ANATOMY

بسم الله الرحمن الرحيم

MID | Lecture 5

Anterior Abdominal Wall

﴿ وَإِن تَتَوَلَّوْا يَسْتَبْدِلْ قَوْمًا غَيْرَكُمْ ثُمَّ لَا يَكُونُوا أَمْثَالَكُم ﴾

اللهم استعملنا ولا تستبدلنا

Written by: Mahmoud Aljunaidi
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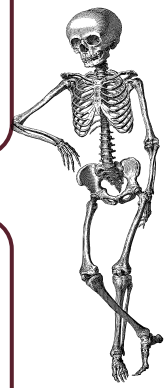


Color Code: Slides + Dr. doesn't mention | Slides + Dr. mentions | Extra from Dr.

Quiz on the previous lecture.

قد تبدوا المحاضرة طويلة وصعبة , وهي فعلا هيك
لا بنمزح ان شاء الله اقل من يوم وبتخلص

وَتَوَكَّلْ عَلَى الْحَيِّ الَّذِي لَا يَمُوتُ وَسَبِّحْ بِحَمْدِهِ ۚ
وَكَفَىٰ بِهِ بِذُنُوبِ عِبَادِهِ خَبِيرًا

Abdominal wall

- The abdominal wall plays a crucial role in medical procedures. Through palpation, a physician can assess which organ may be affected and determine its approximate location. Also, most open surgeries are through the anterior abdominal wall; my advice? Study this system well as it's really important now and along our long years of practice.

- The abdominal wall is divided into;
  - Anterior abdominal wall. (will be addressed this lecture)
  - Posterior Abdominal wall. (will be discussed later)

Borders of the Abdomen

- The abdomen is the region of the trunk located between **the diaphragm above** and the **pelvic inlet below**; it is **separated superiorly** from the thoracic cavity by the diaphragm and **connected inferiorly** to the pelvis.

Borders:

- **Superior:**

1- Xiphoid process → located to the midline of the body.

2- Lower 6 Costal cartilages (7-12) → at the lateral sides. (the Dr. said lower 5, we believe it was mistaken)

- **Inferior:**

  Pubic bone and iliac crest: at the level of L4.

- **Umbilicus:**

  Level of IV disc L3-L4

Abdominal Quadrants

Formed by two intersecting lines:

(1)Vertical (perpendicular)

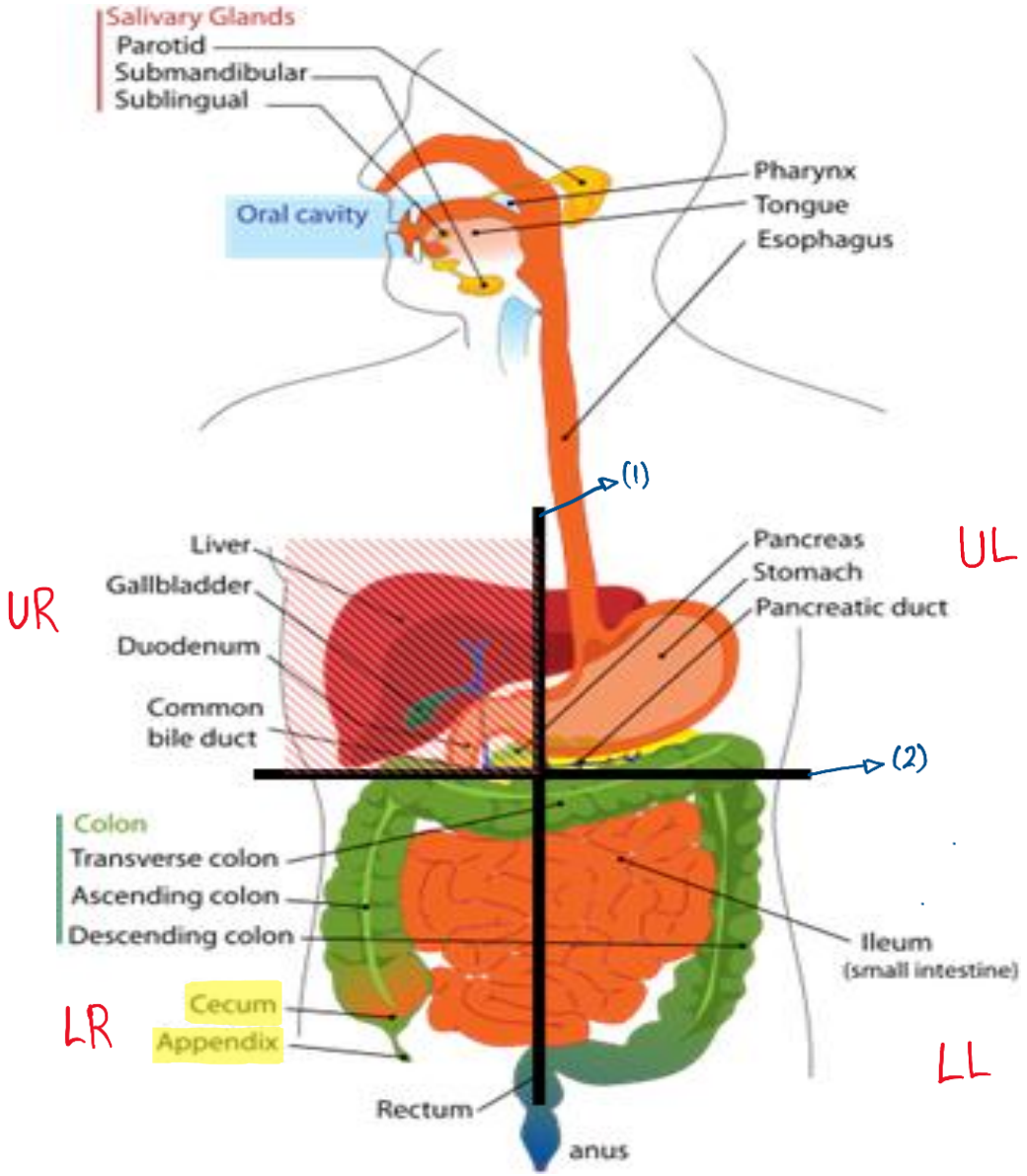
(2)Horizontal (transverse)

Intersect at umbilicus.

