

Abdominal wall



Borders of the Abdomen

- Abdomen is the region of the trunk that lies between the diaphragm above and the inlet of the pelvis below

- Borders, *Boundaries:*

Superior:

Costal cartilages 7-12. on right & left superiorly.

Xiphoid process: → in the midline superiorly.

7 attached to sternum.
8, 9, 10 while 11, 12 → floating ribs posteriorly.

ribs along *الضلع*
from anterior →
7-10
Posterior 11-12.
7-12 ← *الضلع*

- Inferior:

Pubic bone and iliac crest:

Level of L4. *الضلع*

- Umbilicus: *السرة*, in umbilical region.

Level of IV disc L3-L4

between L3 & L4.

Abdominal Quadrants

Formed by two intersecting lines:

Vertical & Horizontal

Intersect at umbilicus.

Quadrants:

Upper left.

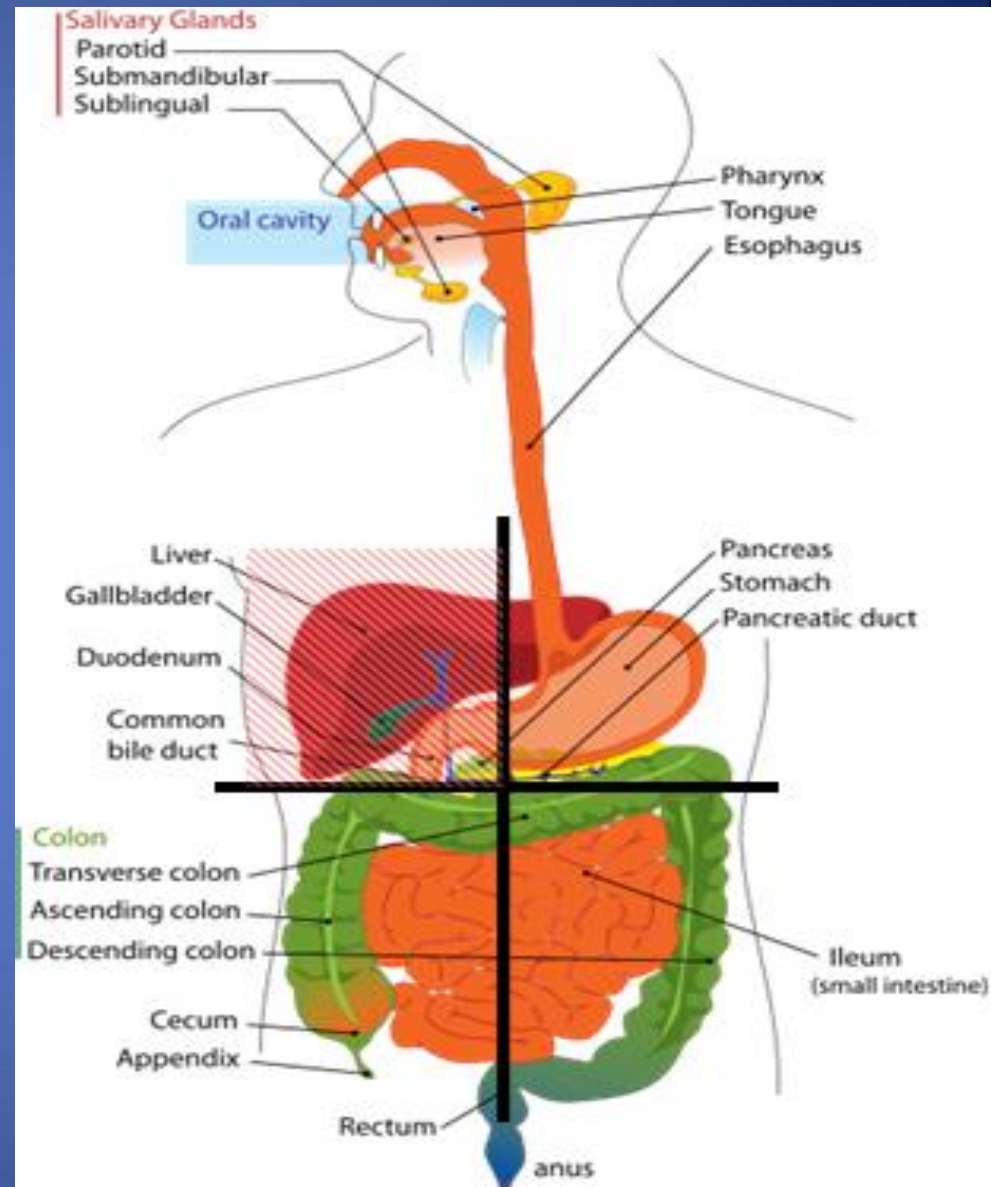
Upper right.

Lower left.

Lower right

In the past, they divided abdominal wall into 4 quadrants, but this isn't accurate.

9 areas clinically (more accurate).



For ex: Pt have appendicitis, osteoarthritis
 - ovaries & cecum ^{causative} _(right iliac) ^{save & gain} _{point} ^{2 Vertical line → midclavicular lines.}

Abdominal Regions

3 lines 9d
 for the description
 of organs.

etc

Divided into 9 regions by two pairs of planes:

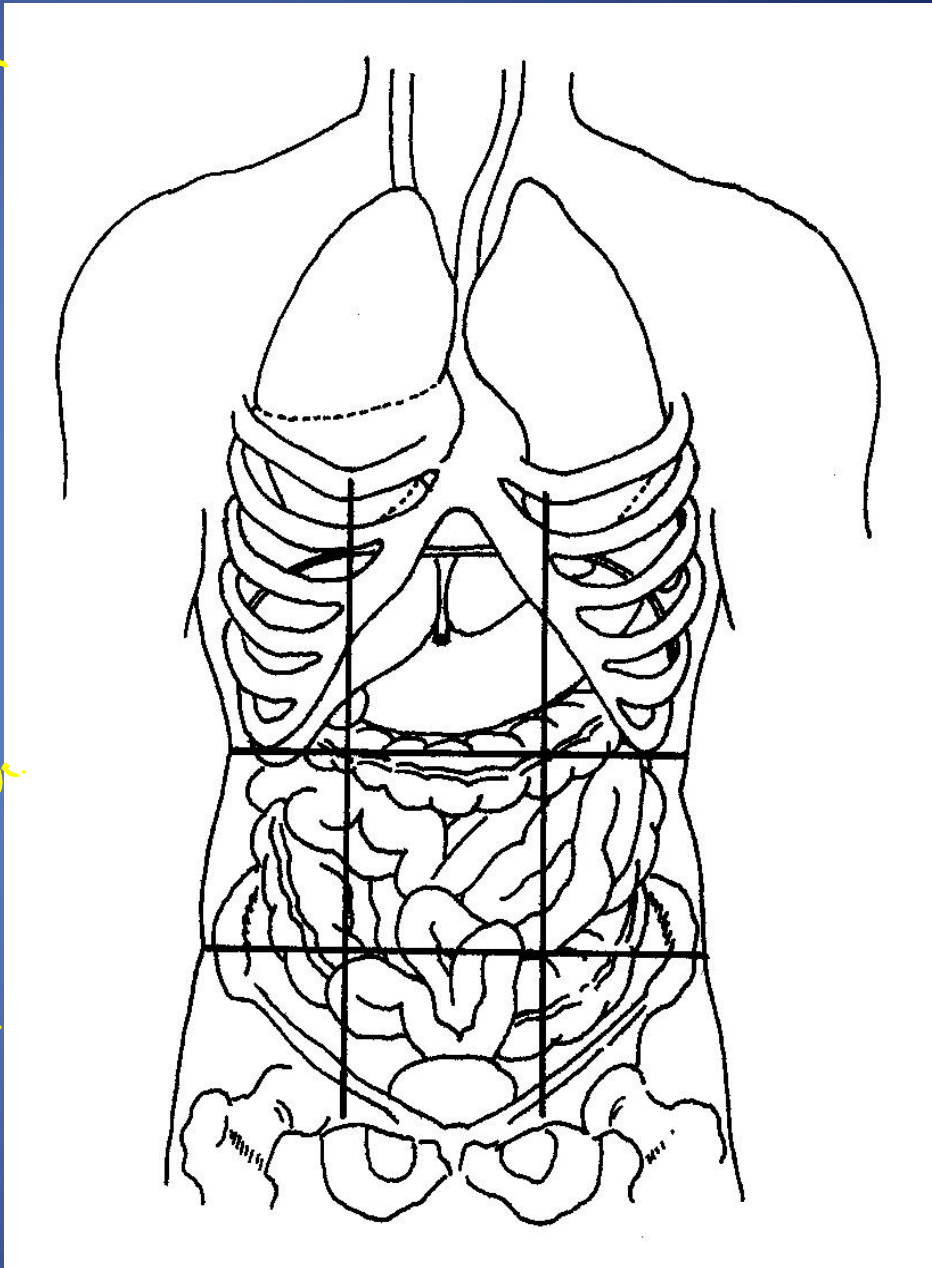
↳ Upper three, middle ~, lower ~.
 ↳ How? → by 2 vertical lines & 2 horizontal lines.

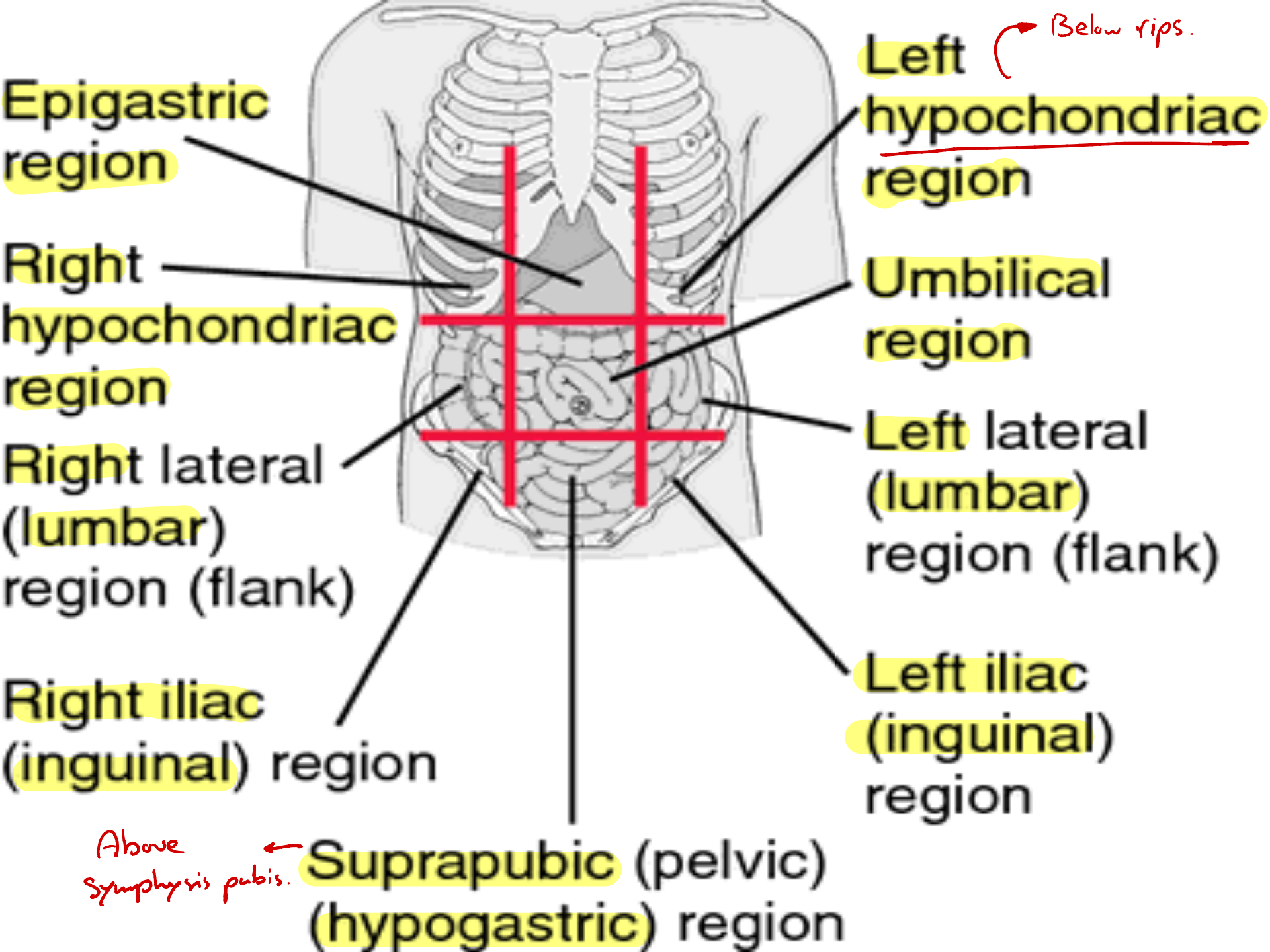
1- Vertical Planes:

- Left and right lateral planes
- Midclavicular planes ^{downward obliquely, vertical. (right & left)}
 - passes through the midpoint between the ant. sup. iliac spine and symphysis pubis

2- Horizontal Planes:

- **Subcostal plane** ^{at level of L3 below costal cartilage.}
 - at level of L3 vertebra
 - Joins the lower end of costal cartilage on each side
- **Intertubercular plane:** ^{between iliac tubercle at iliac crest of hip bone.}
 - At the level of L5 vertebra
 - Through tubercles of iliac crests.





- Left hypochondriac → contain spleen.
- Right hypochondriac → liver, gallbladder.
- Umbilical → small intestine.

- Right lumbar → ascending colon, RT kidney.
- Left lumbar → descending colon, left kidney.
- Right iliac → cecum & ovaries.

hypogastric → urinary bladder.

Abdominal wall divided into:-



Anterior abdominal wall



Posterior abdominal wall

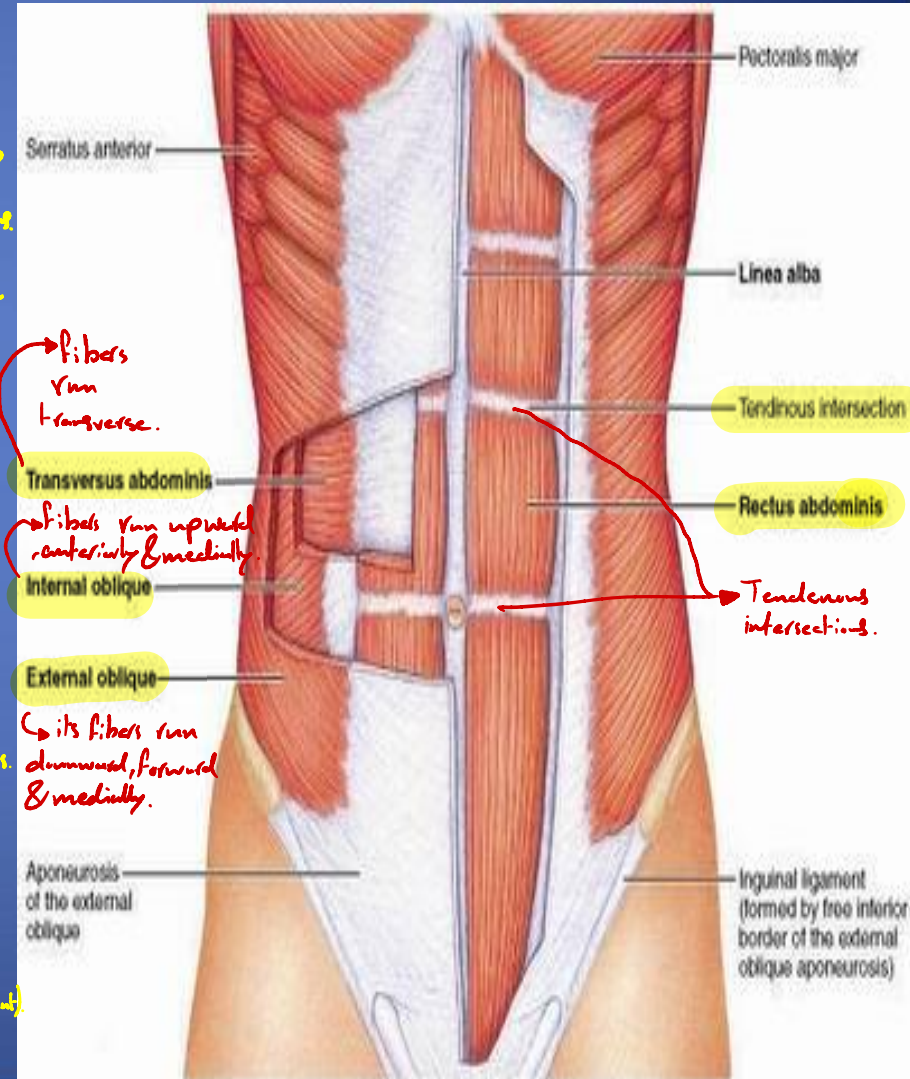
- Kidney lies on it from inside.
- Have the abdominal aorta & inferior vena cava (IVC).

