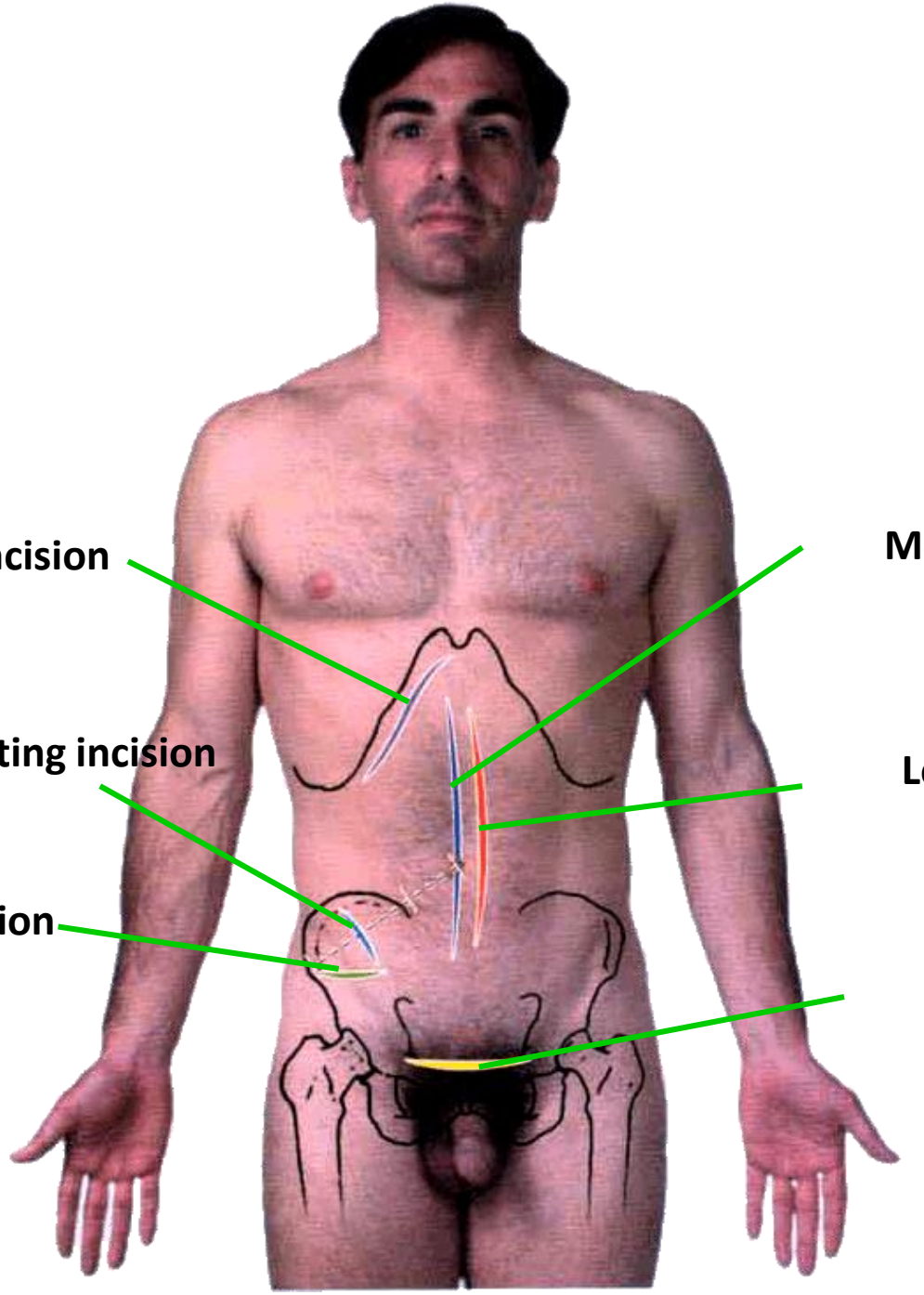


- Longitudinal
  - Midline –
  - Paramedian –
  - Transrectal –
- Oblique
  - Subcostal –
  - McBurney's –
- Transverse
  - Pfannenstiel –
- Combined
  - Thoracal-abdominal –

# Incisions & scars



# Layer ?


Subcostal incision
Muscle-splitting incision
Transverse incision
Median or midline incision
Left paramedian incision
Suprapubic incision

- **Muscles of back are arranged in <u>4 layers.</u>**

- **<u>1st. Layer</u>** :

1- Trapezius.

2- Latissimus Dorsi.

- **<u>2nd Layer:</u>**

1- Levator Scapulae.

2- Rhomboideus minor.

3- Rhomboideus major.

- Also the 2nd layer contains 2 other muscles:

4- Serratus posterior superior.

5- Serratus posterior inferior

- <u>3rd Layer</u> :

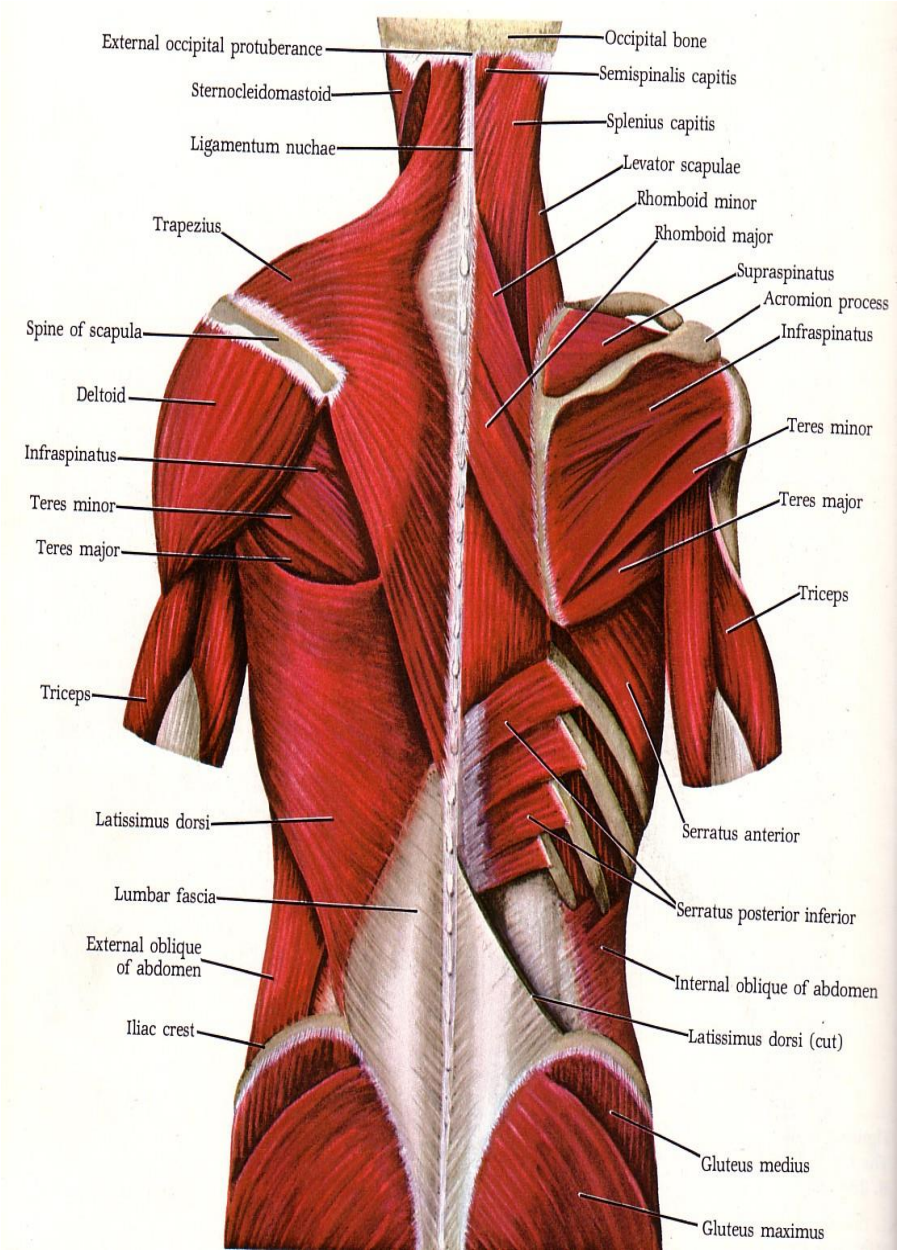
Erector spinae (Sacrospinalis) & Semispinalis.