Quadrants:

- Upper left, UL.
- Upper right, UR.
- Lower left, LL.
- Lower right, LR.

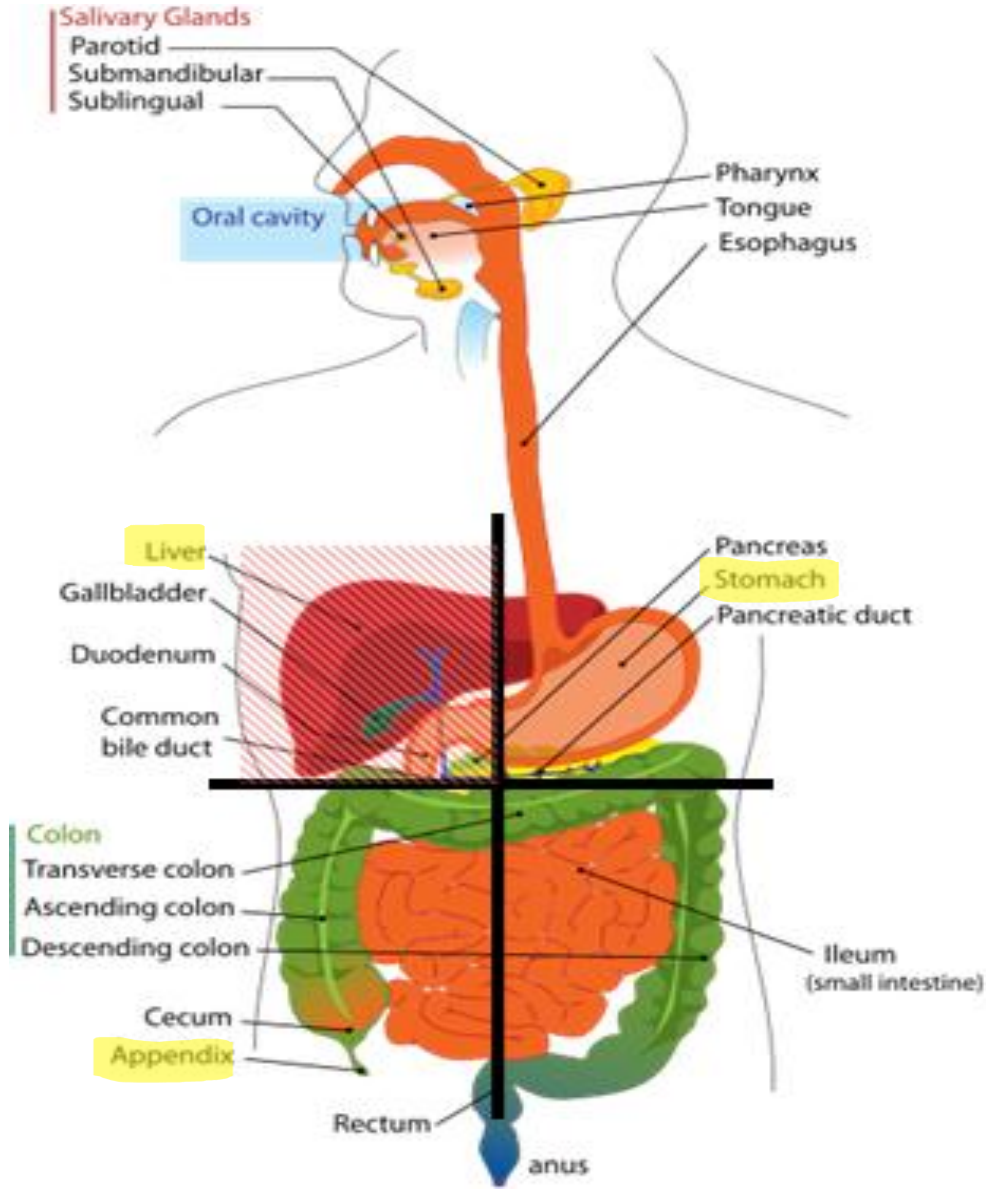
➢ This division was previously used, now it's replaced by **9 abdominal regions.**



Abdominal Quadrants – Clinical correlation

- The **appendix** is located in the **lower right quadrant**, so patients with **appendicitis** they present with **severe pain** in their **LR** quadrant.

- The **liver** is located in the **upper right quadrant,** so conditions causing damage to the liver (ex. Cirrhosis) produce **pain** in the **UR** quadrant. Same for stomach (ULQ), etc.



Abdominal Regions

Divided into **9** regions by **two pairs** (two of each) of planes:

1- Vertical Planes:

-Left and right lateral planes

- Midclavicular planes (lines), as the name implies passes through the midline of the clavicle (**superiorly**).

- Inferiorly passes through the midpoint between the ant.sup.iliac spine and symphysis pubis.

2- Horizontal Planes:

- **Subcostal plane**

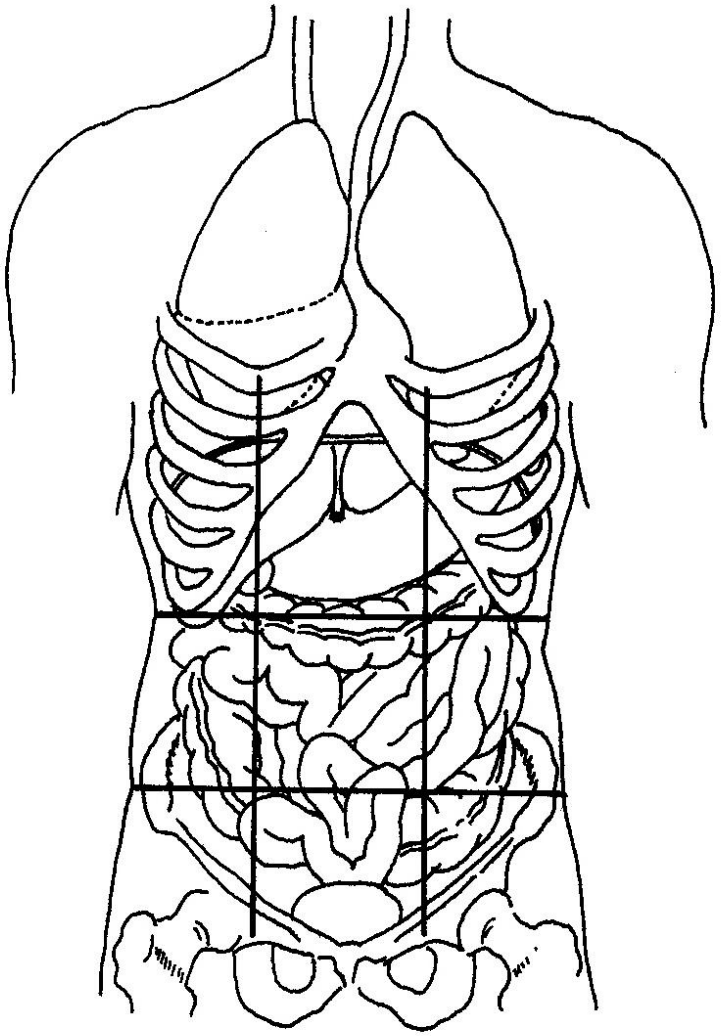
- At **level of L3** vertebra, below the 9th rib.

-Joins the lower end of costal cartilage on each side

- **Intertubercular plane:**

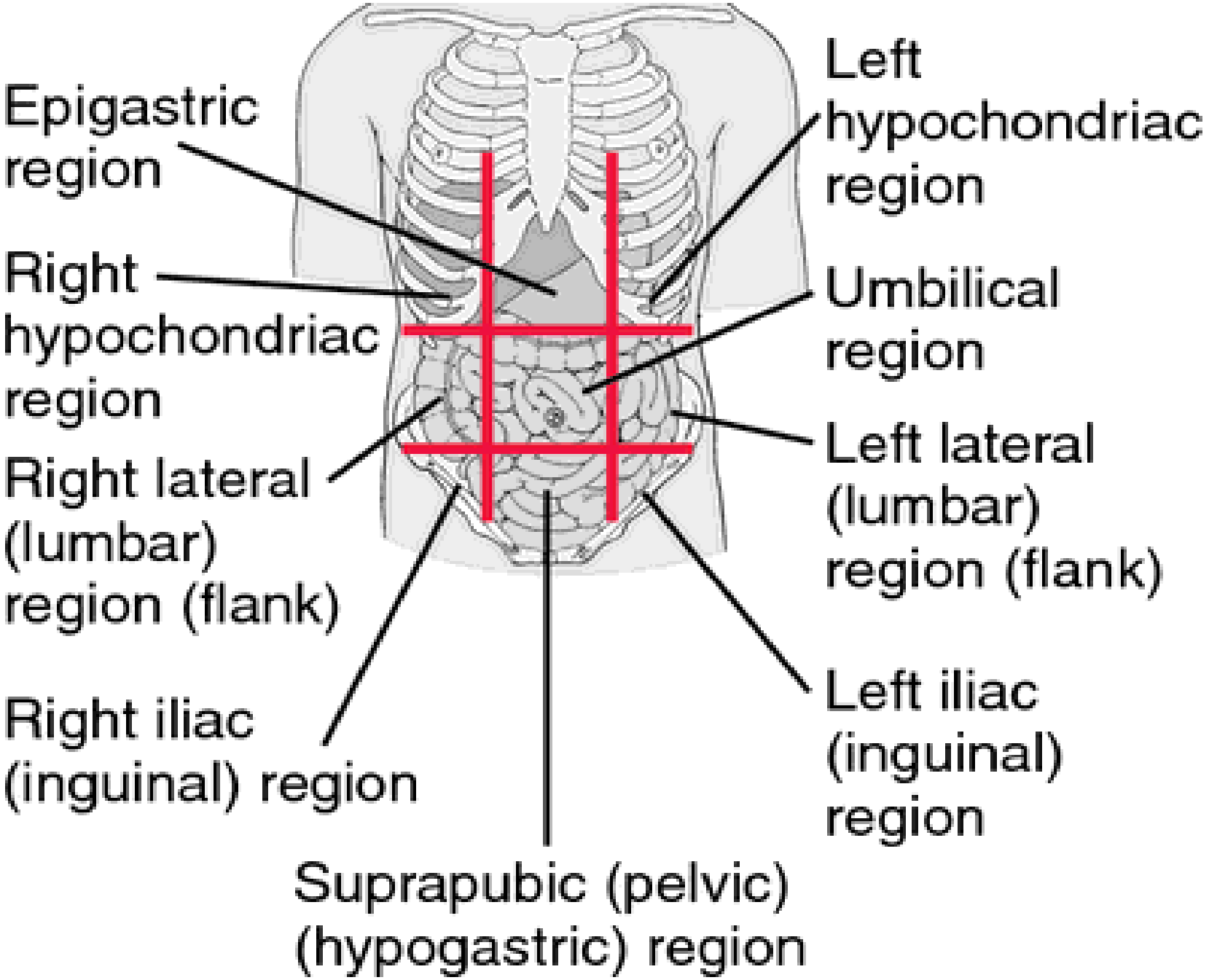
- At the **level of L5** vertebra

- Through (between) tubercles of iliac crests of hip bone.



Everything is included, but it was mentioned that it's important to know regions and what organs are in each one.

Names of Abdominal Regions



Abdominal regions – Notes.