What are the Layers of Anterior Abdominal Wall

كثيرة ال Layers بالتتابع

- ✓ **Skin** → covers all the anterior wall.
- ✓ **Superficial Fascia** → ^{زيتا} skin _{ال}
 - Above the umbilicus one layer (Fatty layer) → ^{Camper's fascia.}
 - Below the umbilicus two layers
 - Camper's fascia - fatty superficial layer. ^{umbilical one fatty}
 - Scarp's fascia - deep membranous layer. ^{one fatty & one membranous}
- ✓ **Deep fascia** → ^{absent in face & abdomen.} ^{Y. 3mi in deep fascia or very thin layer.}
 - Thin layer of C.T covering the muscle may absent ^{why? cuz in preg, the fetus will grow upward & anterior, so we need space for enlargement. → No deep fascia.}
- ✓ **Muscular layer** 4 muscles
 - External oblique muscle (external abdominis).
 - Internal oblique muscle (internal abdominis)
 - Transverse abdominal muscle
 - Rectus abdominis → ^{as squarer, appears in athletes (six-pack)} ^{located in rectus sheath.} ^{Sometimes appears 4, 6, 8, why? → cuz it contains tendinous intersections.} ^{fibrous tendons, usually there is one at level of umbilicus, & 2 above. Sometimes there is one below umbilicus (but also may be absent).} ^{All of this depend on myotomes in embryo}
- ✓ **Transversalis fascia** → ^{in lower limb, in (femoral sheath)} ^{contributes to form}
- ✓ **Extraperitoneal fascia** → ^{فوق قدام} ^{above peritoneum,}
- ✓ **Parietal Peritoneum** → ^{as a balloon surrounds the abdominal viscera.} ^{if u want to do a surgery on abdominal viscera, u should open all layers ending in opening parietal peritoneum. if u didn't open it, u could never reach the viscera.}

Allah created the muscles here as a net (آسكس) to make them very strong muscles, to protect abdominal viscera.



Superficial Fascia

above umbilicus.

- Camper's fascia – fatty layer = dartos muscle in male
- Scarpa's fascia – membranous layer.
or fascia → Completion of Camper's fascia in scrotum.

below umbilicus.

very important.

- Attachment of Scarpa's fascia** = membranous fascia

(1 cm below inguinal ligament) → **INF: Fascia lata**

Sides: Pubic arch

(Pelvis) **Post: Perineal body**

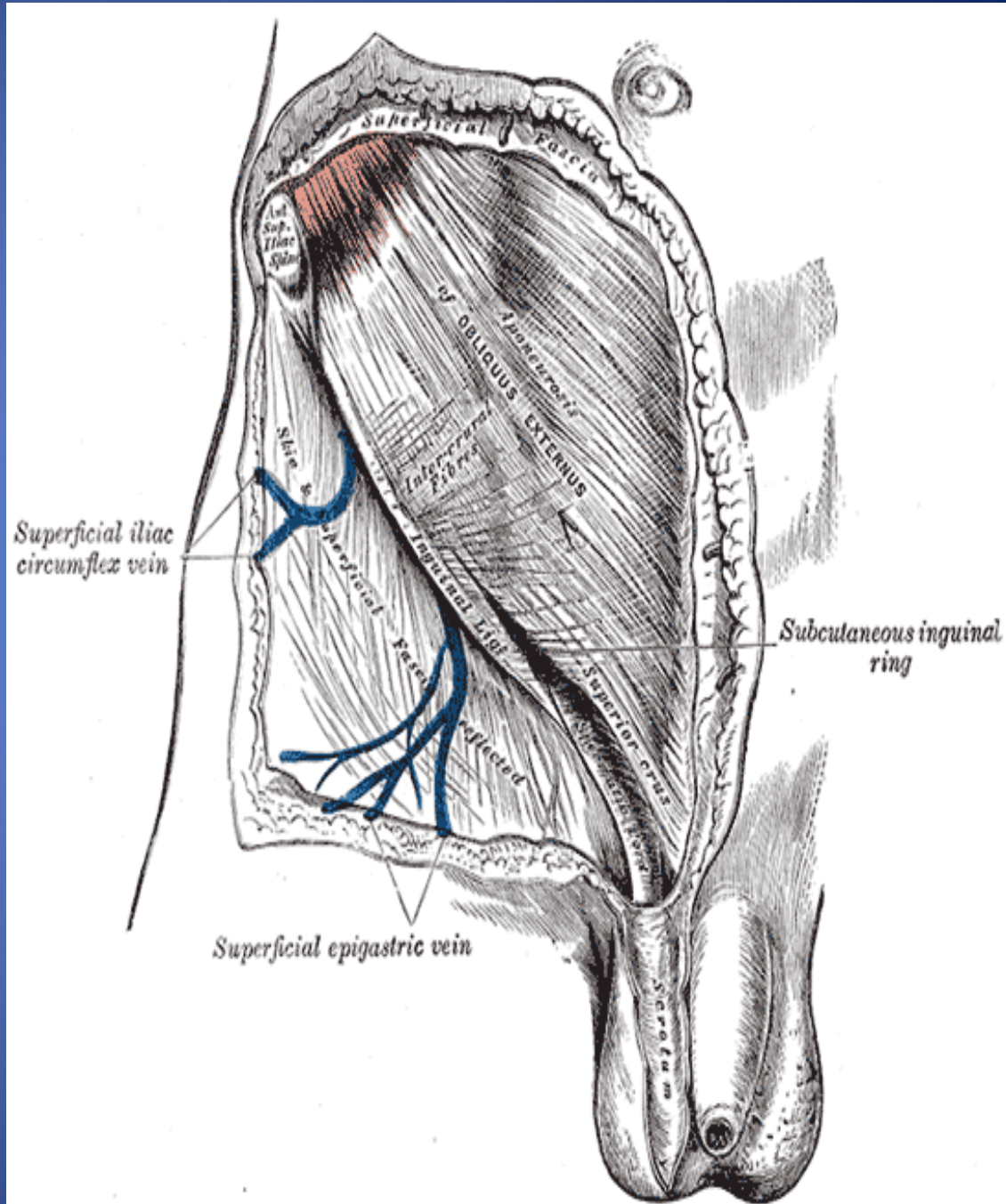
Some abdominal layers extend & surround scrotum.

- Membranous layer in scrotum referred to as colle's fascia

very important, directly think in the attachments.

- Rupture of penile urethra lead to (extravasations of urine) into (scrotum, perineum, penis & abdomen)

means urine got out (leave) of urethra, into (membranous layer) as surrounds like urine, then urine can't get outside it.



Important Q from the doctor:

In the case above (extravasation of urine), does urine open above

Answer: No, cuz membranous layer is below umbilicus (can't get above it),

& attached to fascia lata at 1cm below inguinal ligament → so can't go to lower limb.

✓ Gives strength → **Muscles** Doctor said he will focus on what is related to abdomen. → the most important thing → it is in rectus sheath

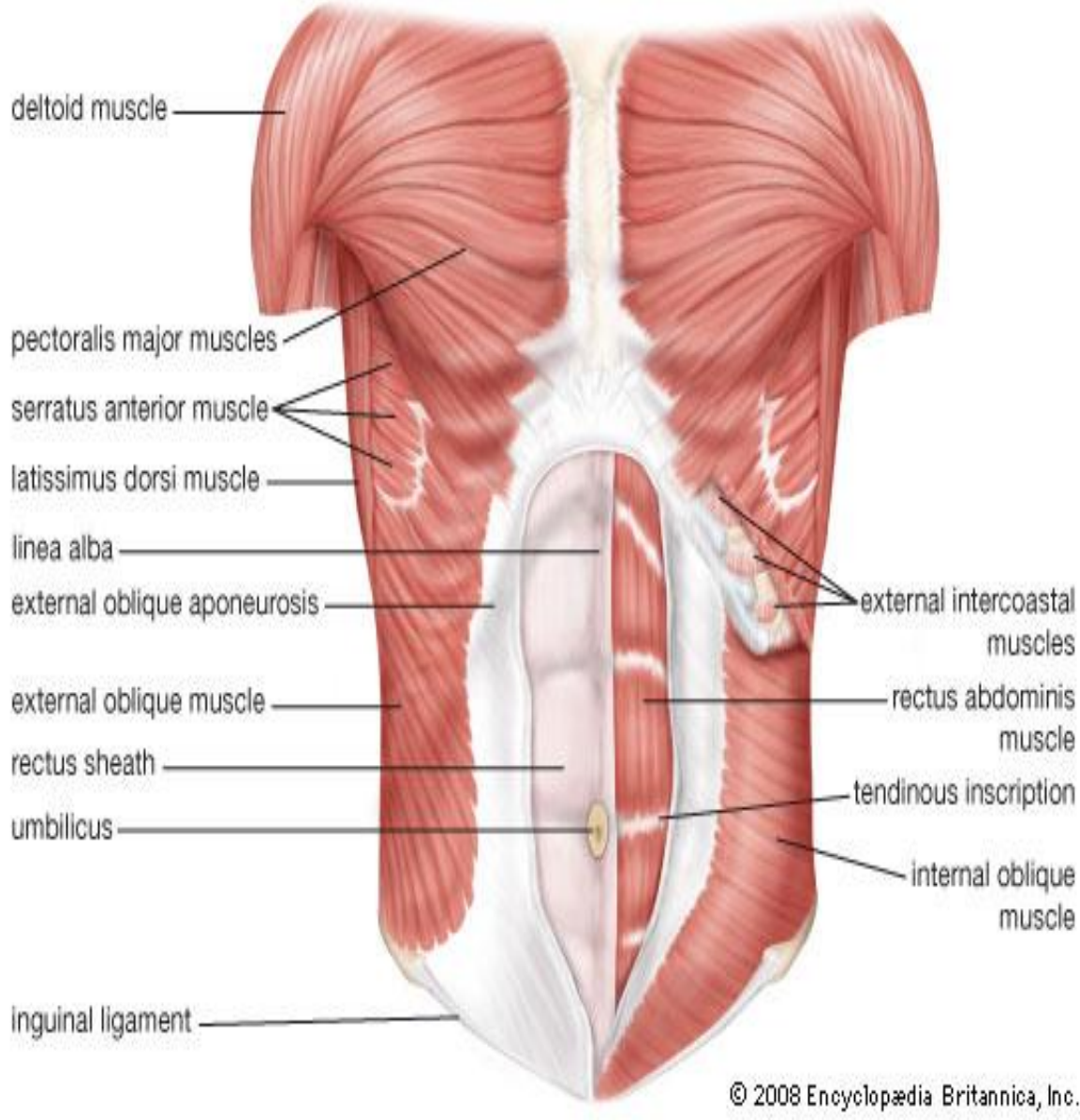
■ **Rectus abdominis**

■ **External oblique muscle**
The insertion is important, cuz it makes anatomical structures, as inguinal ligament.

■ **Internal oblique muscle**
made of aponeurosis of external oblique. → its fibers with transverse form → conjoint tendon. (important in hernia).

■ **Transverse abdominal muscle**
transverse fibers.

Muscles of the abdominal wall



Nerve supply → All abdominal muscles are supplied by

Lower 6 intercostal nerves & L1.
↳ motor of muscles & sensory for skin. ↳ they are thoracic spinal nerves, going downwards to abdomen.
↳ spinal nerve of first lumbar, gives ilioinguinal & iliohypogastric nerves.

External oblique muscle

↳ الدكتور ماقرأ
الorigin

↳ no L1 ← Rectus abdominis is supplied by the lower 6 only.

-Broad

-Thin

✓ Direction:

Downward forward medially

✓ Origin

outer surface of lower 8 ribs.

✓ Insertion

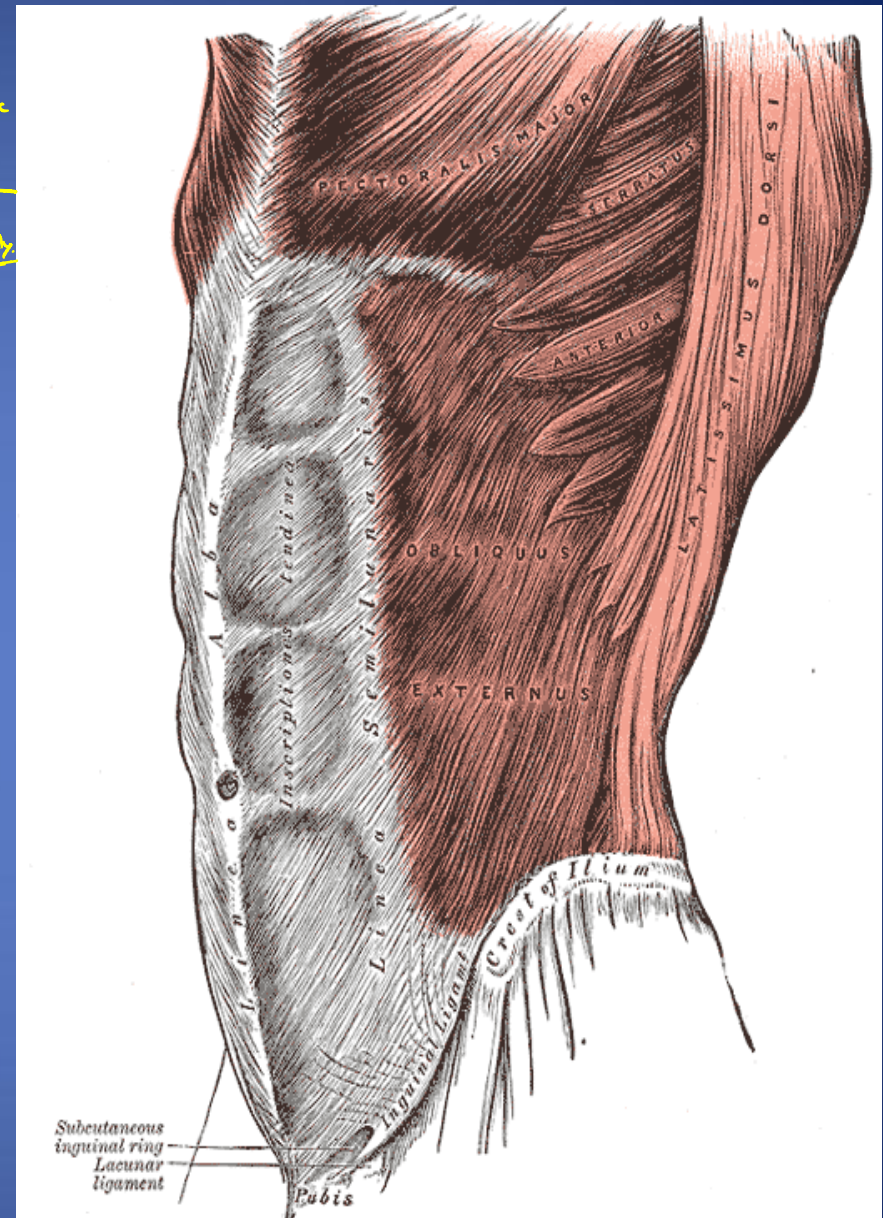
Xiphoid process, Linea alba,
pubic crest, pubic tubercle,
iliac crest(ant. Half).

✓ Nerve Supply

↳ how they reach abdominal wall?
between 2 muscles (internal oblique & transverse abdominis).