- <u>4th Layer</u> :

Number of small muscles called multivators, rotators, interspinalis, intertransverses & muscles forming the suboccipital triangle.

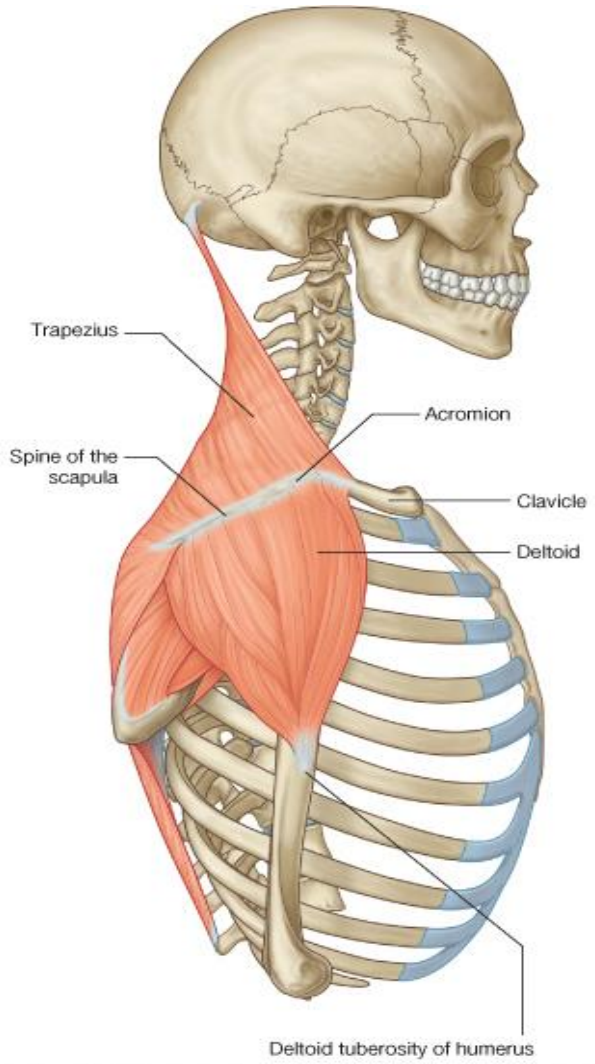
# Trapezius

- **Origin:** From Medial 1/3 of superior nuchal, external occipital protuberance, Ligamentum nuchae, spines of all cervical & all thoracic vertebrae and supraspinous ligament
- **Insertion** : posterior border of lateral 1/3 of the clavicle, medial margin of acromion upper lip of the crest of the spine of the clavicle.



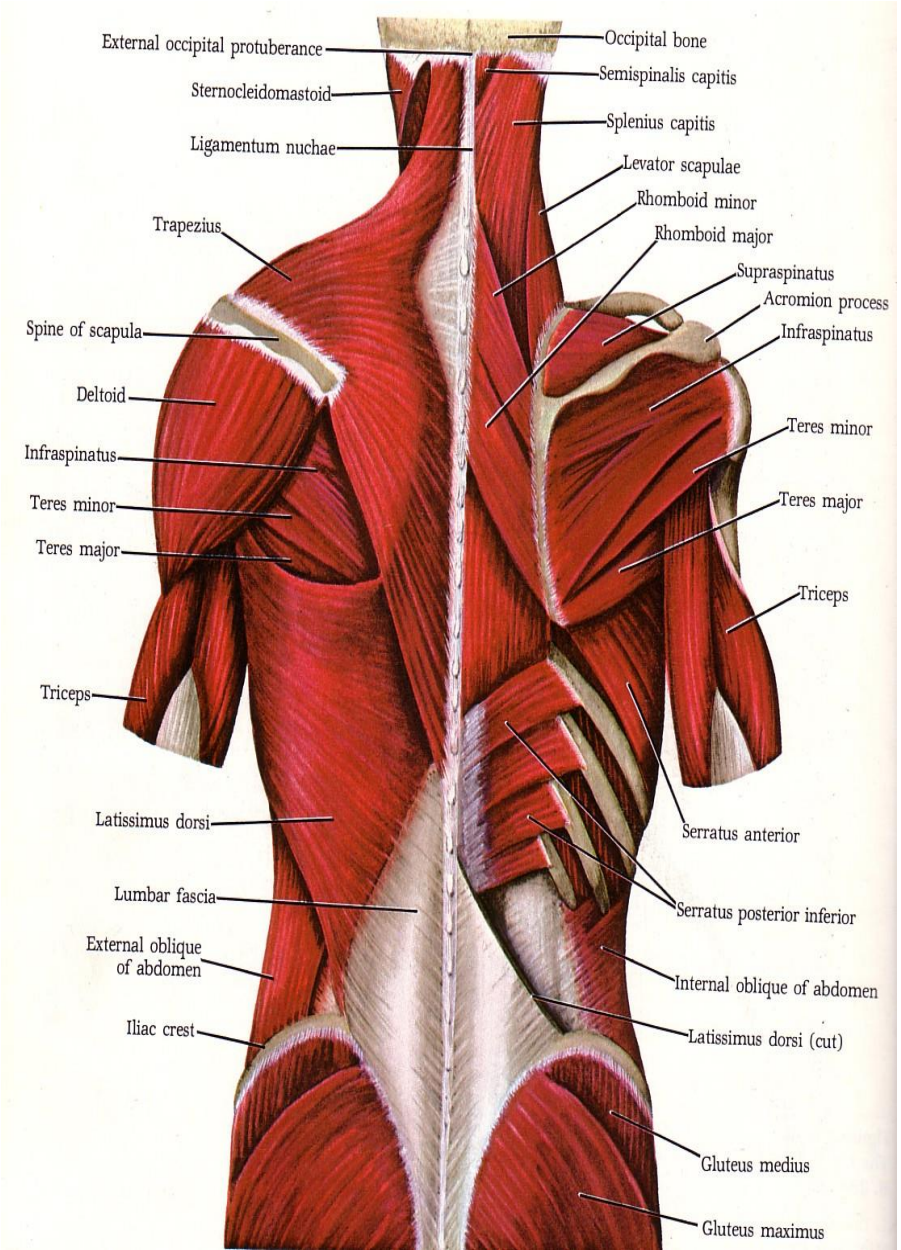
# Trapezius

- **<u>Nerve supply</u>**: Spinal part of the accessory cranial nerve & C 3,4
- **<u>Actions:</u>**
- upper fibers: elevate the shoulder
- Lower fibers: depress the shoulder.
- Middle fibers: brace back (retraction) of shoulder
- It also, helps in raising the arm above 90° with (serratus anterior).



# Latissimus Dorsi

- **Origin:**
  1- Lower 6 thoracic spine.
  2- Thoracolumbar fascia.
  3- Iliac crest.
  4- Lower 3 or 4 ribs.
  5- Back of the inferior angle of the scapula.
- **Insertion:** floor of the bicipital groove.
- **Nerve supply**: Nerve to Latissimus dorsi (thoracodorsal nerve).
- **Action:** adduction, medial rotation.
- It also helps in extension and climbing.