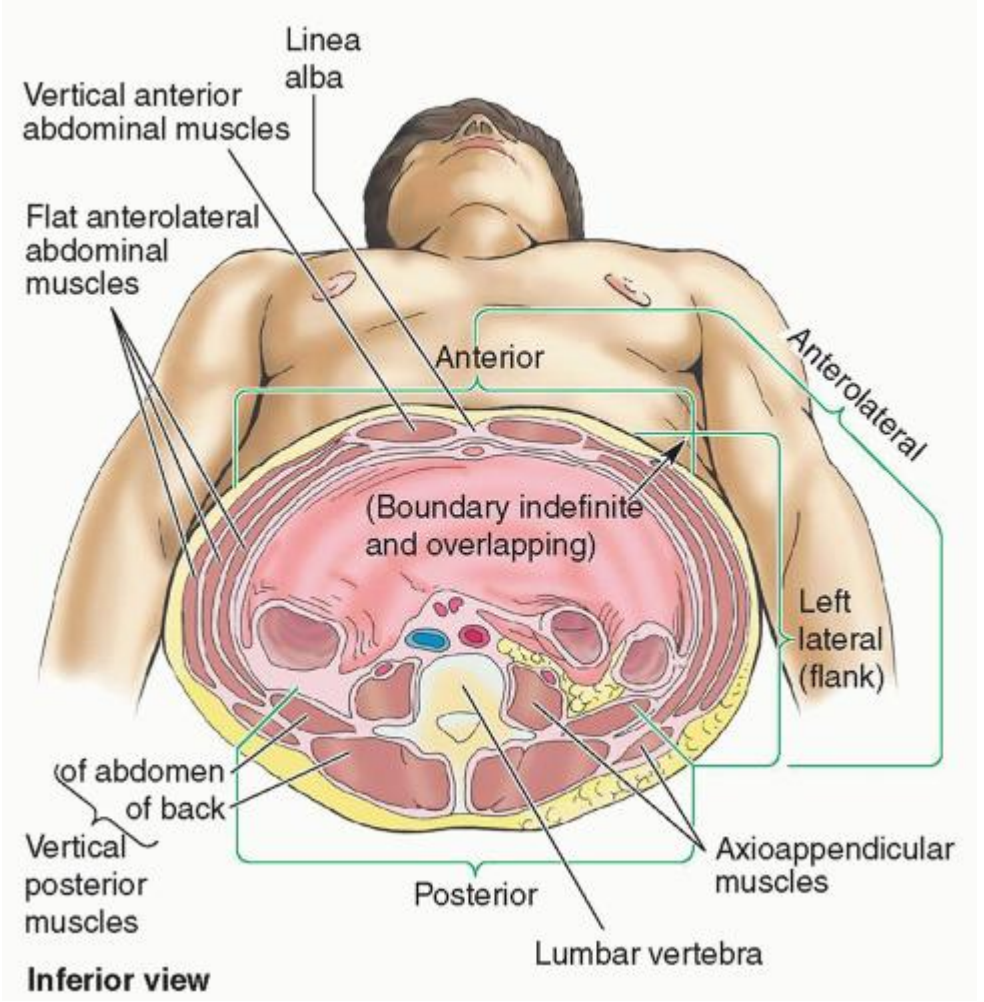
- Terminology, **Hypo** means **below** (wow!)
  - Hypochondriac = below costal cartilage.
- Lumber regions are related to the kidneys.

❖ Clinical correlation, again.

- According to this division, the appendix is located in the **right iliac/inguinal** region, therefore if **appendicitis** has developed, patients present with severe **pain** in that region.
- Appendicitis can develop in both sexes, but when it comes to females, **dysmenorrhea** (pain related to the menstrual cycle) should be ruled out, important to differentiate between them both.
- Patients with **renal colic**, present with pain in the lumber region (either (Rt. or Lt.) or both, one side is more common), this pain is called renal colic pain.

Abdominal wall divided into:-

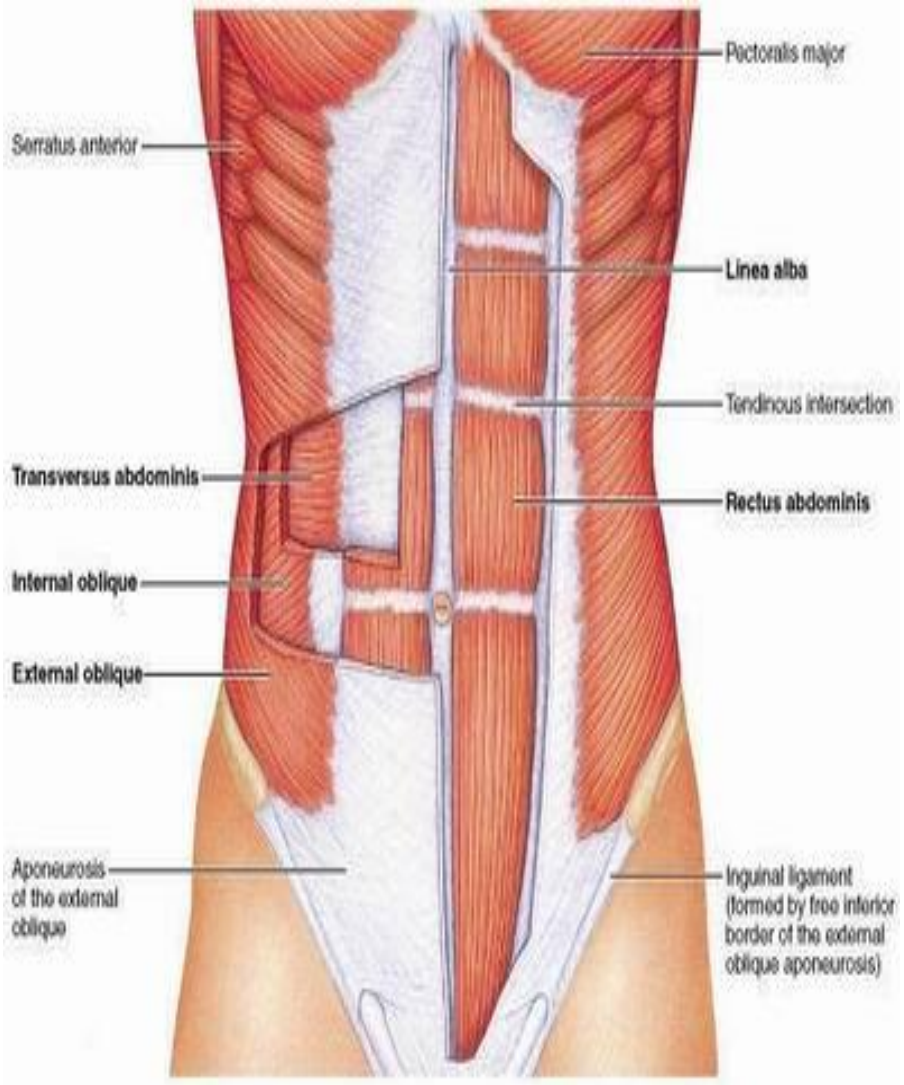
- ☞ **Anterior abdominal wall**
- ☞ **Posterior abdominal wall**



Extra image.