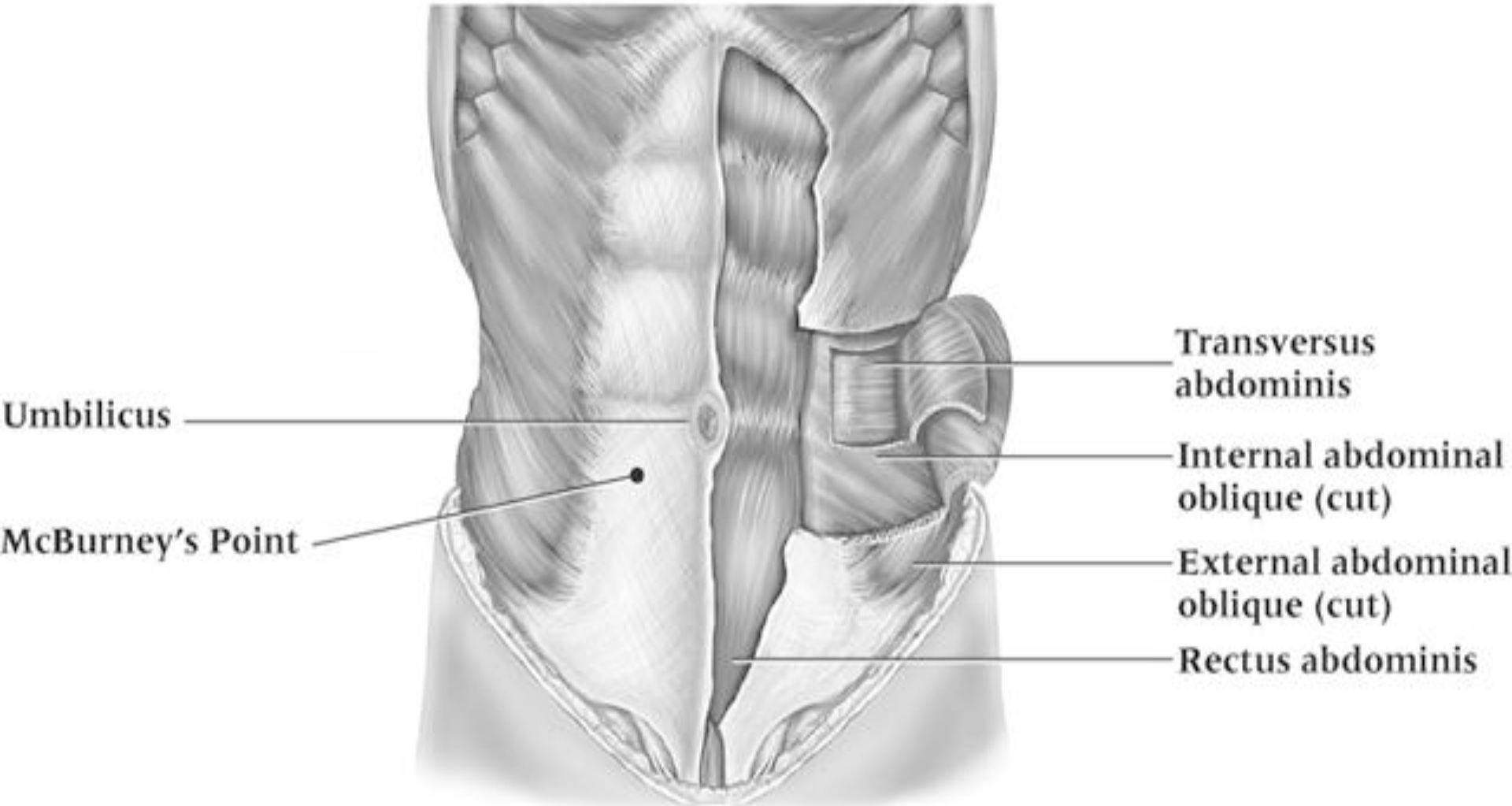
1- Lower 6th thoracic nerves

2- L1 (iliohypogastric n., ilioinguinal n.)



Muscles of the anterior abdominal wall

Anterior view



Umbilicus

McBurney's Point

Transversus abdominis

Internal abdominal oblique (cut)

External abdominal oblique (cut)

Rectus abdominis

✓ Aponeurosis of external oblique muscle

Q from doctor: What is the anatomical structures of external oblique?

↳ All below → can contribute to inguinal canal.
 ↳ have right & left crura.

↳ Spermatic cord comes from inguinal canal, then goes through & exit superficial inguinal ring.

1. Superficial inguinal ring.

2. Inguinal ligament

↳ folding of aponeurosis of external oblique, attached to anterior superior iliac spine & goes to pubic tubercle.

3. Lacunar ligament

↳ extension of aponeurosis, forms the medial boundary of femoral ring.

4. Pectineal ligament

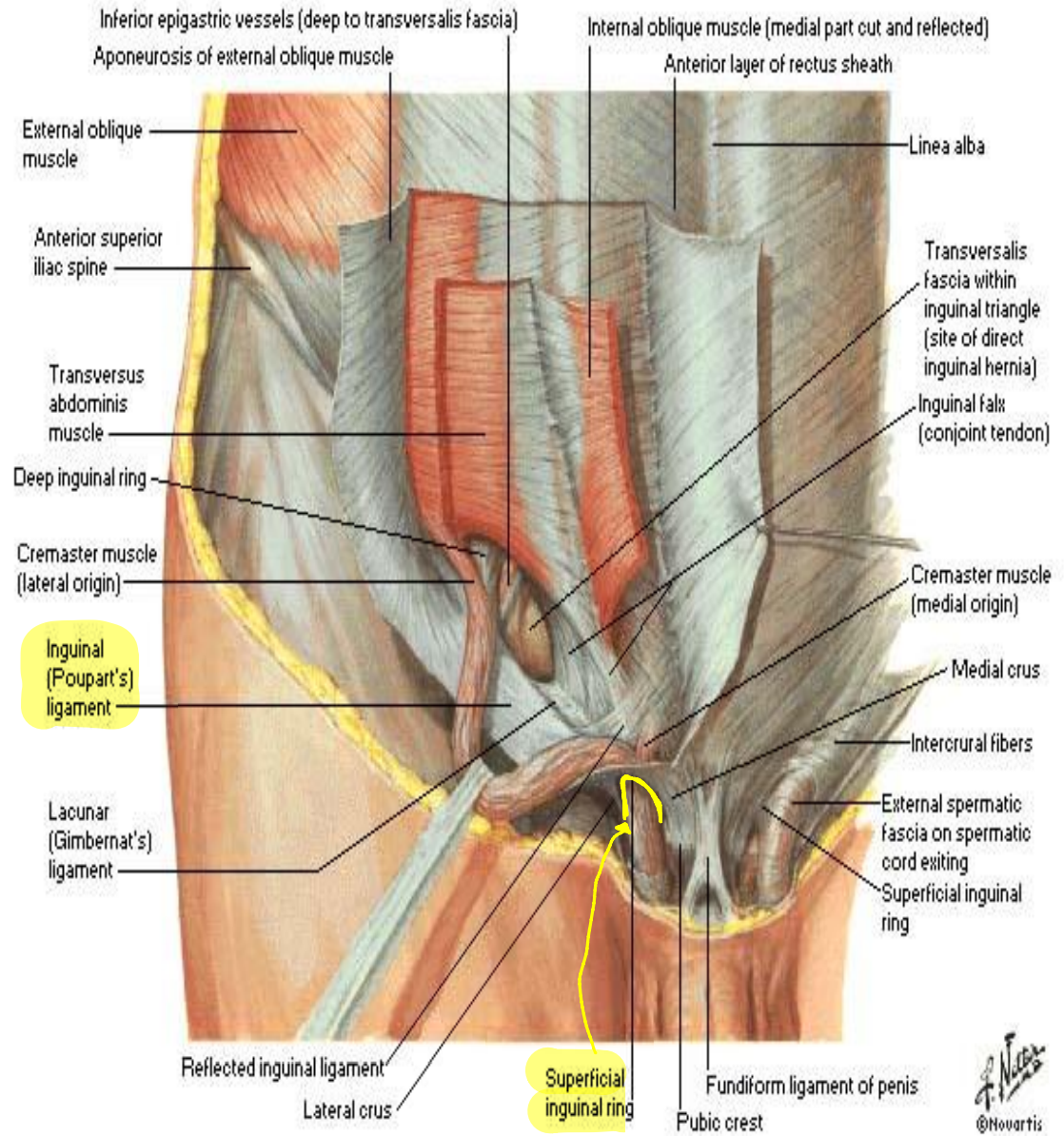
↳ made an extension attached to pubic ramus, or called (iliopectineal line).

5. Boundaries of inguinal canal

↳ external → 2 crura

6. Formation of rectus sheath (

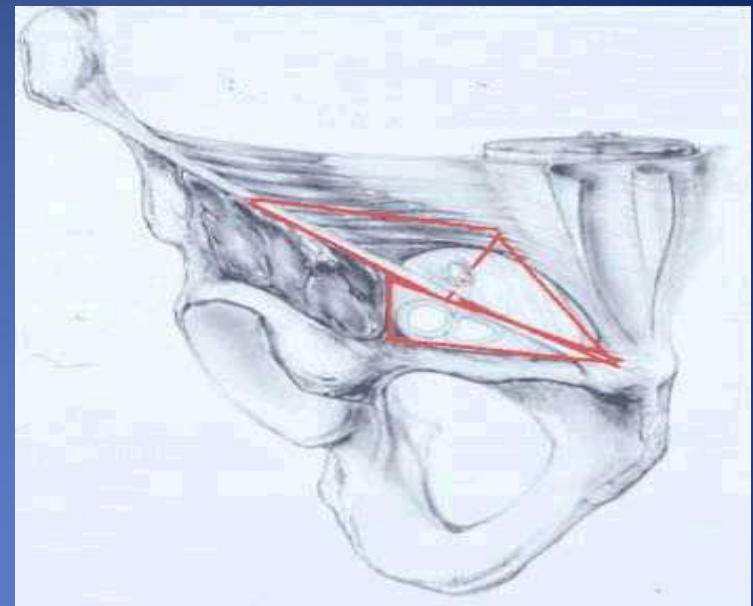
↳ formed by aponeurosis of abdominal muscles (external, internal, transverse).
 ↳ Rectus sheath contains rectus abdominis muscle.



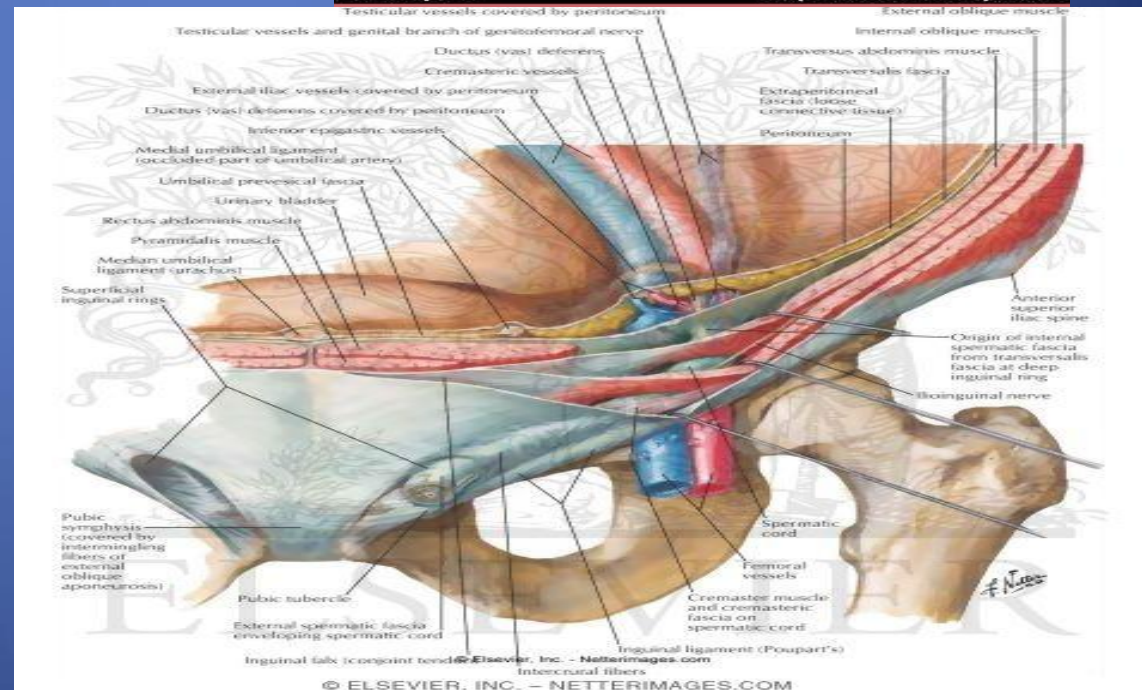
Inguinal ligament

1- folded back ward the lower border of aponeurosis of external muscle on it self

2- between ant.sup.ilic spine and the pupic tubercle



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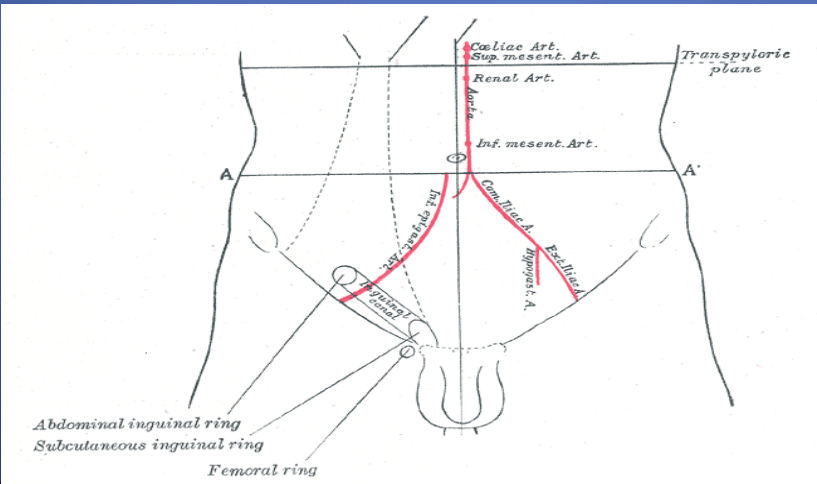
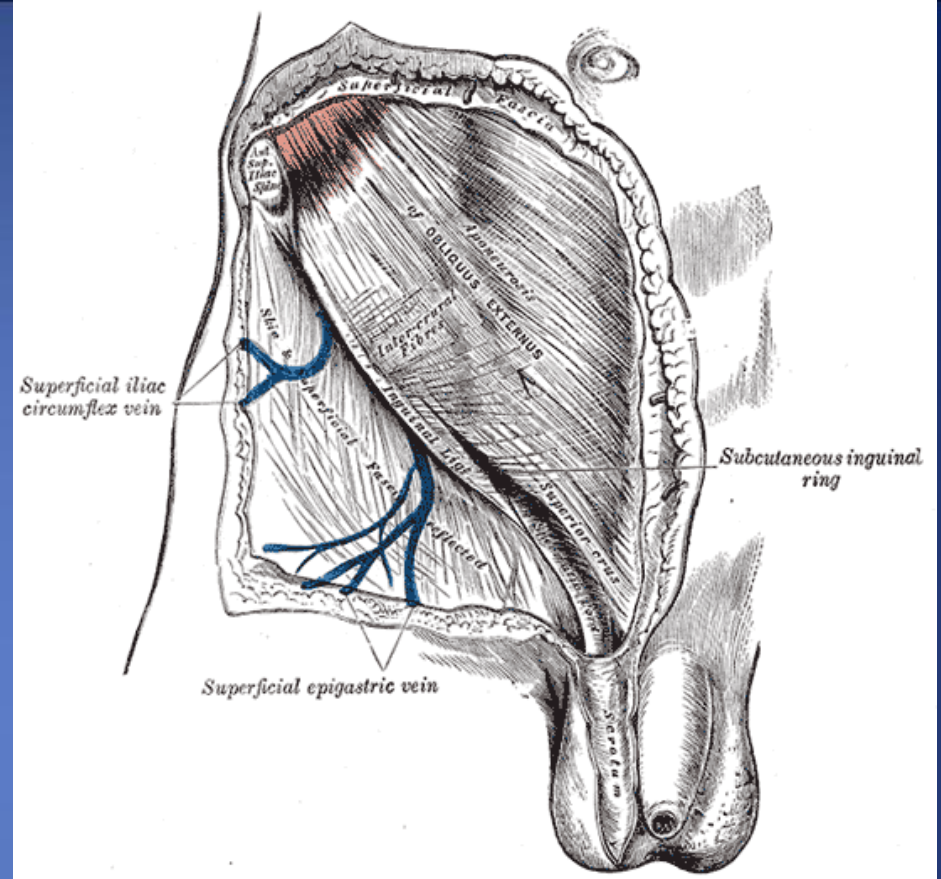
Superficial inguinal ring.