## Levator scapulae

- Origin: Transverse processes of upper 4 cervical vertebrae.
- Insertion: Medial border of scapula.
- Nerve supply: C3,4 & 5
- Action: Elevate the medial border of the scapula.

## Rhomboid minor

- Origin: Ligamentum nuchae & spines of C 7& T1
- Insertion: Medial border of the scapula.
- Nerve supply: C4& 5
- Action: Raises the medial border of scapula upward & medially.

## Rhomboid Major

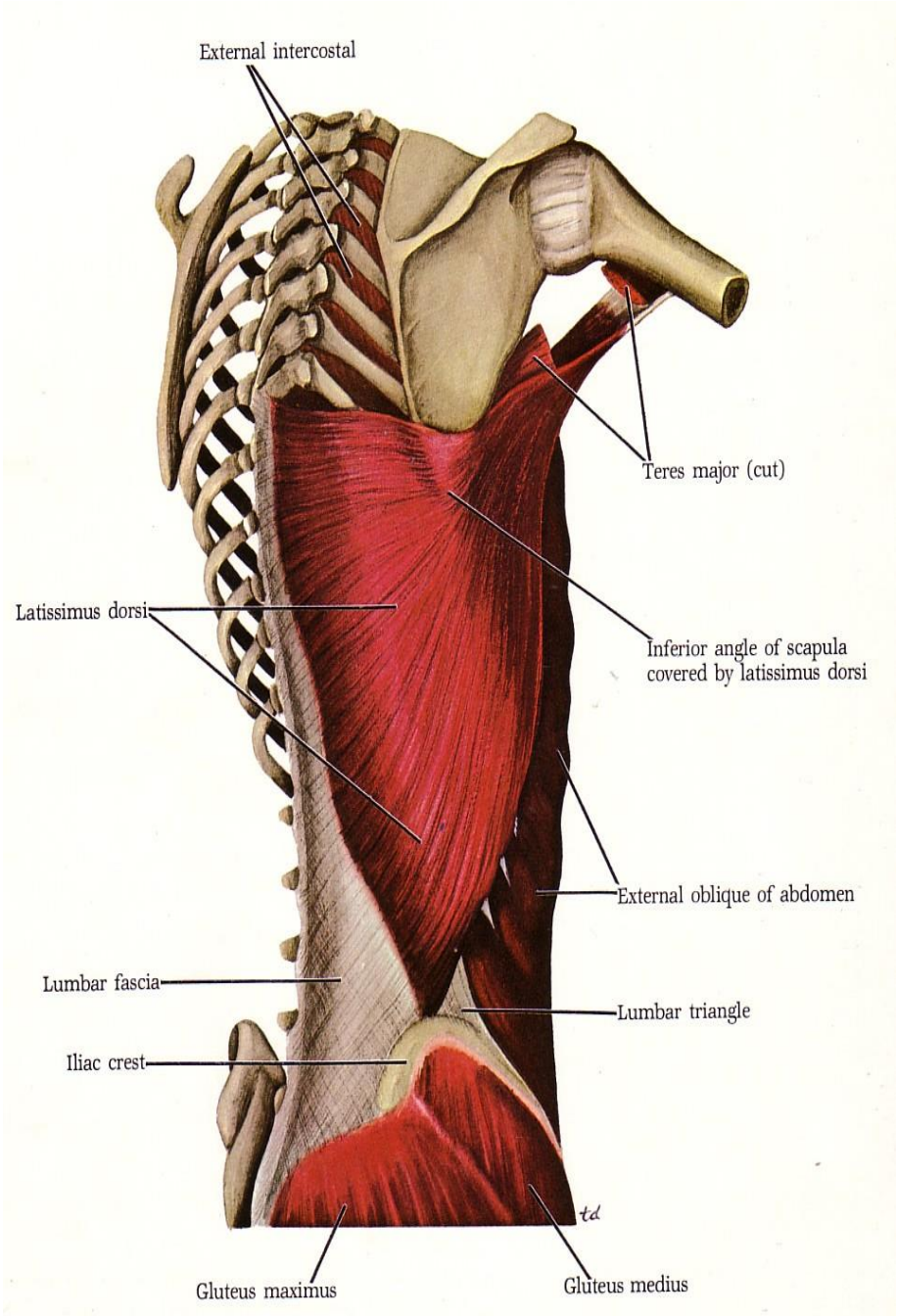
- **Origin:** Spines of T2,T3,T4 & T5.
- **Insertion**: Medial border of scapula.
- **Nerve supply**: C4 & 5.
- **Action**: Raises the medial border of the scapula upward and medially.

**Origin:**

- 1- Lower 6 thoracic spine,
- 2- Thoracolumbar fascia,
- 3- Iliac crest
- 4- Lower 3 or 4 ribs and
- 5- Back of the inferior angle of the scapula

**Insertion:**

floor of the bicipital groove



# Muscles of the back are organized in layers

## Movements of upper limb and respiration.

Extrinsic:

Trapezius — 1st layer:

Latissimus Dorsi

Levator Scapulae — 2nd layer:

Rhomboids (minor & major)

Serratus posterior (superior & inferior) — 3rd layer:

## Act on vertebral column and neck.

Intrinsic:

Splenius — 1st layer:

Iliocostalis — Erector Spinae: — 2nd layer:

Longissimus

Spinalis

Multifidus — Transversospinal: — 3rd layer:

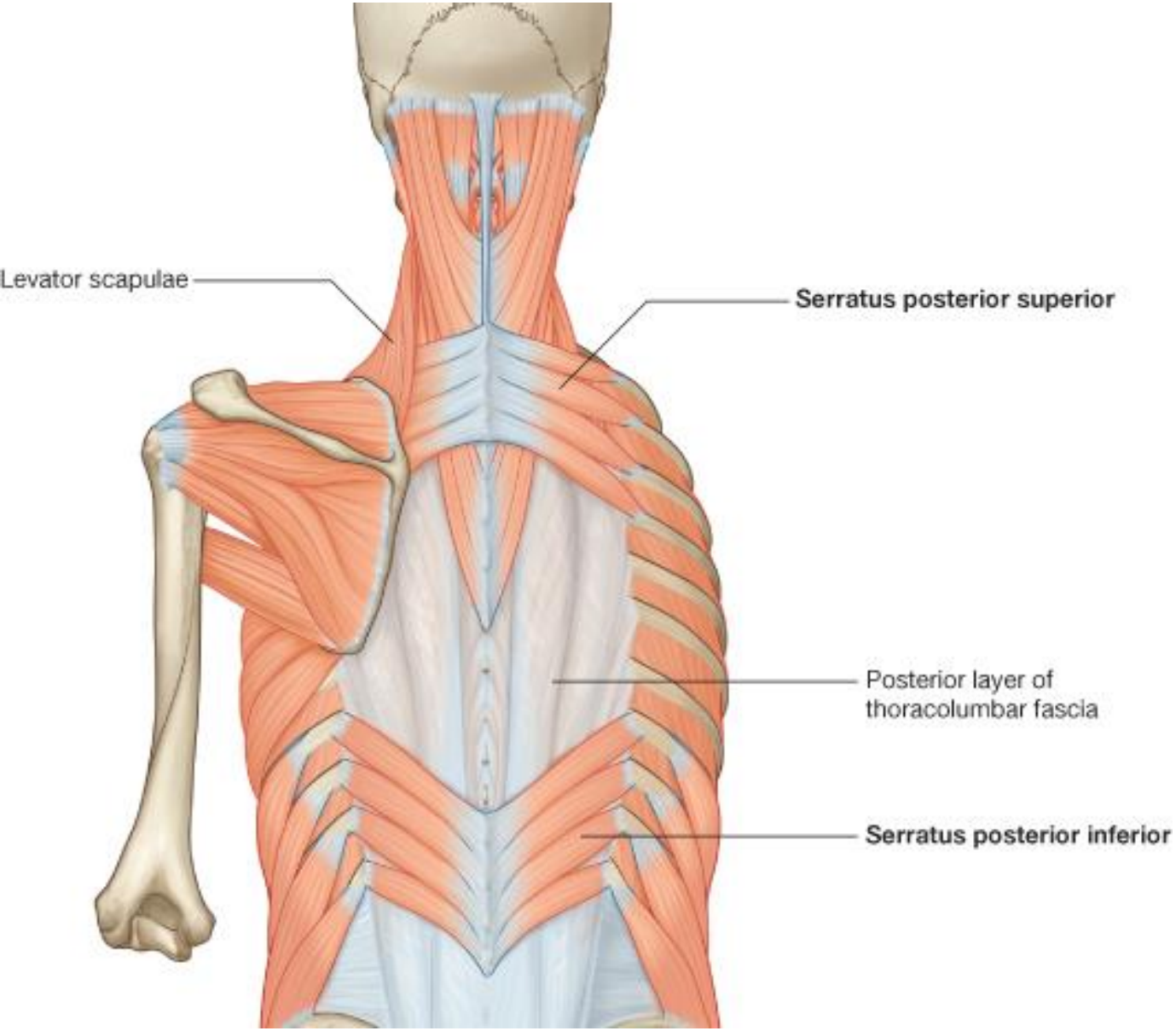
Rotatores

Semispinalis

# The Exceptions

- Serratus Posterior Superior
  - Lig. Nuchae and spinous processes of C7-T3 to 2nd – to 5th ribs
- Serratus Posterior Inferior
  - Spinous Proceses of T11-L2 to inferior borders of – last 4 ribs
- Elevate or depress ribs (accessory respiratory muscles)
- Innervated by ventral rami

# Serratus Post.



# Major Groups of Back Muscles

- Those that arise from the mid-line and run superiorly and laterally – The Splenius Muscles (Bandage)
- Those that arise from near the mid-line or slightly laterally and run almost longitudinally with no marked inward or outward slant – called the Erector Spinae

# Major Groups

- The third group are those that arise laterally and run towards the mid-line as they travel up

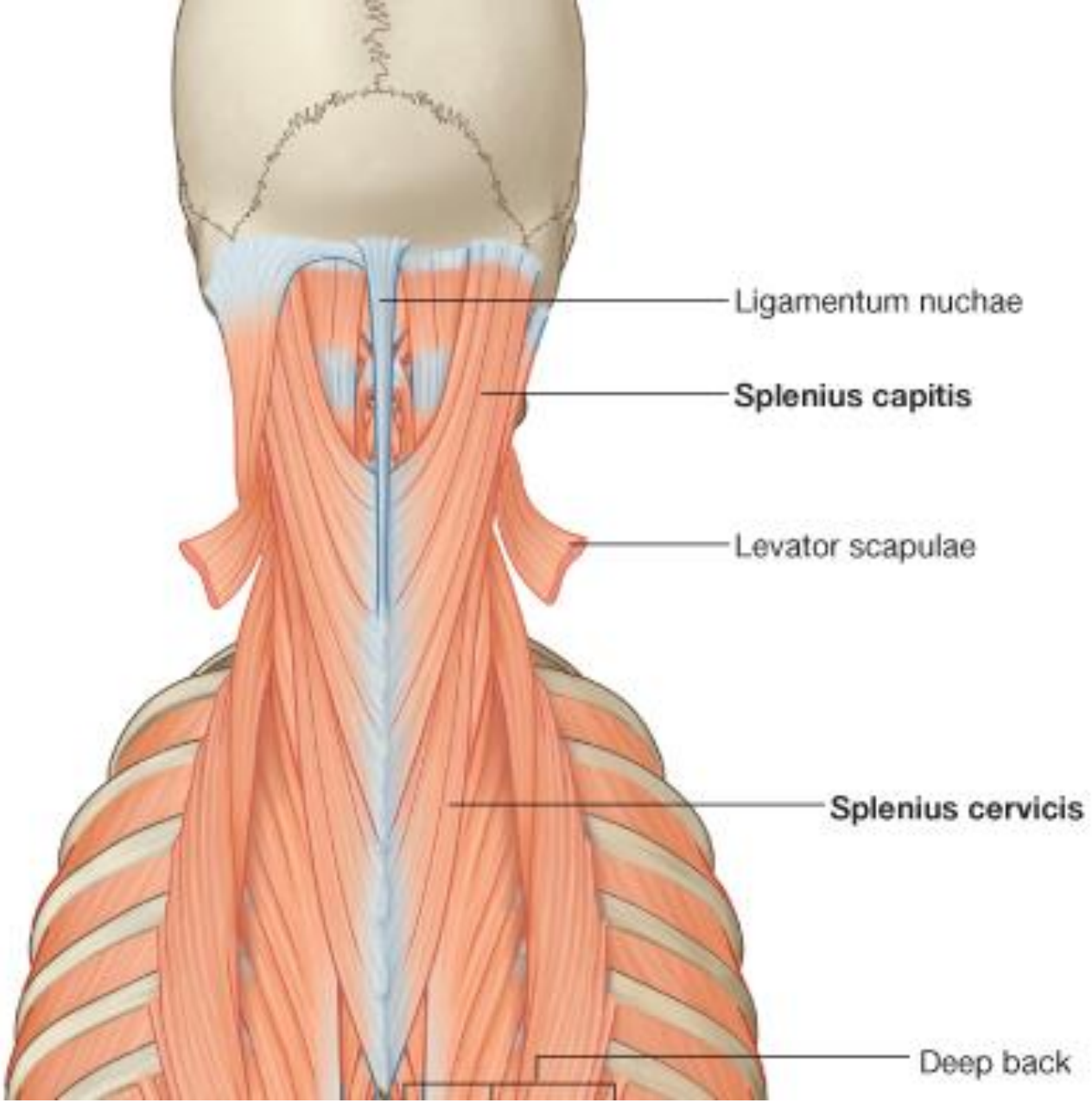
  Called the Transversospinalis group –

- Last – small muscles that run from one spinous process to another or one transverse process to another (interspinales **and** intertransvesus)

# Splenius Muscles

- Splenius Capitis
  - Lig. Nuchae and Spinous Process of C7-T4 to sup. Nuchal line and mastoid process
- Splenius Cervicis
  - Spinous processes of T3-T6 to Transvers process of C2-C4
- Both extend head and neck and can laterally flex (side bend) the head; Also support and can contribute to rotation of cervical spine and, thus, the head
- Dorsal rami of spinal nerves nearest their respective origins