What are the Layers of Anterior Abdominal Wall

- ✓ **1. Skin**
- ✓ **2. Superficial Fascia**
- Above the umbilicus one layer → Camper's fascia
- Below the umbilicus two layers
  - Camper's fascia - fatty superficial layer.
  - Scarp's fascia - deep membranous layer.
- ✓ **3. Deep fascia :**
  - Thin layer of C.T covering the muscle, may be absent.
- ✓ **4. Muscular layer**
  - External oblique muscle
  - Internal oblique muscle
  - Transverse abdominal muscle
  - Rectus abdominis
- ✓ **5. Transversalis fascia**
- ✓ **6. Extraperitoneal fascia**
- ✓ **7. Parietal Peritoneum**



The white regions indicate CT or Aponeurosis.

Anterior Abdominal Wall – Layers.

- Most superficial lies the (1)**skin**, then (2a)**camper's fascia**, deep to it lies the (2b)**scarpa's fascia**. Beneath the superficial fascia is the (3)**deep fascia** that is absent in females, to accommodate for the enlargement of the uterus during pregnancy, while in males in it's composed of a thin layer of CT. As known, deep fascia surrounds (4)**muscles** (see slides 13 and 14), deep to these muscles is the (5)**transversalis fascia,** recall in the lower limb: where it forms the anterior layer of the femoral sheath, followed by (6)**extraperitoneal fascia/fat**. Finally, (7)**parietal peritoneum** forms the deepest layer.

- The parietal peritoneum is like a balloon lining the abdominal cavity. It has significant medical and surgical importance because, to access intraperitoneal organs (ex. stomach), this layer must be incised during surgery.

Superficial Fascia

- Camper's fascia - fatty layer, around scrotum = dartos muscle in male.
- Scarpa's fascia - membranous layer, around scrotum = Colle's fascia

- **Attachment of scarpa's fascia (membranous fascia):**

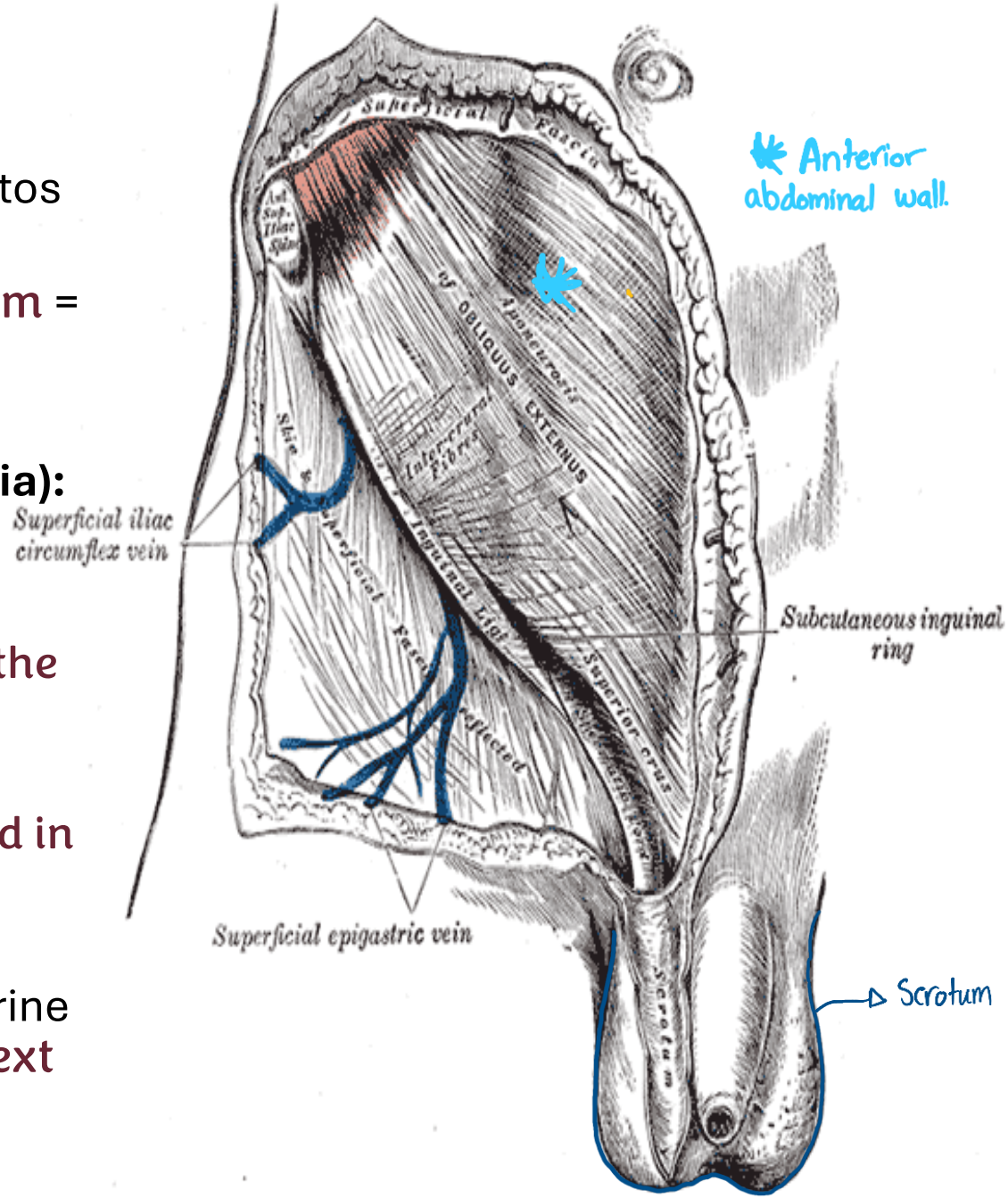
INF: Fascia lata, extends for 4cm below the inguinal ligament.