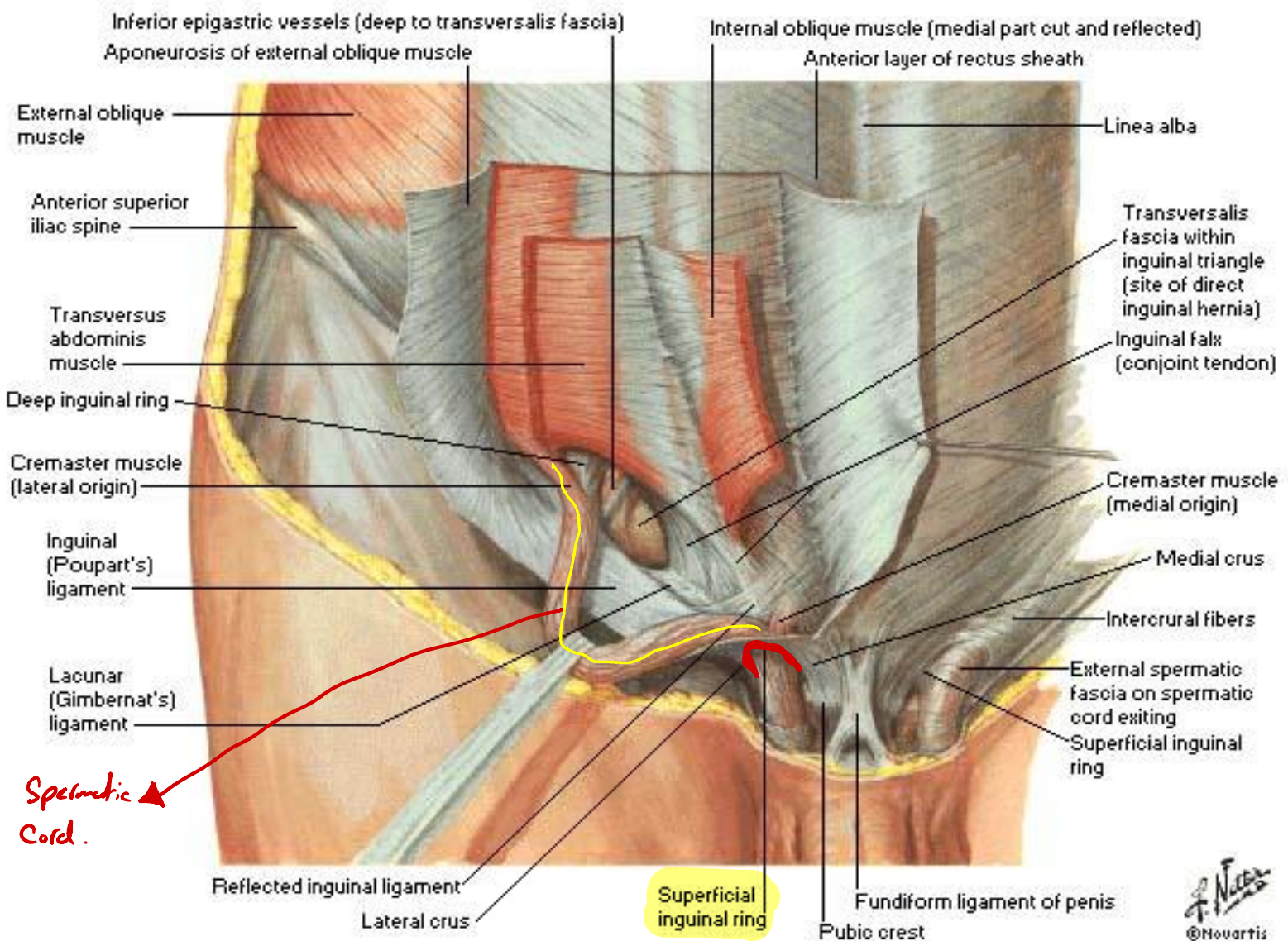
↳ in Both genders.

- 1- triangular shape
- 2- Defect in external oblique aponeurosis
- 3- lies immediately above and medial to the pubic tubercle
- 4- Opening for passing the spermatic cord or ligament of uterus

↳ in males. ↳ round

↳ in females attached to labia majora in females.



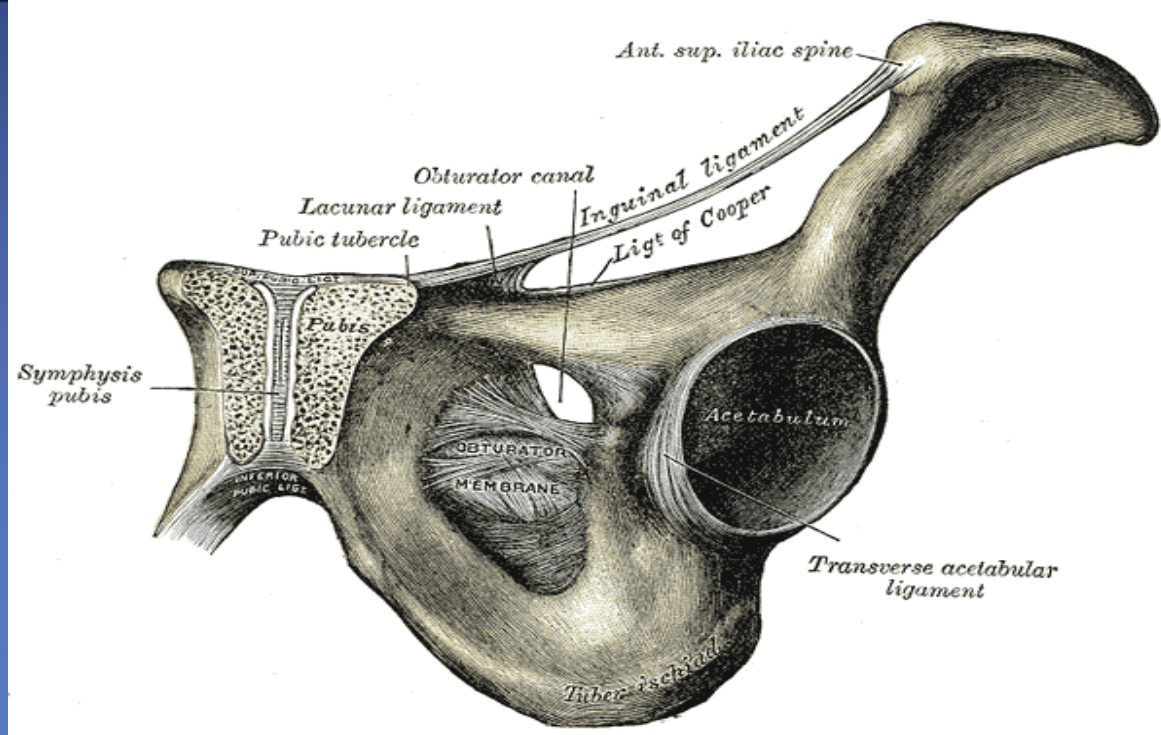


Spermatic Cord.

Superficial inguinal ring

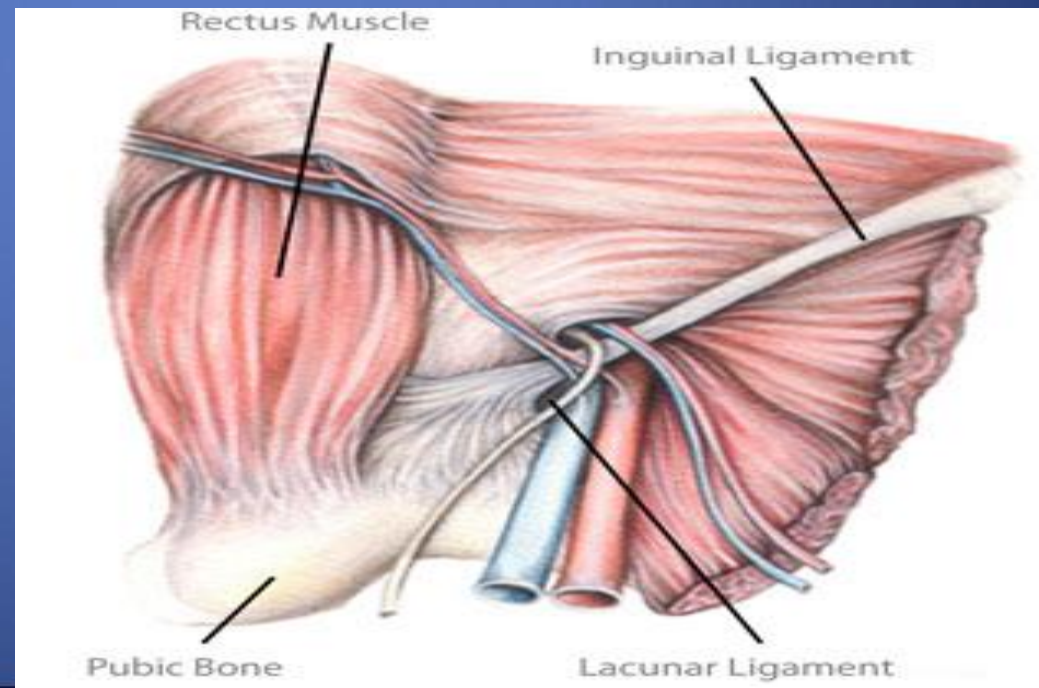
Lacunar ligament

- 1- extension of aponeurosis of external muscle backward and upward to the pectineal line
- 2- on the superior ramus of the pubis
- 3- its sharp, free crecentric edge forms the medial margin of the femoral ring



Pectineal ligament

- 1- Continuation of the lacunar ligament at pectineal line
- 2- Continuation with a thickening of the periosteum



Internal Oblique

↳ Conjoint tendon is very important.

✓ Direction:

upward forward medially

✓ Origin

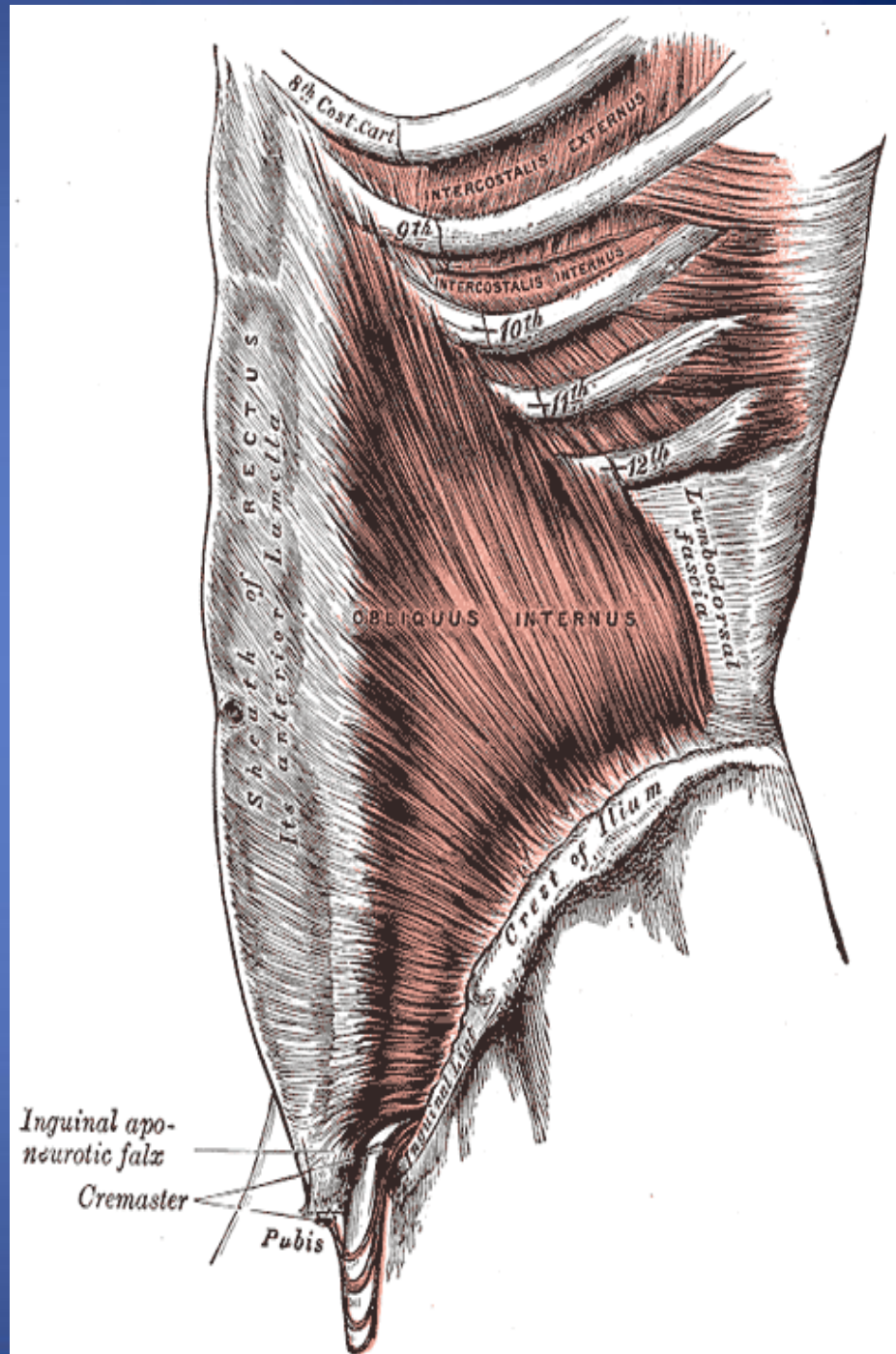
Lumbar Fascia, Ant 2/3 iliac crest, lateral two thirds of inguinal ligament.

✓ Insertion

- Lower three ribs & costal cartilage, Xiphoid process, Linea alba, symphysis pubis.

✓ Nerve Supply

Lower 6th thoracic nerves, iliohypogastric n & ilioinguinal n → L1.



Internal oblique muscle.....cont

Conjoint tendon

Very strong tendon, make an reinforcement of superficial inguinal ring.
(support) → when there is pressure on?
↳ to avoid hernia

- The lowest tendinous fibers of internal oblique which joint with transversus abdominis
- Attach medially to linea alba
- Support the inguinal canal
- Has lateral free border

Cremastric fascia

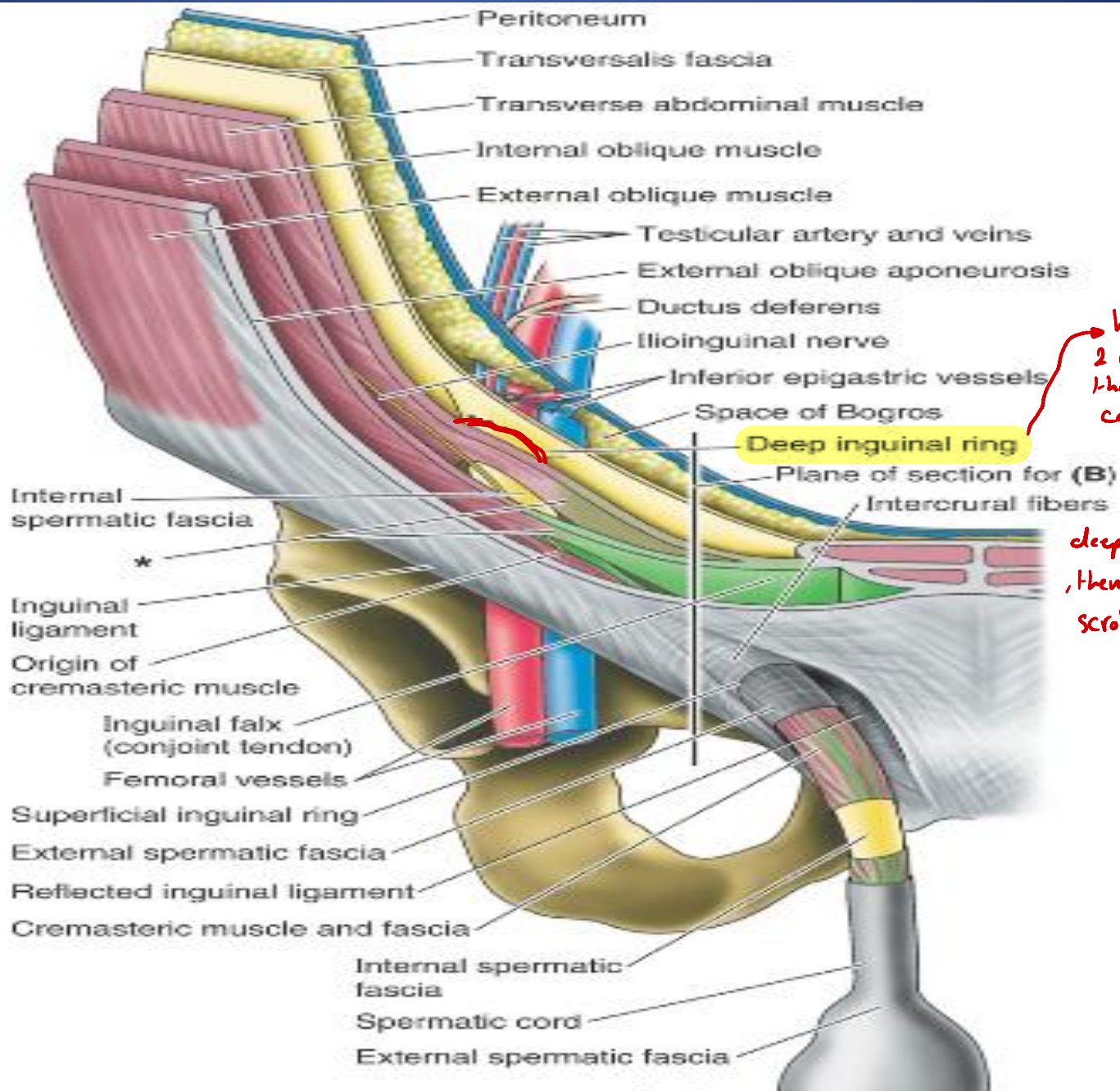
Internal oblique has free lower border arches over the spermatic cord or ligament of uterus

- Cremastric muscle
- Fascia

Cover the →
all of these
Spermatic cord.
↳ we also have
(external & internal)
spermatic fascia.