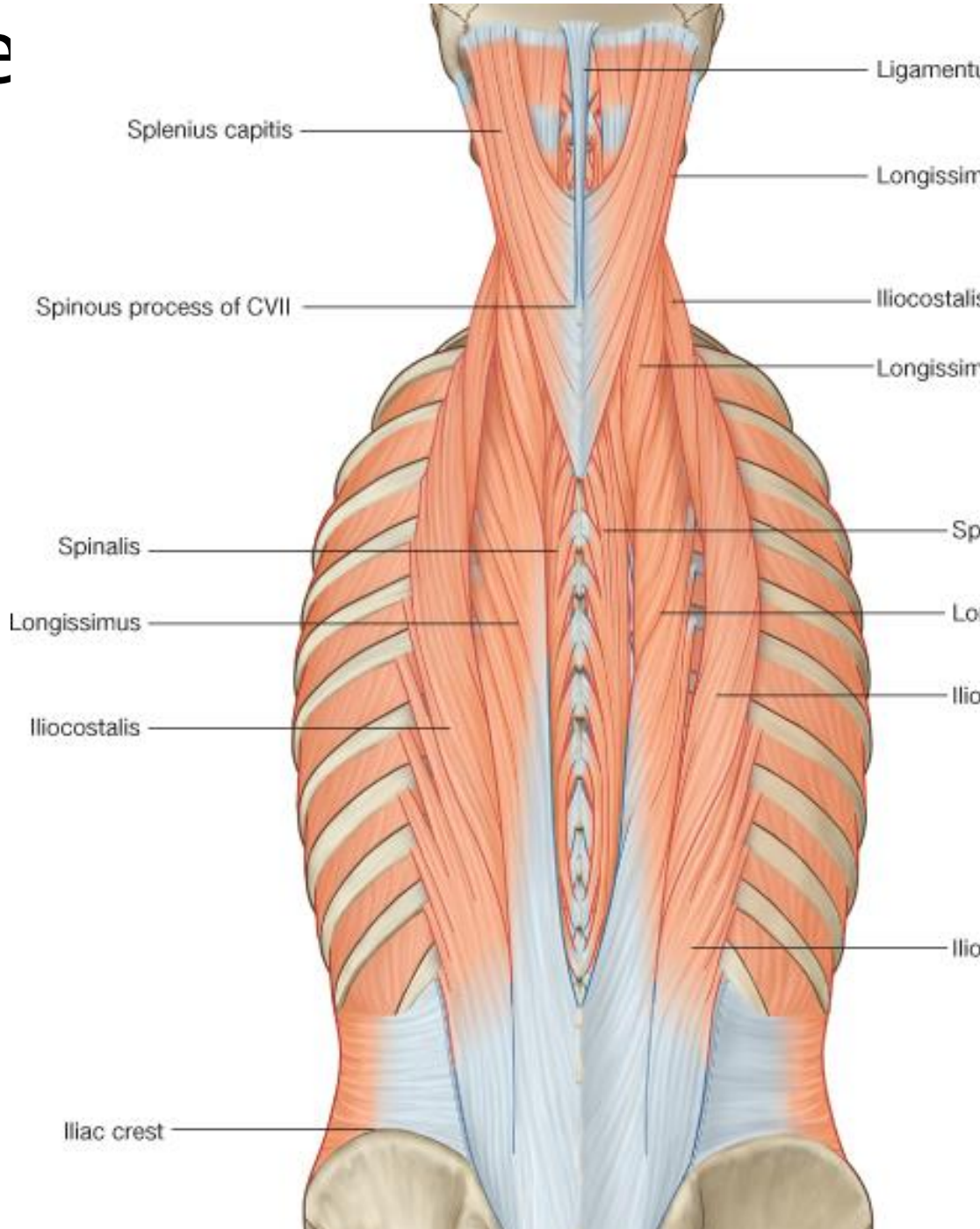
# Splenius


Ligamentum nuchae
Splenius capitis
Levator scapulae
Splenius cervicis
Deep back

# Erector Spinae

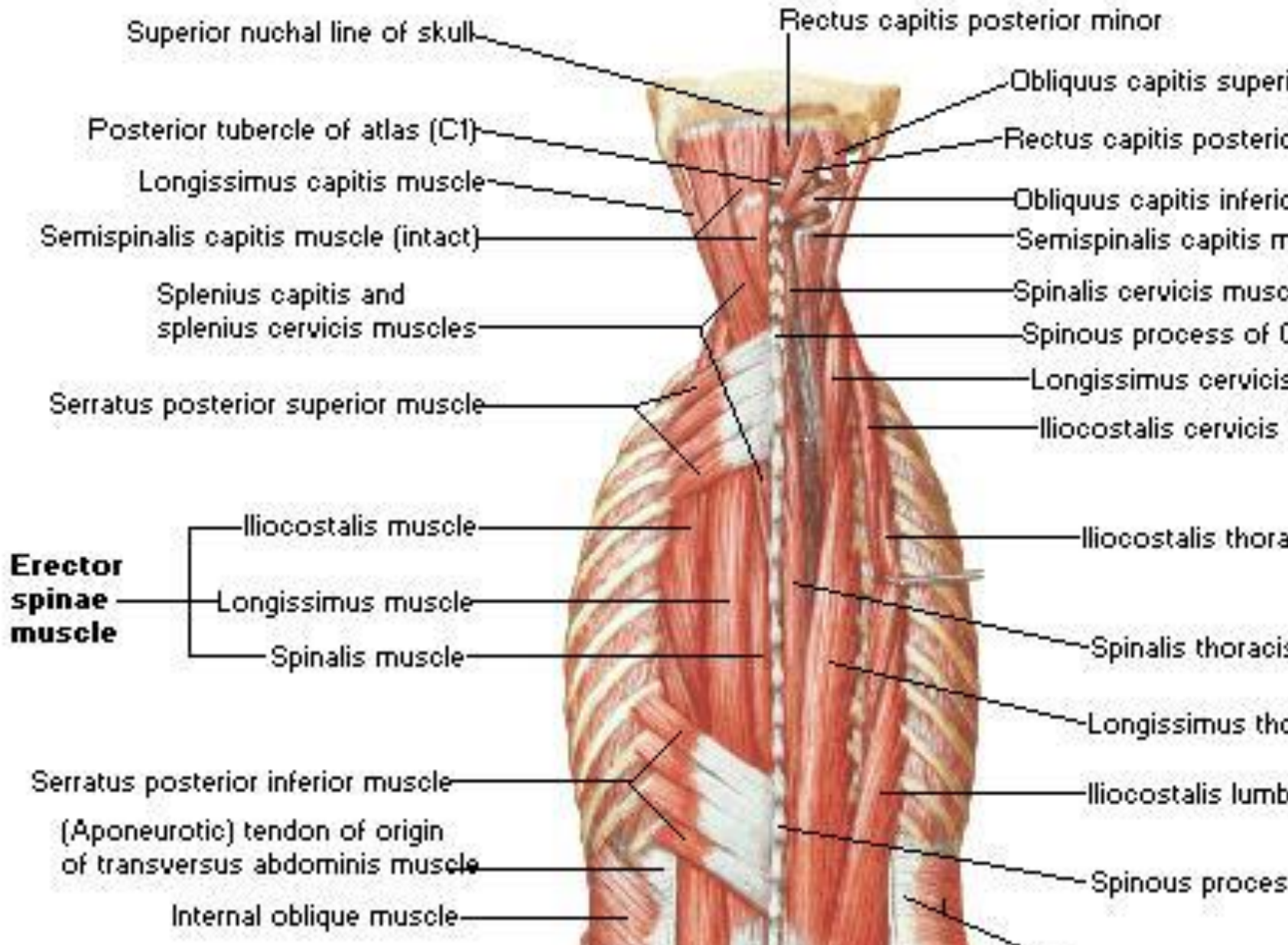
- Long Muscles with multiple, overlapping, origins
- Three sub groups; iliocostalis, longissimus, spinalis
- Common “origin” of the entire group is a muscle mass located on the posterior sacrum, iliac crest, and spinous process of lumbar vertebrae
- Beyond that, specific muscles have various attachments