Function of the attachment: to close the space above the membranous layer.

Sides: Pubic arch

Post: Perineal body, mass of fibrous tissue located in the perineum.

- Rupture of penile urethra leads to extravasations of urine into (scrotum, perineum, penis & abdomen) – see next slide.

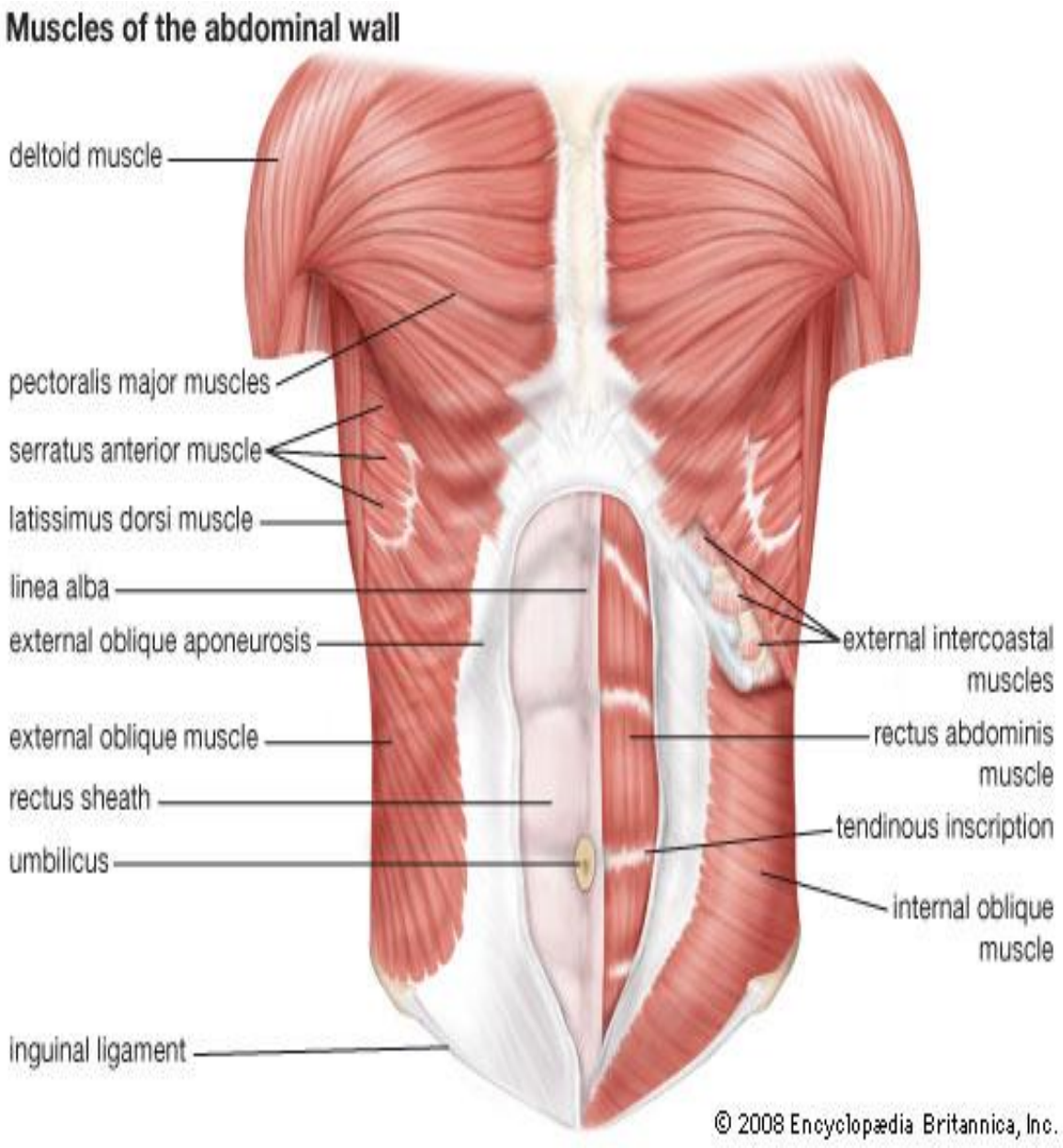


Clinical issue – Rupture of Penile Urethra.

- If penile urethra got ruptured, urine goes deep to the membranous layer, reaching:
  - The umbilicus in the abdomen, as this layer starts below the umbilicus.
  - Fascia lata in the thigh, if there's no fascia lata urine will reach low in the lower limb, therefore, the prescence of fascia lata confines urine to the upper part of the thigh.
  - Around the scrotum and the penis.

✓ Muscles

- Rectus abdominis
- External oblique muscle
- Internal oblique muscle
- Transverse abdominal muscle



Anterior Abdominal Wall – Muscles (pt.1)

- Muscles of the abdominal wall are very **strong** muscles, where they form a **network** that contribute to this feature.
- These muscles originate as fleshy fibers and terminate as connective tissue (aponeurosis).
- These muscles **insert**, and contribute to the formation of, **Linea alba**.
  - A fibrous, midline structure extending from the xiphoid process down to symphysis pubis (where the 2 hip bones meet) passing the umbilicus.
- Fibers of external oblique are going downward, forward and medially (كإنك بتحط ايديك بجيابك), while those of internal oblique are upward, forward and medially.
- Fibers of transversus abdominis are transverse.

Anterior Abdominal Wall – Muscles (pt.2)

- Rectus abdominis is adjacent to Linea alba, its lateral edge is called **Linea semilunaris**. This muscle appears segmented into squares by **tendinous intersections** (fibrous lines) – (This is the muscle of six packs).
- This segmented organization originates from the embryonic myotomes, where the rectus abdominis initially develops in segments separated by fibrous tissue.
- The aponeuroses of the **lateral 3 muscles**, form the **rectus sheath.**
- The rectus sheath splits into **anterior** and **posterior** walls to surround the rectus abdominis muscle.