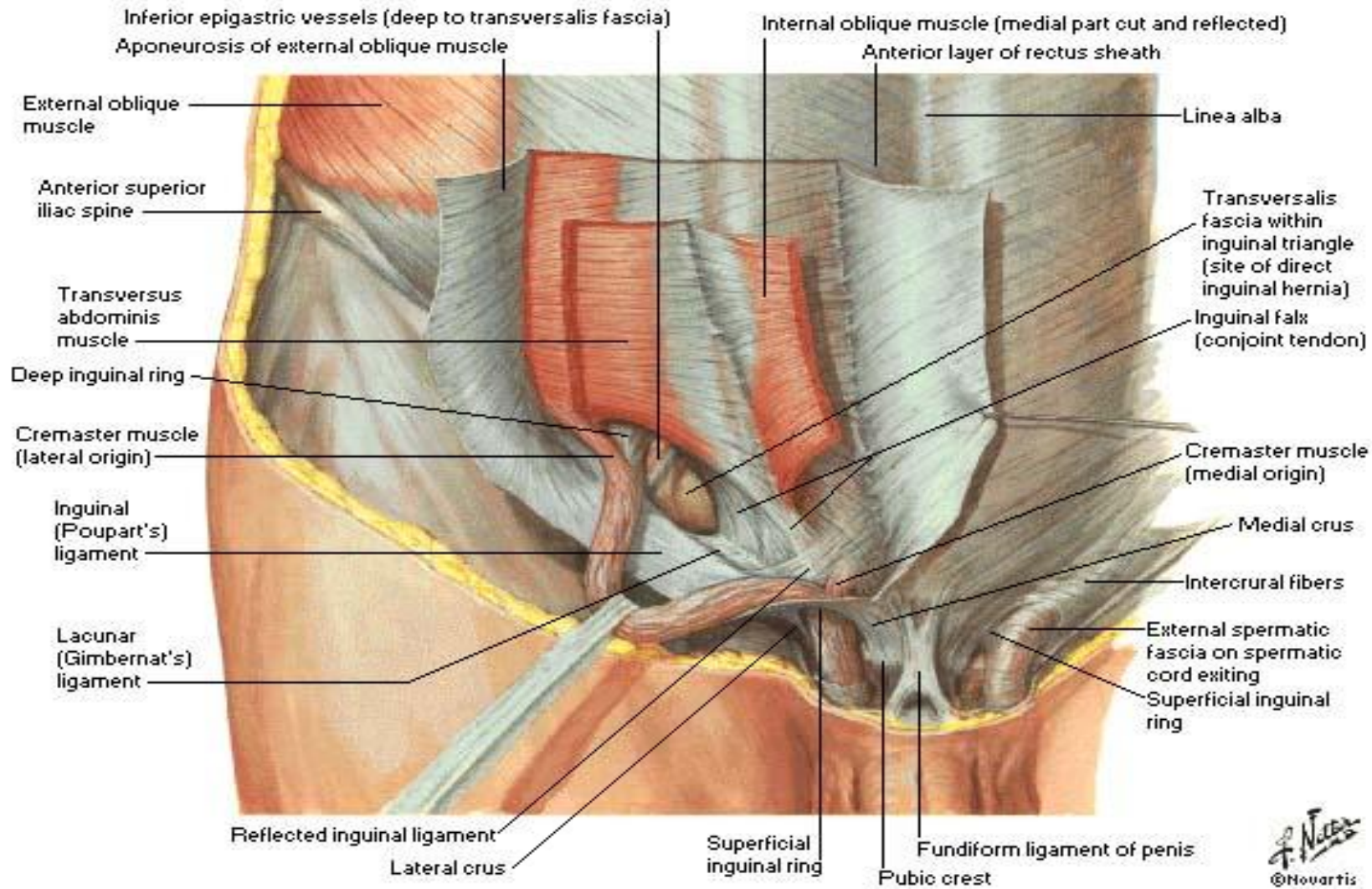
- Int. abd. muscle assist in the formation of the **Roof of the inguinal canal**

Very important.



between the 2 rings, there is the inguinal canal (containing spermatic cord).
starts from deep ring to superficial, then goes to scrotum.

Conjoint tendon & Cremasteric fascia



❖ Transversus Abdominis

Direction

- Its fibers run horizontally forward under the internal oblique

✓ Origin

- Inner surface of lower six costal cartilage, lumbar fascia, anterior two thirds of iliac crest, lateral third of inguinal ligament.

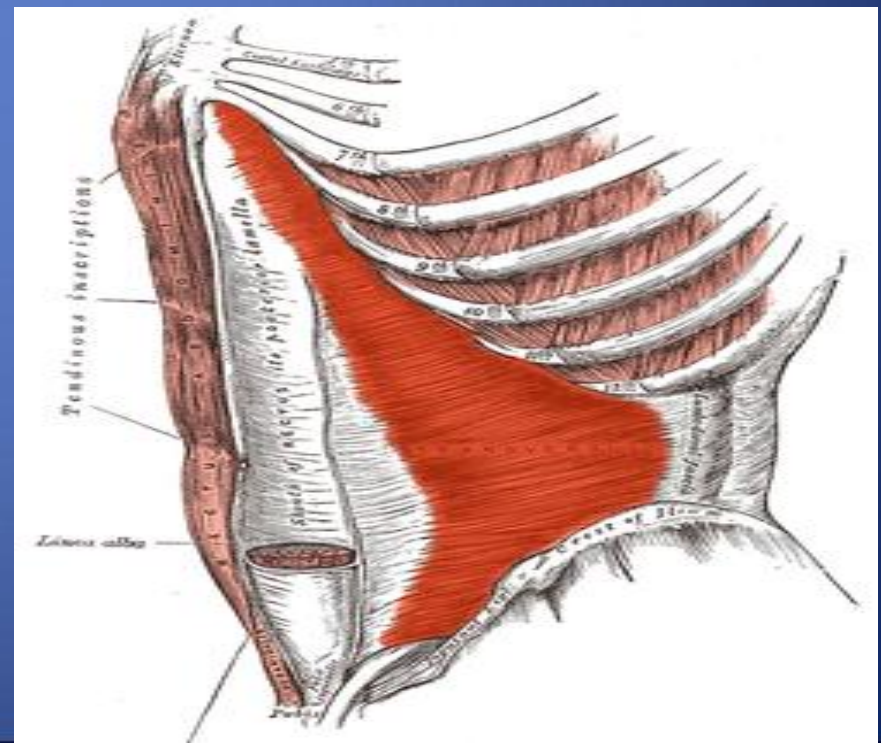
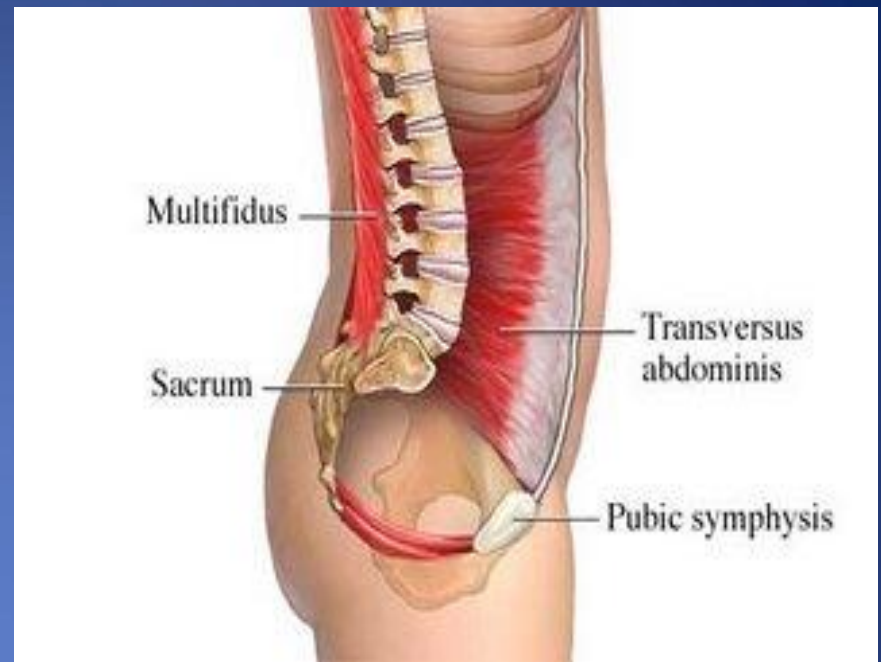
✓ Insertion

Xiphoid process, Linea alba, symphysis pubis.

- ✓ The lower part fuses with internal oblique to form conjoint tendon which attach to pubic crest and pectineal line

✓ Nerve Supply

Lower six thoracic nerves, L1 (iliohypogastric n. & ilioinguinal n.)



Transversus Abdominis.....cont

Assist in the formation of

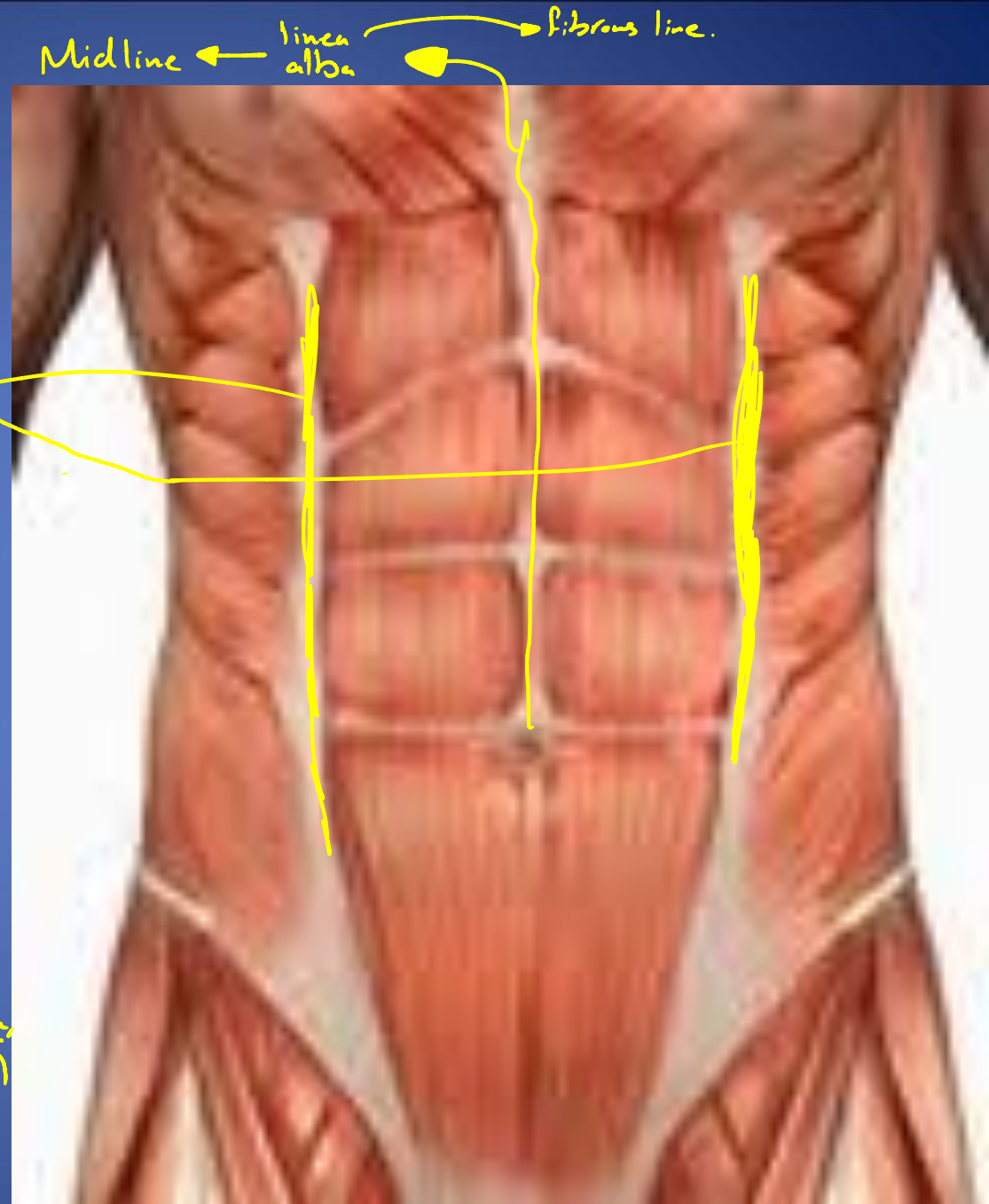
- Conjoint tendon
- Rectus sheath

RECTUS ABDOMINIS

- Long strap muscle
- Extends along the whole length of the anterior abdominal wall
- In the rectus sheath
- ✓ Origin
Symphysis pubis, pubic crest

- ✓ Insertion
5th, 6th and 7th costal cartilage & xiphoid process.

- ✓ Nerve Supply
Lower 6th thoracic nerves
*no L1, why? cuz it is in the rectus sheath
& only the intercostal nerves get in (thoracic)*



Rectus abdominis muscle.....cont

- **Linea semilunaris** → The lateral edge of rectus abdominis.
→ Beginning of rectus sheath.
- **Tendinous intersection:**

Lines & Land marks of the Anterior Abdominal Wall

→ advantage:

Low level of bleeding

→ disadvantage:

Healing needs a lot time

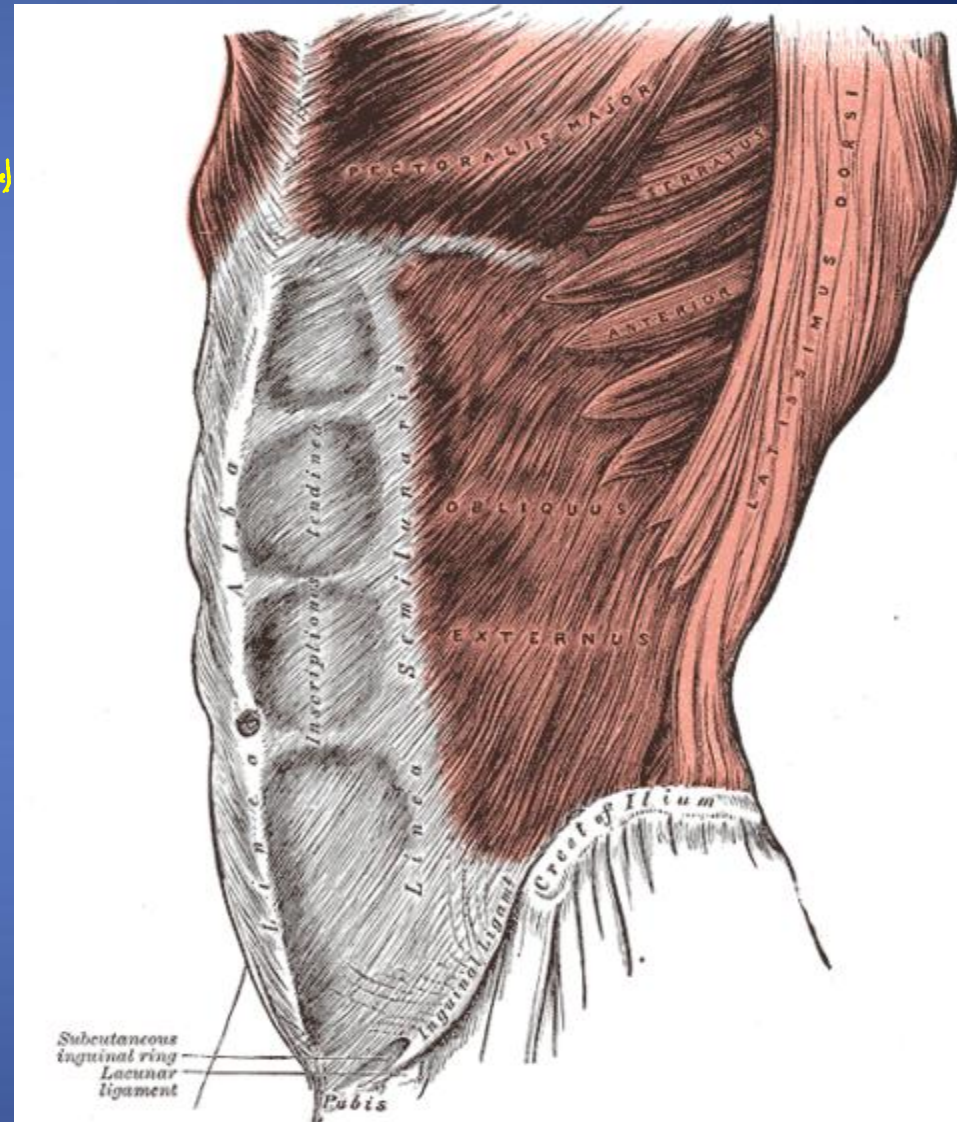
→ fibrous line, very important in surgeries, for ex. when there a big tumor in the abdomen, we make a midline incision in linea alba (to make a great space)

Linea alba:

fibrous line, very important in surgeries, for ex. when there a big tumor in the abdomen, we make a midline incision in linea alba (to make a great space)

- Located along the **midline**.
- Between the xiphoid process & symphysis pubis
- Formed by the fusion of aponeuroses of three abdominal wall (Ex.In, Tran. Abd.muscle)

- **Linea semilunaris**
- **Lateral margins of rectus abd. muscle**
- Can be palpated
- Extend from 9th c.c to pubic tubercle



Tendinous intersection: = Linea
transverses

- 3 transverse fibrous bands
- divide the rectus abdominis muscle into distinct segments
 - 1- one at level of xiphoid process
 - 2- one at level of umbilicus and
 - 3- one half way between these two
- They can be palpated as a transverse depressions



Pyramidalis muscle

↳ Not always present.