# Erector Spinae

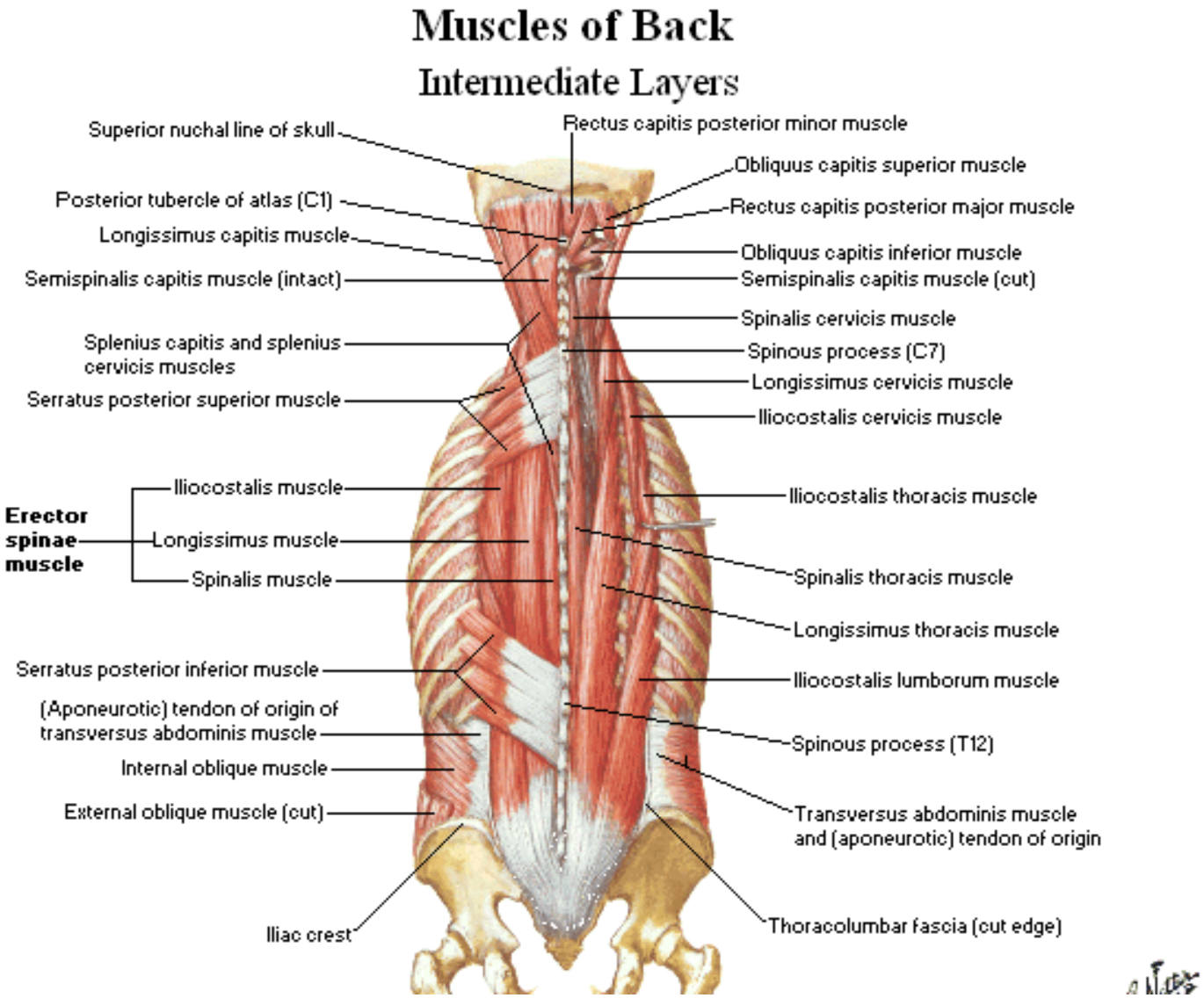


# Muscles of Back

## Intermediate Layers



# E. Spinae


Muscles of Back
Intermediate Layers
Superior nuchal line of skull
Posterior tubercle of atlas (C1)
Longissimus capitis muscle
Semispinalis capitis muscle (intact)
Splenius capitis and splenius cervicis muscles
Serratus posterior superior muscle
Erector spinae muscle
Iliocostalis muscle
Longissimus muscle
Spinalis muscle
Serratus posterior inferior muscle
(Aponeurotic) tendon of origin of transversus abdominis muscle
Internal oblique muscle
External oblique muscle (cut)
Iliac crest
Rectus capitis posterior minor muscle
Obliquus capitis superior muscle
Rectus capitis posterior major muscle
Obliquus capitis inferior muscle
Semispinalis capitis muscle (cut)
Spinalis cervicis muscle
Spinous process (C7)
Longissimus cervicis muscle
Iliocostalis cervicis muscle
Iliocostalis thoracis muscle
Spinalis thoracis muscle
Longissimus thoracis muscle
Iliocostalis lumborum muscle
Spinous process (T12)
Transversus abdominis muscle and (aponeurotic) tendon of origin
Thoracolumbar fascia (cut edge)

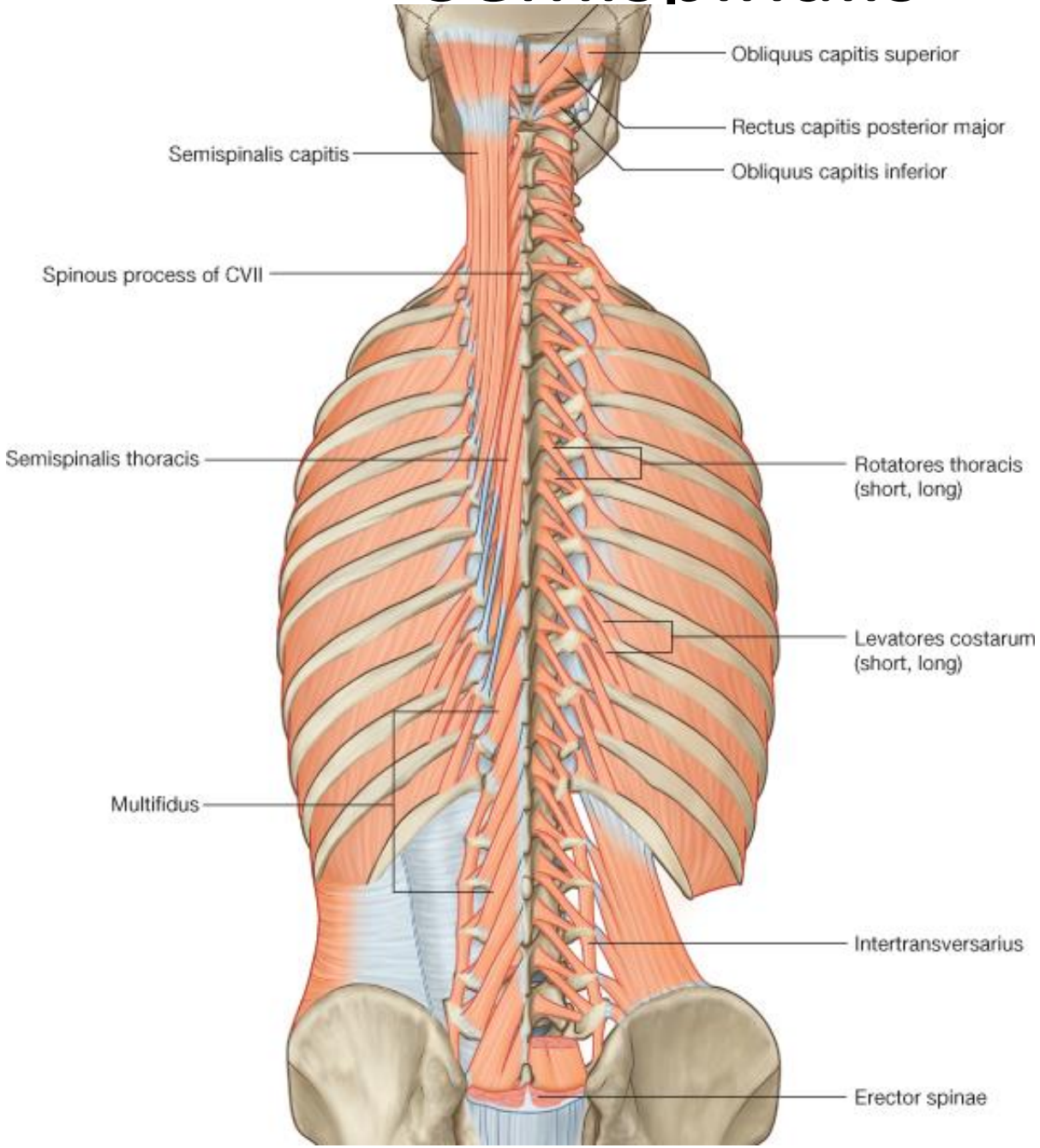
# Longissimus

- Generally, run from the transverse processes of one level of v. column up several levels to attach to another transverse process
- The longissimus capitis originates on t. processes of T1-T4 and attach to the skull at the mastoid process, hence the name capitis
- Is the only **E.Spinae** to attach to skull