External oblique muscle

-Broad

-Thin

✓ **Direction:**

Downward forward medially

✓ **Origin**

outer surface of lower 8 ribs.

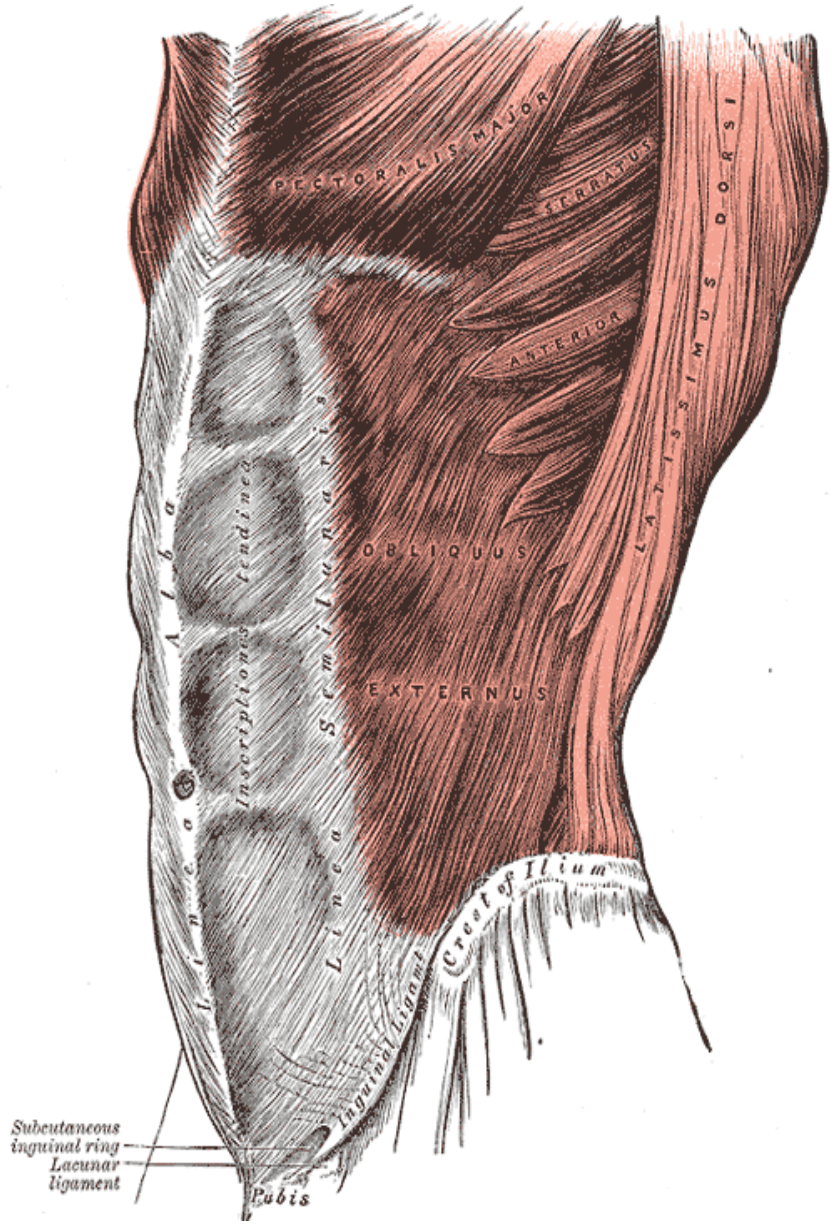
✓ **Insertion**

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

✓ **Nerve Supply**

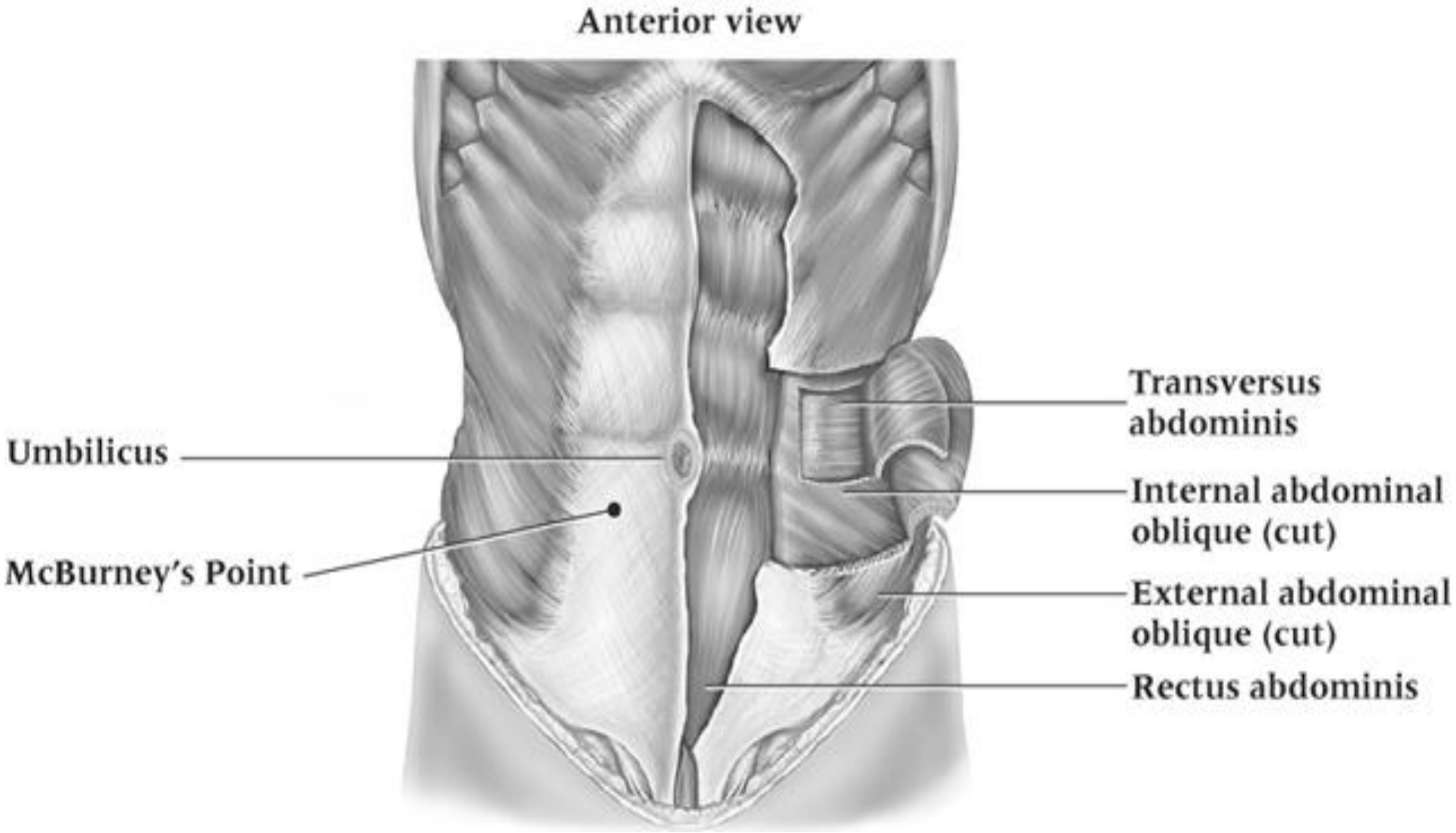
1- Lower 6th thoracic nerves

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



- There are 12 thoracic nerves, also named thoracic spinal nerves.