Origin

Ant. Surface of the pubis

↳ at the lower part of rectus sheath.

↳ anterior to rectus abdominis.

Insertion:

Linea alba

-It lies in front of the lower part of the rectus abdominis muscle

-Nerve supply

12th subcostal nerve (last thoracic spinal nerve).



Rectus sheath

- * Muscles come from lateral to midline, at linea semilunaris, each muscle will split into ant. & post. wall, or stays in ant. or post. wall.

Rectus sheath.....cont

↳ has anterior & posterior walls.

- The **rectus sheath** is a **long fibrous sheath**
- **Formed mainly** by the **aponeuroses** of the **three lateral abdominal muscles.**

external
internal
transverse.

• Contents

- **Rectus abdominis** muscle
- **Pyramidalis** muscle (if present)
- The **anterior rami of the lower six thoracic nerves**
- The **superior and inferior epigastric vessels**
- **Lymphatic vessels.**

↳ (Ends in skin) (as sensory)
↳ Ends as cutaneous in the skin anterior to rectus sheath.
↳ They innervate the rectus abdominis (inside rectus sheath).

One from above & the other from below.

(arteries)

↳ 2 epigastric arteries in rectus sheath, they anastomose with each other. ↳ they meet at level of umbilicus.

↳ from external iliac artery.
↳ from internal thoracic artery

Rectus sheath.....cont

- Description the rectus sheath is considered at **three levels.**

1. Above costal margins (Xiphoid process).

2. Above & below umbilicus
Above: between xiphoid & umbilicus
Below: ~ symphysis & umbilicus.

1- **Above the costal margin** 3- Below anterior superior iliac spine, at the pelvis.

2- **Between the costal margin and the level of the anterior superior iliac spine**

3- **Between the level of the anterosuperior iliac spine and the pubis the anterior wall**

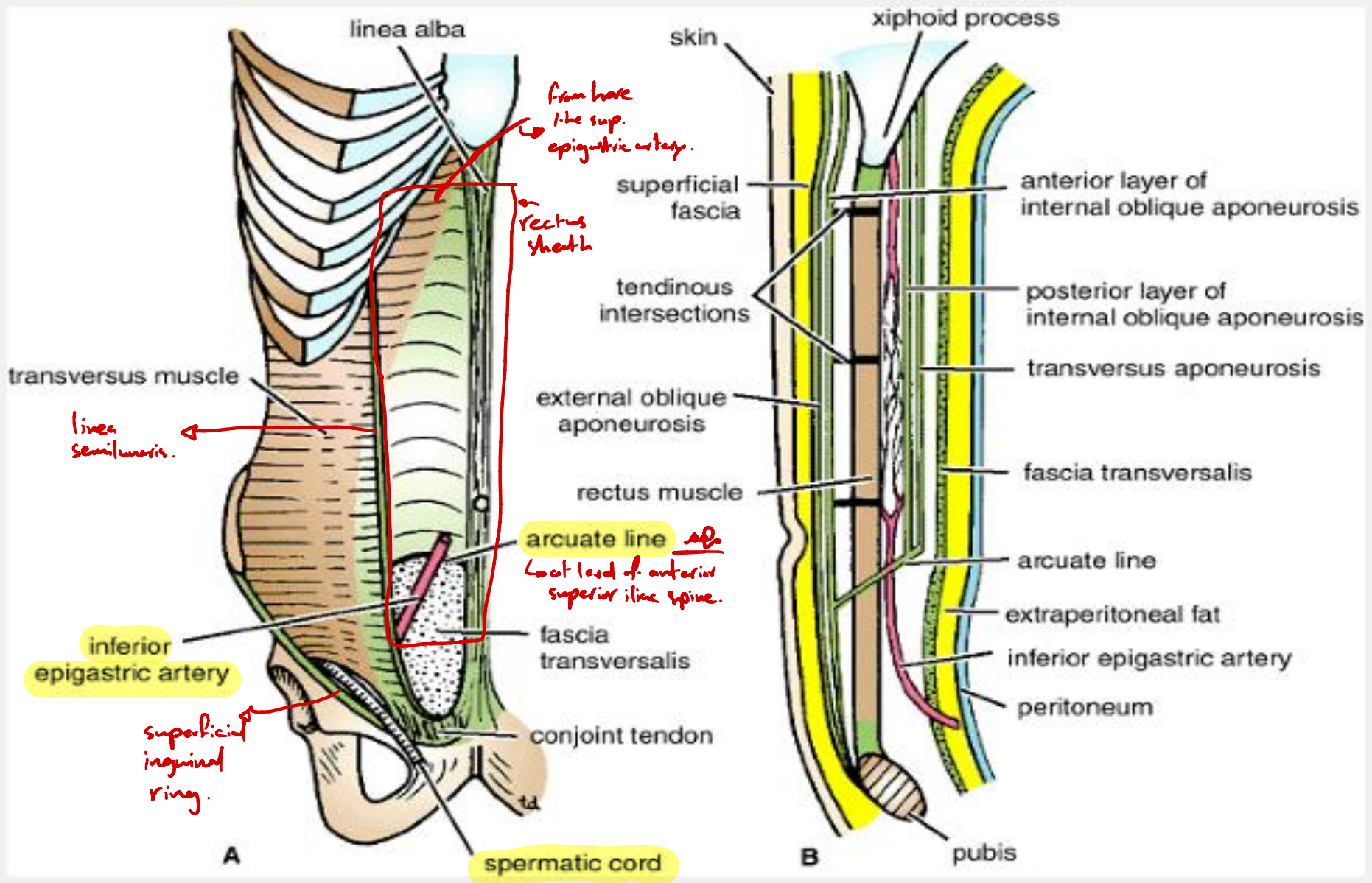
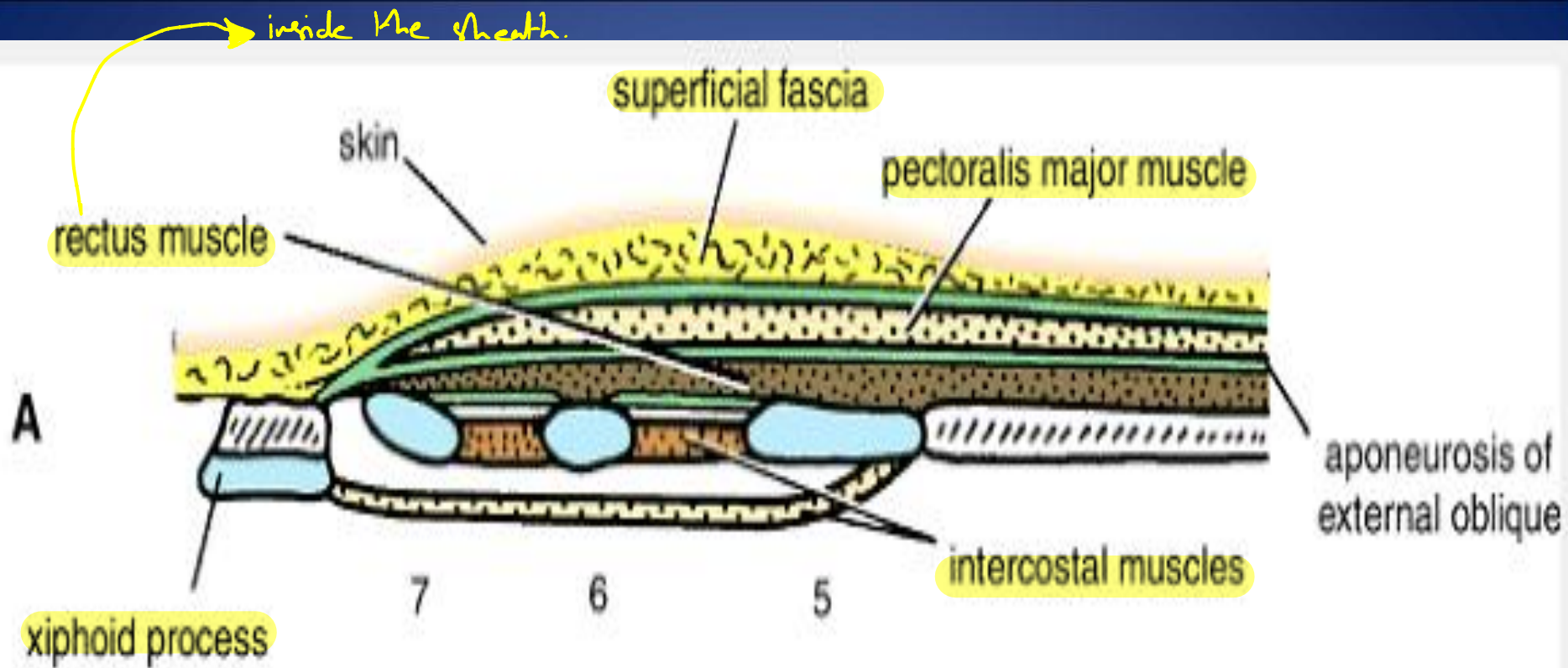


Figure 4-10 Rectus sheath in anterior view (A) and in sagittal section (B). Note the arrangement of the aponeuroses forming the rectus sheath.



No internal oblique
& transversus at this level.

Anterior: skin, superficial fascia, pectoralis major, external oblique.
Posterior: Costal cartilages, intercostal muscles.

1- ABOVE THE COSTAL MARGIN,

- ANTERIOR WALL # APONEUROSIS OF THE EXTERNAL OBLIQUE.
- POSTERIOR WALL # THORACIC WALL THAT IS, THE FIFTH, SIXTH, AND SEVENTH COSTAL CARTILAGES AND THE INTERCOSTAL SPACES.

(Around umbilicus)

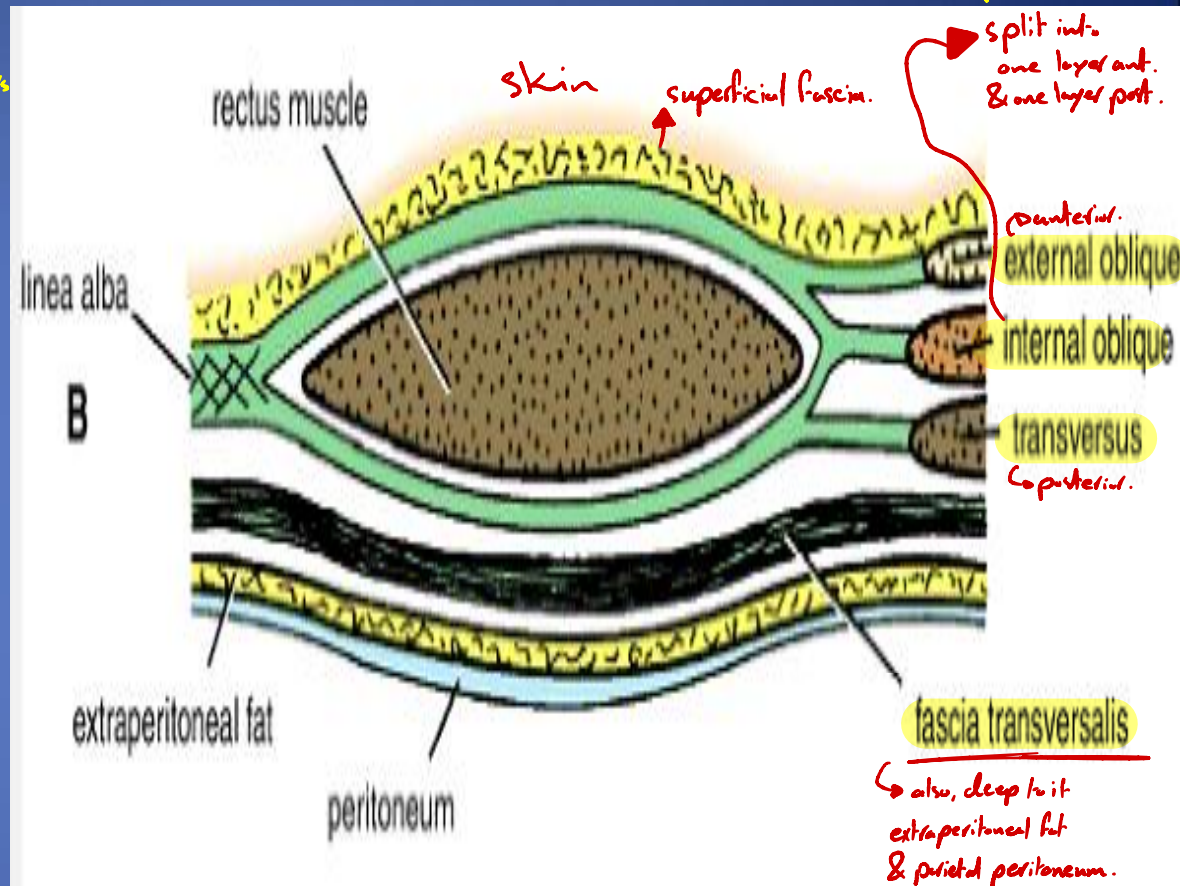
(Above & below umbilicus).

2-Between the costal margin and the level of the anterior superior iliac spine

Knowing the layers is important for incisions.

Anterior : Skin, superficial fascia, external oblique aponeurosis & one layer of internal oblique.

Posterior : one layer of internal oblique, transversus, transversalis fascia, extra peritoneal fat & parietal peritoneum.



- The aponeurosis of the internal oblique splits to enclose the rectus muscle
- the external oblique aponeurosis is directed in front of the muscle
- the transversus aponeurosis is directed behind the muscle.

Arcuate line → at level of ant. sup. iliac spine. (deep to it Coextraperitoneal fat & parietal peritoneum.)
 Below them, post. wall of rectus sheath is only fascia transversalis (All muscles are anterior). (Anterior wall of rectus sheath here is made of all aponeurosis of the 3 muscles. with skin, superficial fascia.)

Between the level of the anterosuperior iliac spine and the pubis

the anterior wall : the aponeurosis of all three muscles form.

The **posterior wall** is absent, and the rectus muscle lies in **contact with the fascia transversalis**.

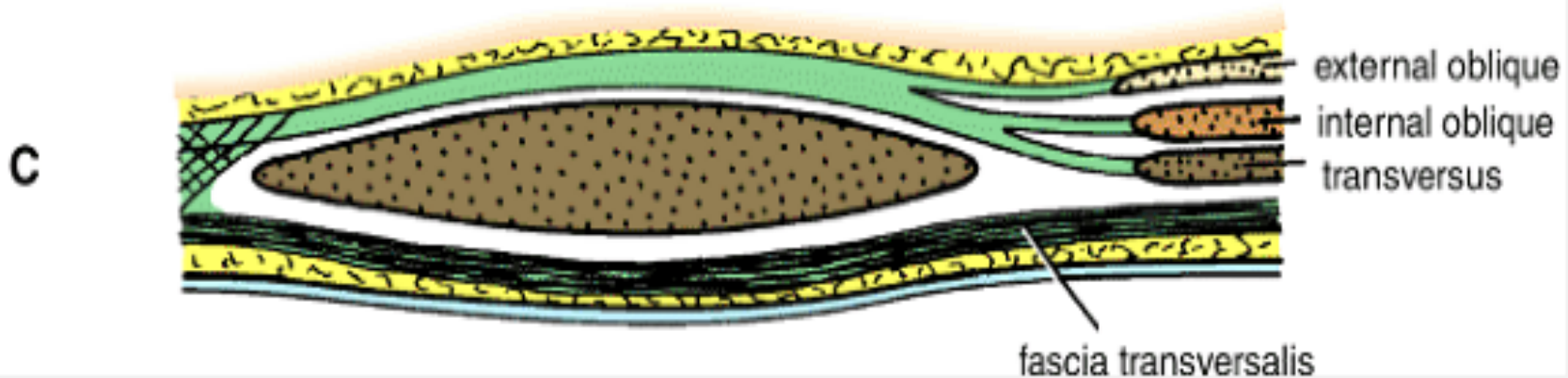


Figure 4-13 Transverse sections of the rectus sheath seen at three levels. **A.** Above the costal margin. **B.** Between the costal margin and the level of the anterior superior iliac spine. **C.** Below the level of the anterior superior iliac spine and above the pubis.

Rectus sheath.....cont

- The posterior wall of the rectus sheath is not attached to the rectus abdominis muscle. The anterior wall is firmly attached to it by the muscle's tendinous intersections
- **Linea semicircularis** (arcuate line)
- Is a crescent-shaped line marking the inferior limit of the posterior layer of the rectus sheath just below the level of the iliac crest.