# Transversospinalis Group

- Arise laterally and run, more or less, to the mid-line
- Semispinalis Capitis
  - Transverse Process C7-T6 to Occipital bone, near mid-line, Extend head, rotate to same side
- Semispinalis Cervicis
  - Transverse process T1-T6 to Spines of C2-C6, Extend head (Cervical Spine) and side bend

# Semispinalis



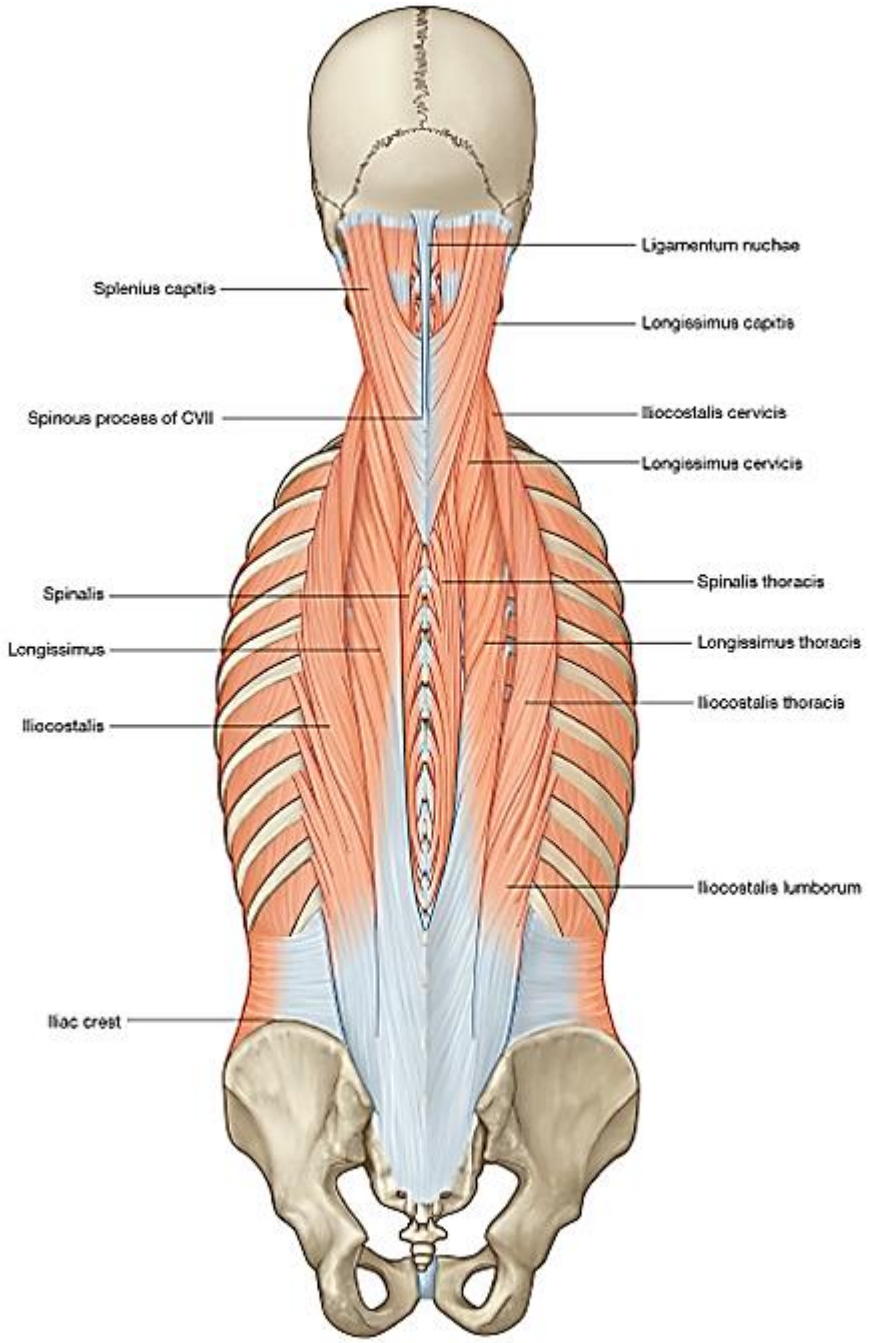
# Intrinsic Muscles of the Back

## Intermediate intrinsic back muscles: 2.

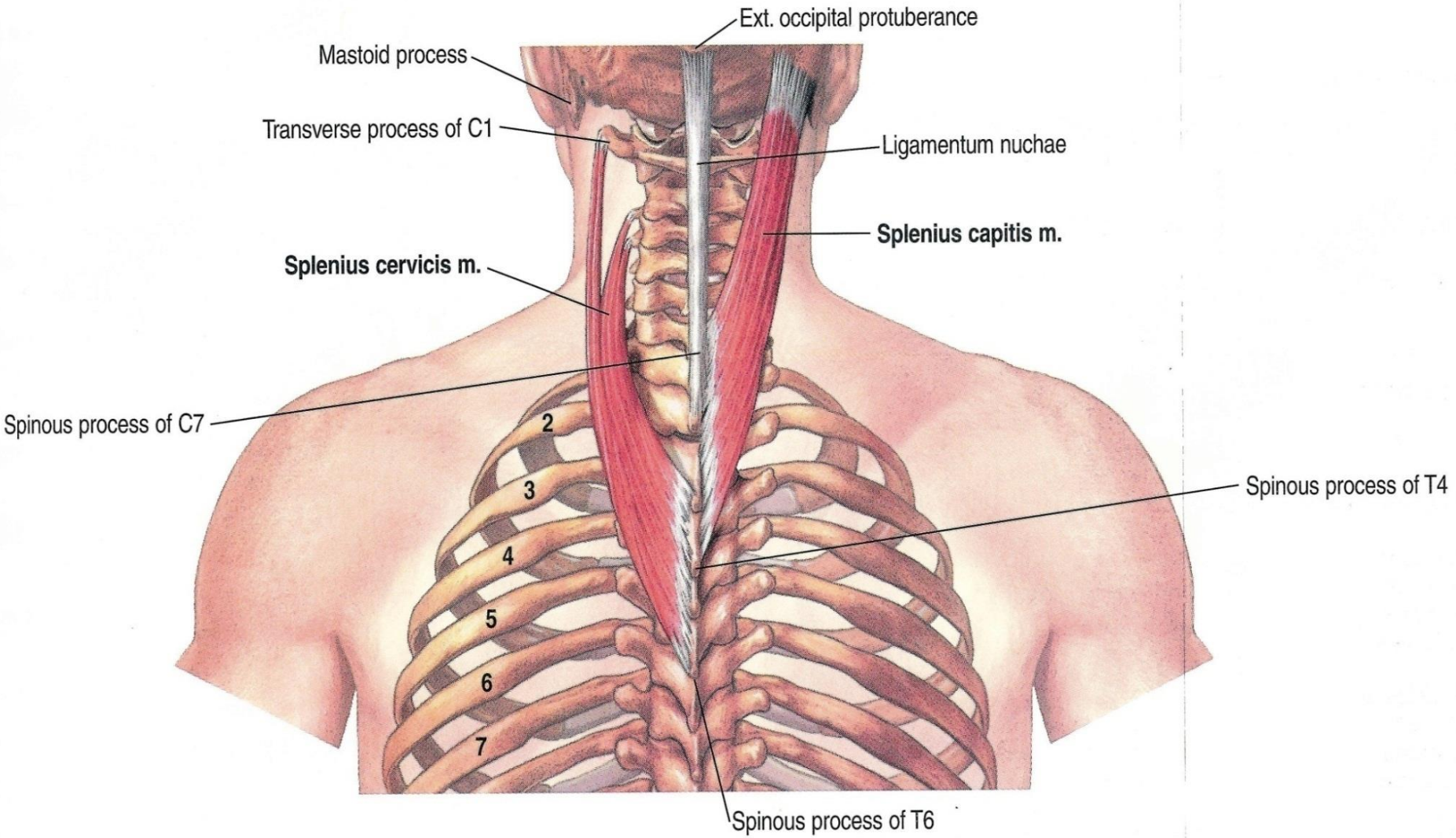
- Erector spinae is the chief extensor of the vertebral column & is divided into three columns (also called as the long muscle of the back).
  - Ilio-costalis (forms lateral column)
  - Longissimus (forms intermediate column)
  - Spinalis (forms medial column)