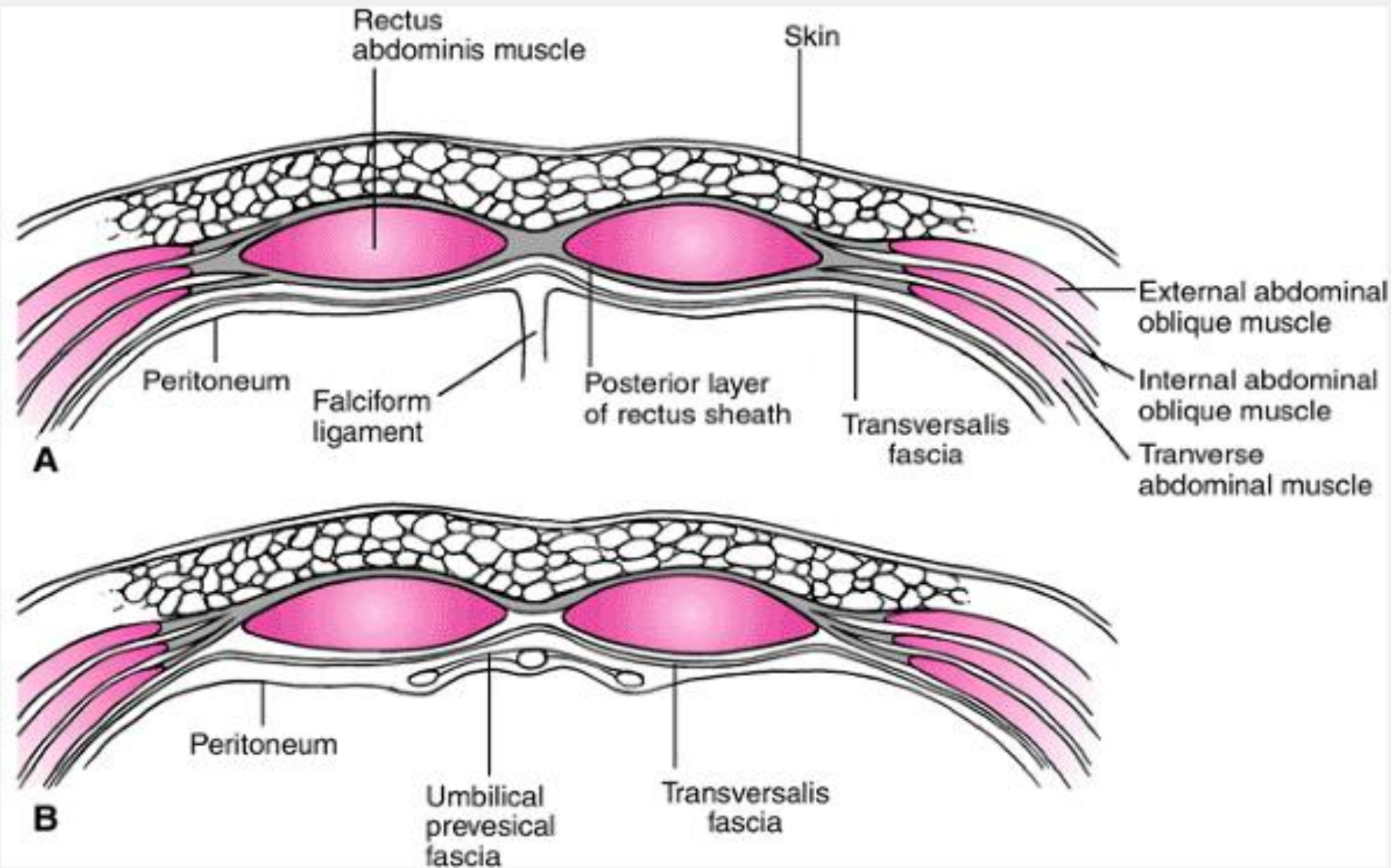


Figure 5-2 Arrangement of the rectus sheath above the umbilicus (upper) and below the arcuate line (lower).

Others fascia in the ant. abd.ominal wall

❖ **Transversalis fascia**

(deep to the muscle)

- a thin layer of fascia that lines the Transversus Abdominis muscle
- continue to diaphragm , iliac muscle & pelvis fascia
- contribute to femoral sheath

❖ **Extraperitoneal Fascia**

- ✓ The thin layer of C.T and adipose tissue between the peritoneum and fascia transversalis.

❖ **Parietal peritoneum**

- ✓ It is a thin serous membrane
- ✓ Continuous below with the parietal peritoneum lining the pelvis.

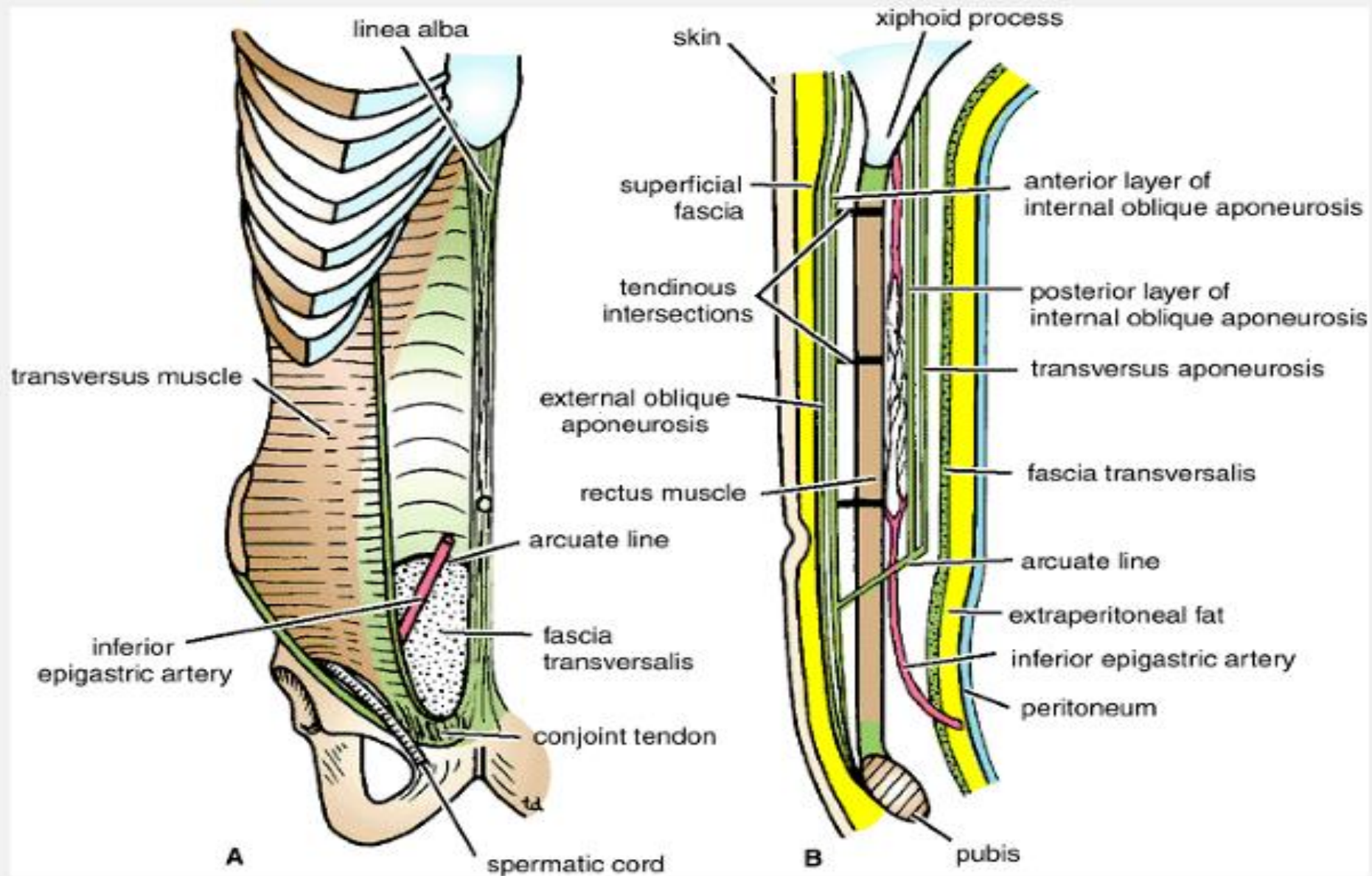
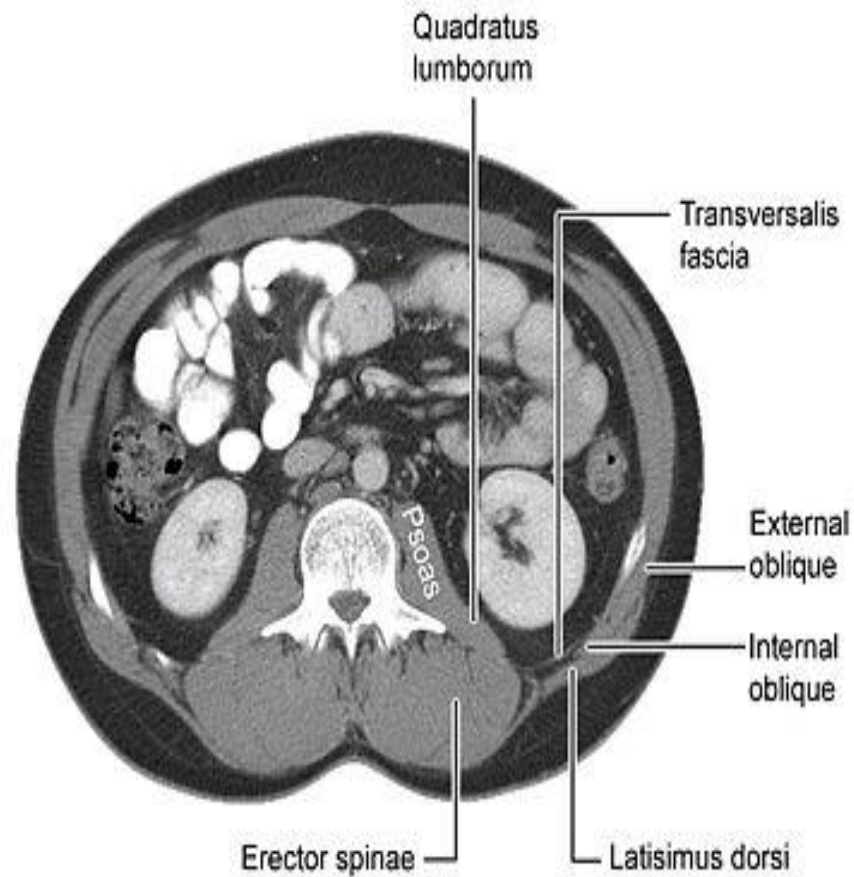
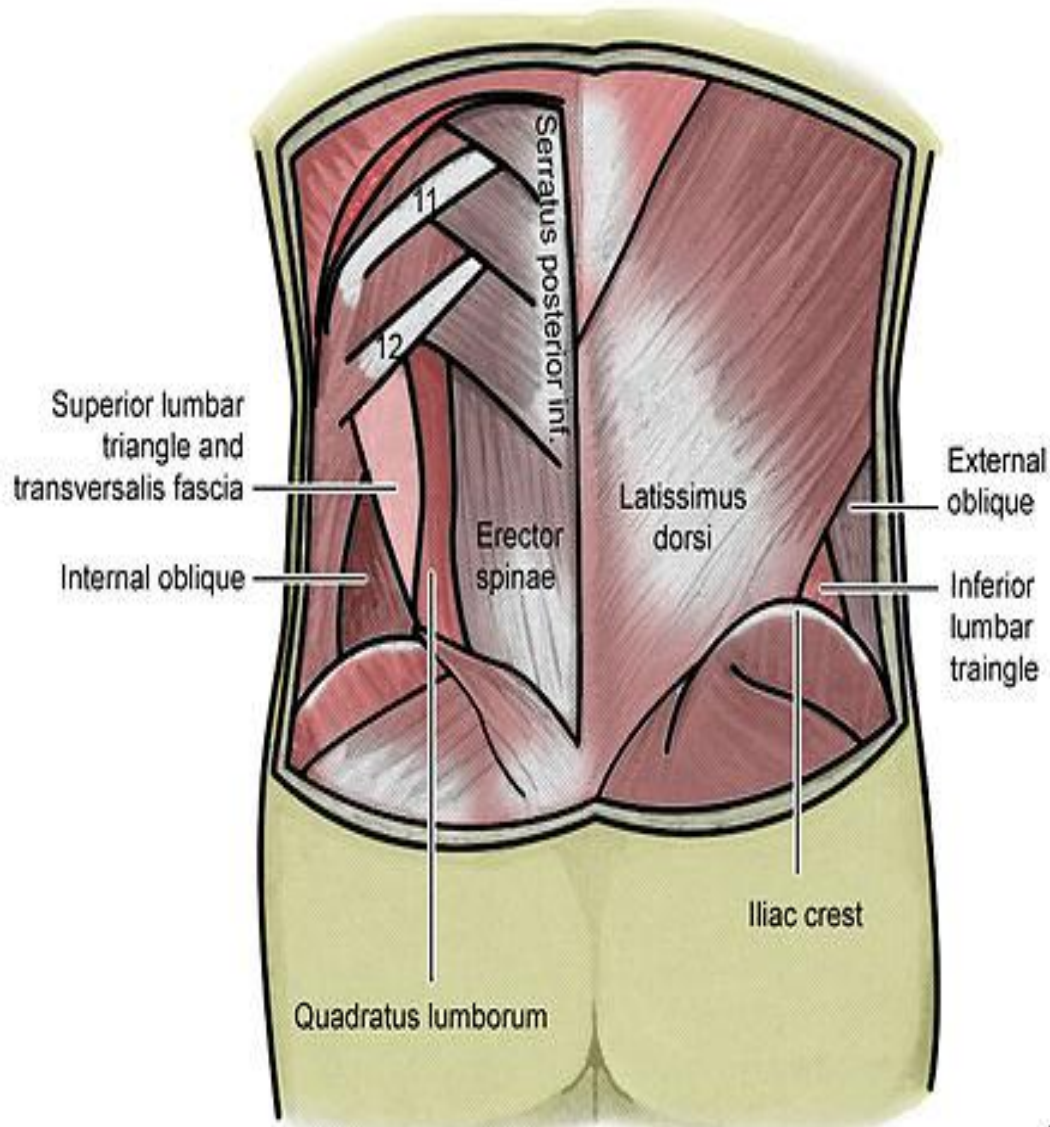


Figure 4-10 Rectus sheath in anterior view (A) and in sagittal section (B). Note the arrangement of the aponeuroses forming the rectus sheath.

X Lumbar triangle Not included



X lumbar triangle

- 1- the inferior lumbar (Petit) triangle, which lies superficially
 - 2- the superior lumbar (Grynfeltt) triangle, which is deep and superior to the inferior triangle.
- Of the two, the superior triangle is the more consistently found in cadavers, and is more commonly the site of herniation
 - however, the inferior lumbar triangle is often simply called the lumbar triangle, perhaps owing to its more superficial location and ease in demonstration.

X Lumber triangle (petitis)

- The inferior lumbar (Petit) triangle is formed
 - **Medially** by the latissimus dorsi muscle
 - **laterally** by the external abdominal oblique muscle
 - **Inferiorly** by the iliac crest
 - **The floor** internal abdominal oblique muscle.
- The fact that herniation occasionally occur here is of clinical importance.