# Intermediate Intrinsic Back Muscles

Erecter Spinae
(Ilio-costalis
Longissimus
Spinalis)

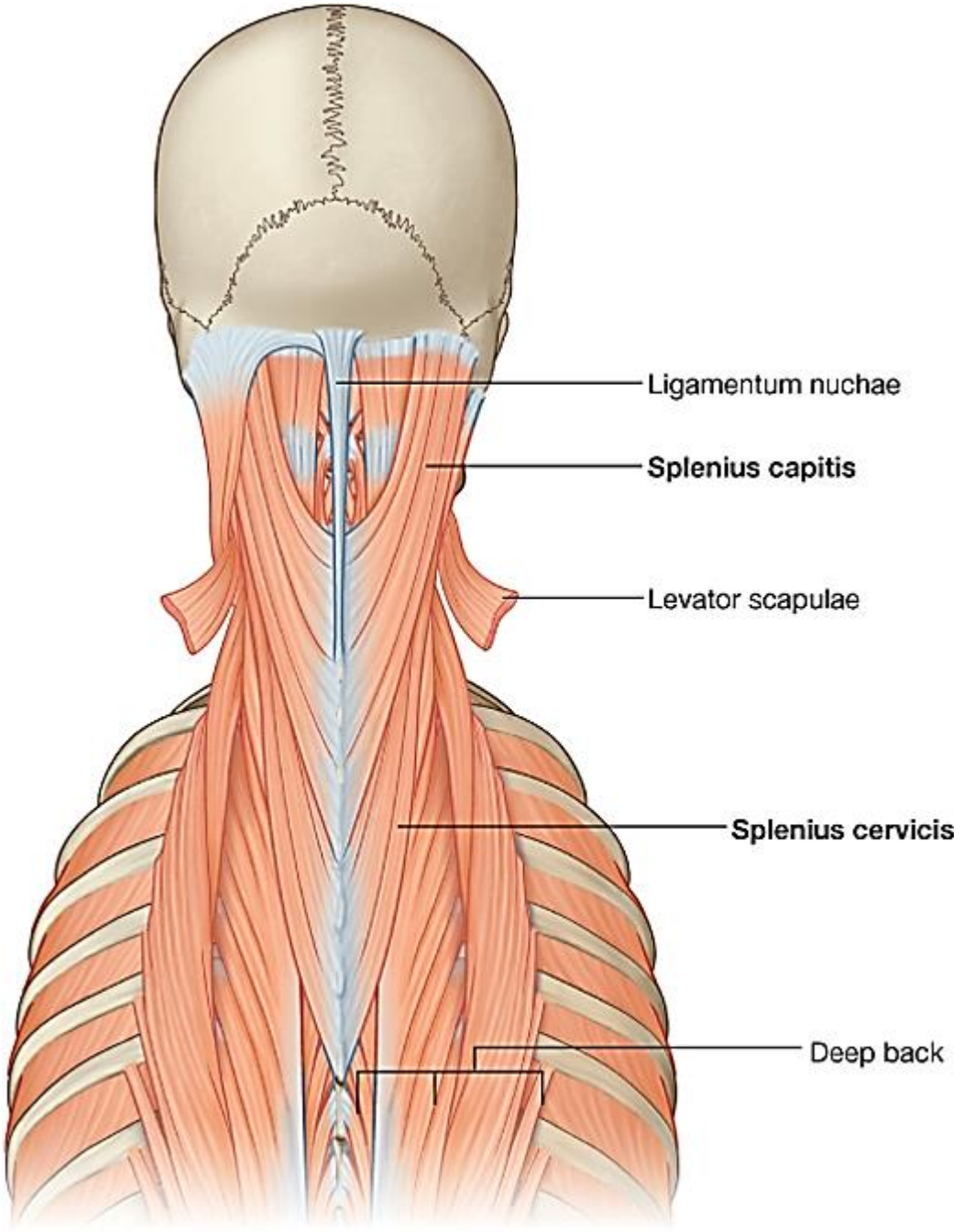


# Superficial Intrinsic Back Muscles



# Superficial Intrinsic Back Muscles

Splenius cervices
&
splenius capitis



Following an emergency appendectomy your patient complained of having paresthesia (numbness) of the skin at the pubic region. The most likely nerve that has been injured during the operation is:

A. Genitofemoral

B. Iliohypogastric

C. Subcostal

D. Spinal nerve T10

E. Spinal nerve T9

An obstetrician decides to do a Caesarean section on a 25-year-old pregnant woman. A transverse suprapubic incision is chosen for that purpose. All of the following abdominal wall layers will be encountered during the incision EXCEPT the:

Anterior rectus sheath .A

Posterior rectus sheath .B

Rectus abdominis muscle .C

Skin and subcutaneous tissue .D

Transversalis fascia, extraperitoneal fat, and peritoneum .E

Surgical approaches to the abdomen sometimes necessitate a midline incision between the two rectus sheaths, i.e., through the:

A. Linea aspera

B. Arcuate line

C. Semilunar line

D. Iliopectineal line

E. Linea alba

Surgical approaches to the abdomen sometimes necessitate a midline incision between the two rectus sheaths, i.e., through the:

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D. Iliopectineal line

E. Linea alba

Which structure passes through the deep inguinal ring?

A. Iliohypogastric nerve

B. Ilioinguinal nerve

C. Inferior epigastric artery

D. Medial umbilical ligament

E. Round ligament of the uterus

The superficial inguinal ring is an opening in which structure?

A. External abdominal oblique aponeurosis

B. Falx inguinalis

C. Internal abdominal oblique muscle

D. Scarpa's fascia

E. Transversalis fascia

Which nerve passes through the superficial inguinal ring and may therefore be endangered during inguinal hernia repair?

A. Femoral branch of the genitofemoral

B. Ilioinguinal

C. Iliohypogastric

D. Obturator

E. Subcostal

During exploratory surgery of the abdomen, an incidental finding was a herniation of bowel between the lateral edge of the rectus abdominis muscle, the inguinal ligament and the inferior epigastric vessels. These boundaries defined the hernia as a(n):

Congenital inguinal hernia .A

Direct inguinal hernia .B

Femoral hernia .C

Indirect inguinal hernia .D

Umbilical hernia .E