Superior lumbar (Grynfeltt-Lesshaft)

 triangle

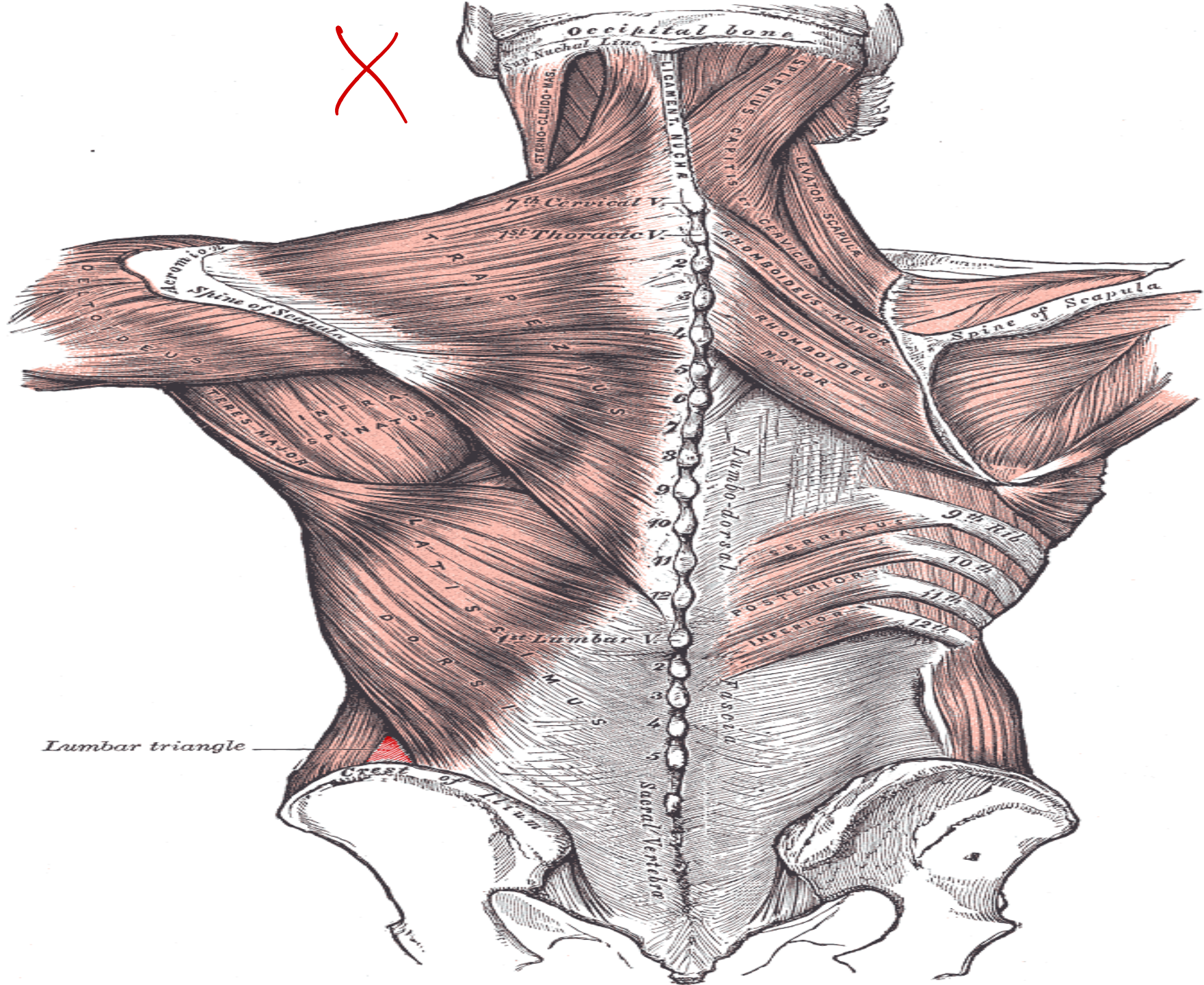
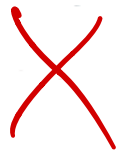
Medially: by the quadratus lumborum muscle

laterally :by the internal abdominal oblique muscle

Superiorly: by the 12th rib.

The floor : transversalis fascia

Roof: is the external abdominal oblique muscle



Lumbar triangle

Action of the Ant. Abdominal muscle

- Deep expiration
- Increase the intra abdominal pressure in
 - Vomiting
 - Cough
 - Defecation
 - Labour
- Protect viscera
- keep viscera in position
- Rectus abdominis → bends trunk forward

In boxing, the player won't get hurted if punched in the abdomen, of course the abdominal muscle have to be contracted.

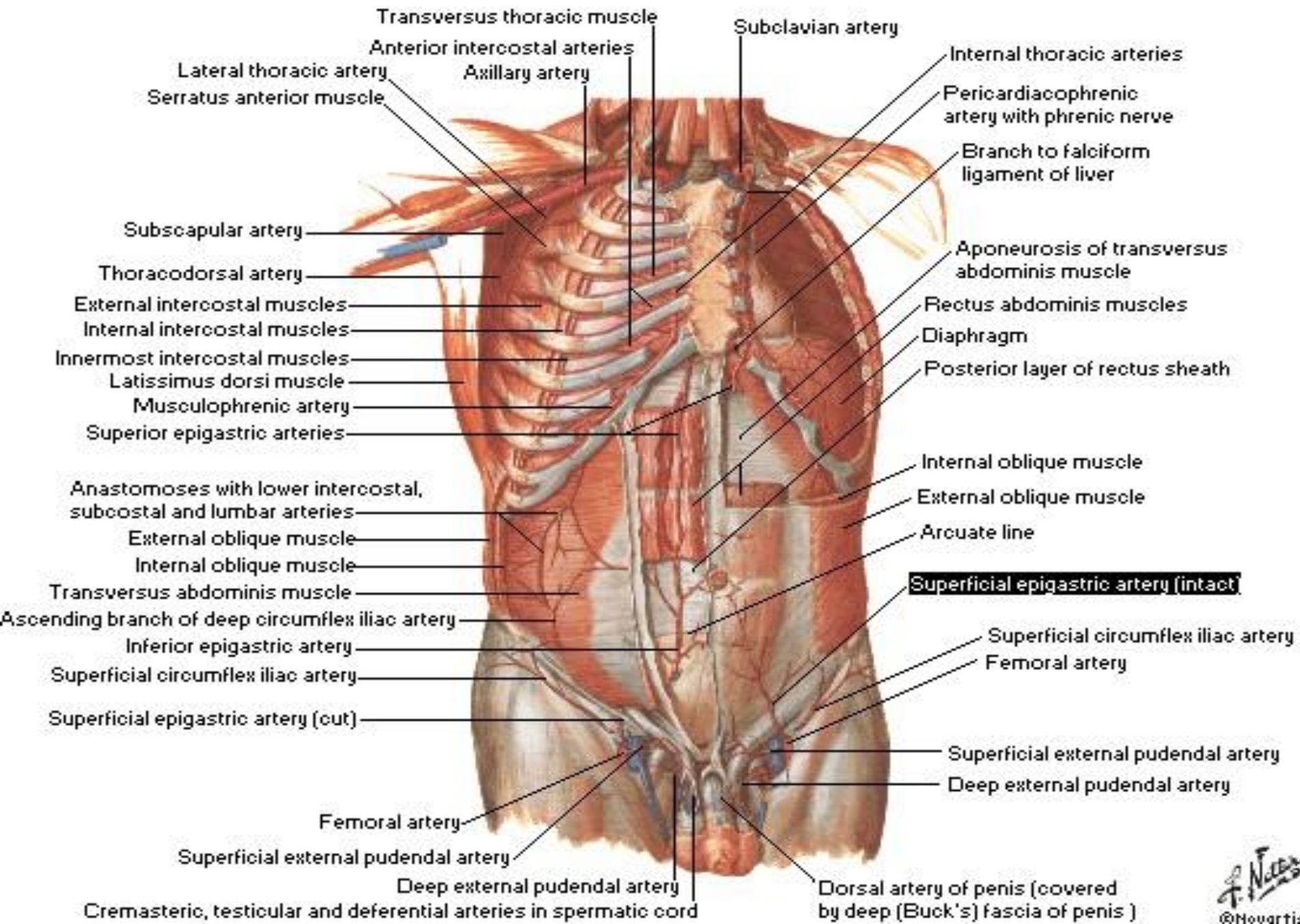
- In last rounds → muscles get tired, nervous system gets slower → no contraction → if get punched → rupture of viscera.

Blood supply of the ant. Abdominal wall

Arteries

- Sup. Epigastric artery
 - Inf. Epigastric artery
- Contents of rectus sheath.
- Intercostal arteries → From chest to the abdomen (lower six).
 - Lumbar arteries → Branches of abdominal aorta.
→ 4 on the right & 4 on the left of the abdomen.
 - Deep circumflex artery → Branch of external iliac artery.

Arteries of Anterior Abdominal Wall



Blood supply.....cont

Veins *Same as arteries, but where they drain?*

3 levels.

1- Above the umbilicus

- Lat. Thoracic vein. → Axillary vein

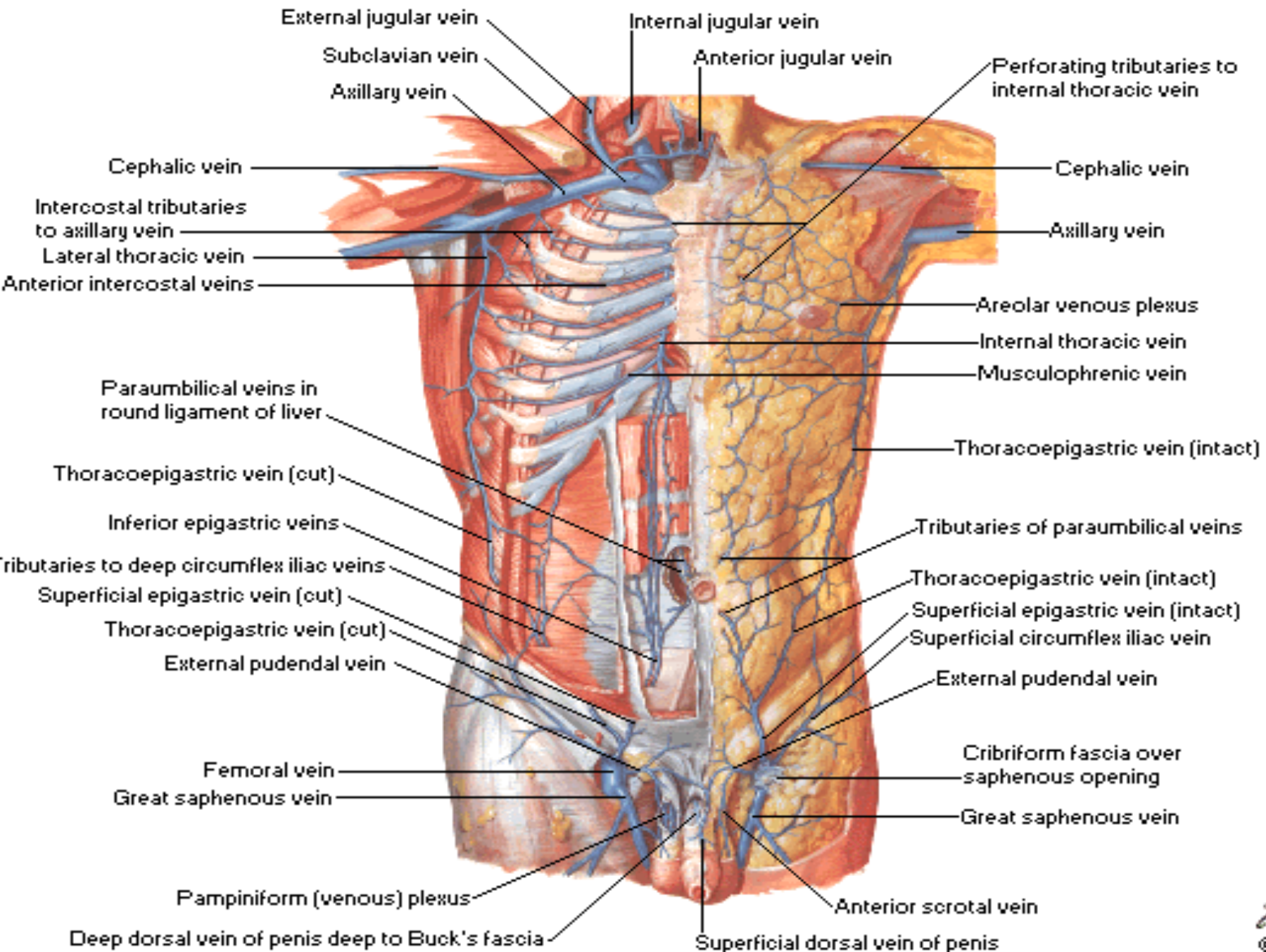
2- Below the umbilicus

- Inf. Epigastric → Femoral vein

3- Paraumbilical veins → *we will learn about them in liver & important in porto-systemic anastomosis.*

- Ligamentum teres → portal vein (Porto-systemic anastomosis)

Veins of Anterior Abdominal Wall



Nerve supply of the ant. Abdominal wall

- Thoracoabdominal nerve: Lower 6th thoracic nerves & 12th subcostal nerve

→ Relation between nerves & skin.

- **Dermatomes** (Anterior, lateral cutaneous nerve terminal branches of Thoracoabdominal nerve)
 - T7 to skin superior to umbilicus below xiphoid process
 - T10 to skin surrounding umbilicus
 - L1 to skin inferior to umbilicus above sym. pubis

** In appendicitis → the pain starts around umbilicus,*

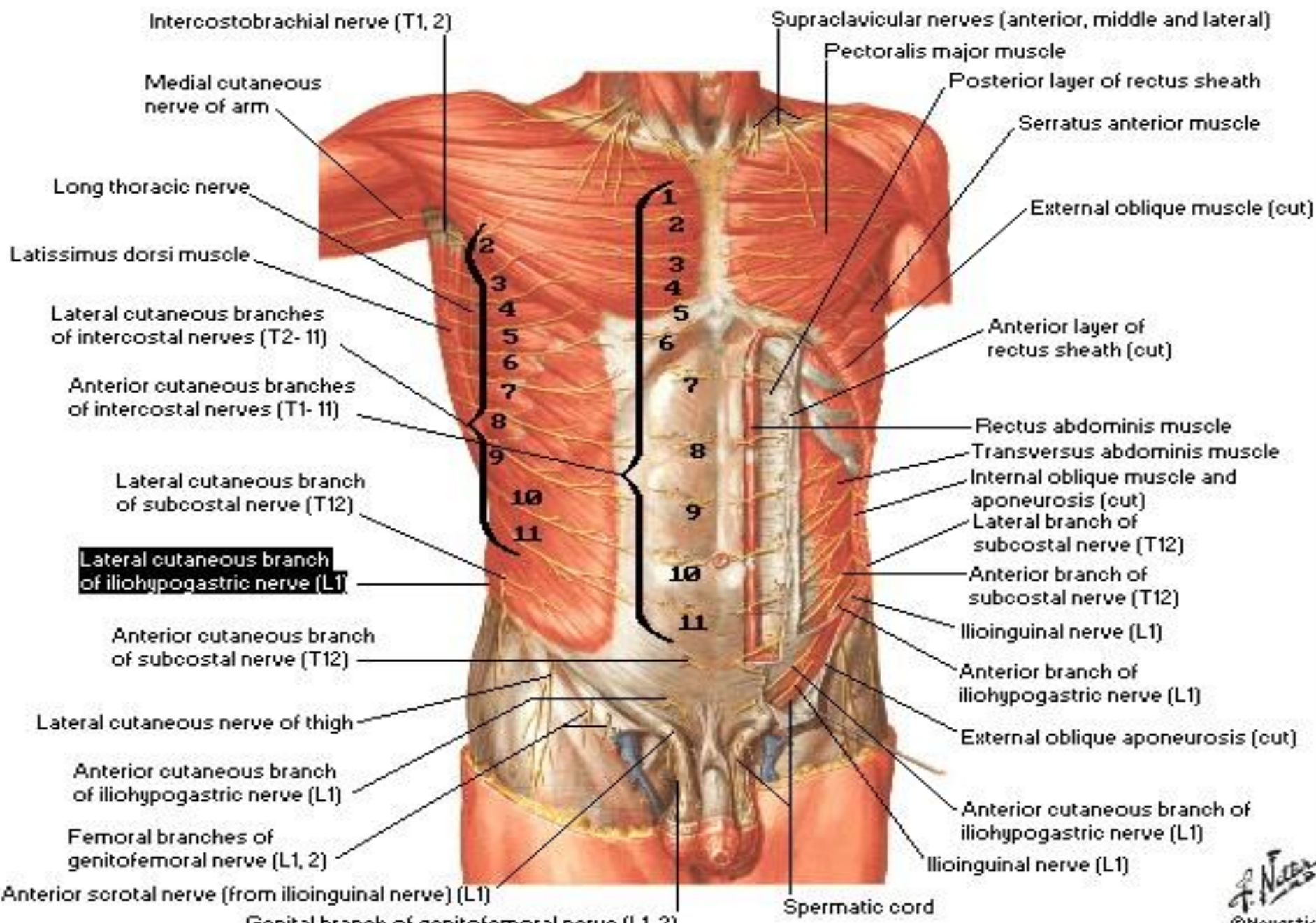
then concentrated in right iliac fossa.

Because the same nerve (T10)

that supplies the pelvis, starts around umbilicus.

- **L1 nerve**
 - Iliohypogastric nerve
 - Ilioinguinal nerve

Nerves of Anterior Abdominal Wall



Lymphatic drainage of ant. Abdominal wall

- Above the umbilicus → Ant. axillary L.N
- Below the umbilicus → Sup. Inguinal L.N
- Above the iliac crest → Post. axillary L.N
- Below the iliac crest → Sup. inguinal L.N

Posteriorly.

Clinical notes

Abdominal **stab wounds**

Surgical incision

↳ You need to know
place of the stab wound,
& what layers deep to it.

Abdominal stab wounds

- Lateral to rectus sheath
- Ant. To rectus sheath
- In the midline= Linea alba
- Structures in the various layers through which an abdominal stab wound depend on the anatomical location

Surgical incision

- The length and direction of surgical incision through the ant. Abdominal wall to expose the underlying viscera are largely controlled by
 - 1- position & direction of nerves
 - 2- direction of muscle fibers
 - 3- arrangement of the apponeurosis forming the rectus sheath
- The incision should be made in the direction of the line of cleavage in the skin so that the hairline scar is produced

Incision through the rectus sheath

- Widely used
- The rectus abdominis muscle and its nerve supply are kept intact
- On closure the ant & post wall of the sheath are sutured separately and the rectus muscle back into position between the suture lines

Common types of incisions

Doctor said these names are just for your knowledge.

- Paramedian incision
- Pararectus incision
- **Midline incision** (*Very popular*)
- Transrectus incision
- Transverse incision
- Muscle splitting
- Abdominothoracic incision