  - Lower 6 supply all the muscles of the abdominal wall.
- L1 (first lumbar spinal nerve), gives a and b.

Muscles of the anterior abdominal wall

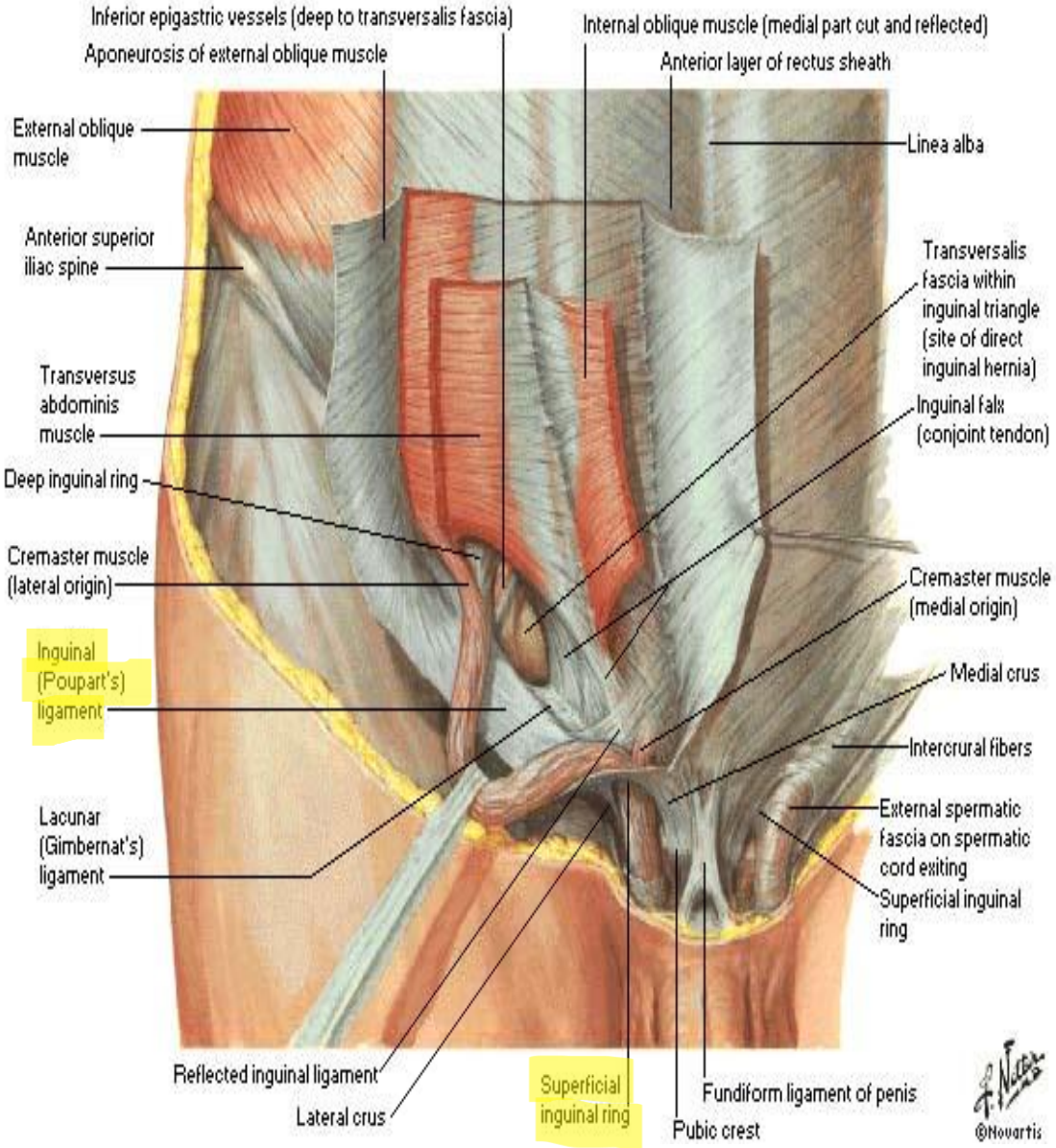


Aponeurosis of external oblique muscle :

- It forms the following:

- **Superficial inguinal ring**
- **Inguinal ligament.**
- **Lacunar ligament.** (1)
- **Pectineal ligament.** (2)
- **Boundaries of inguinal canal (anterior wall)** (3).
- **Formation of rectus sheath. (by all three muscles**

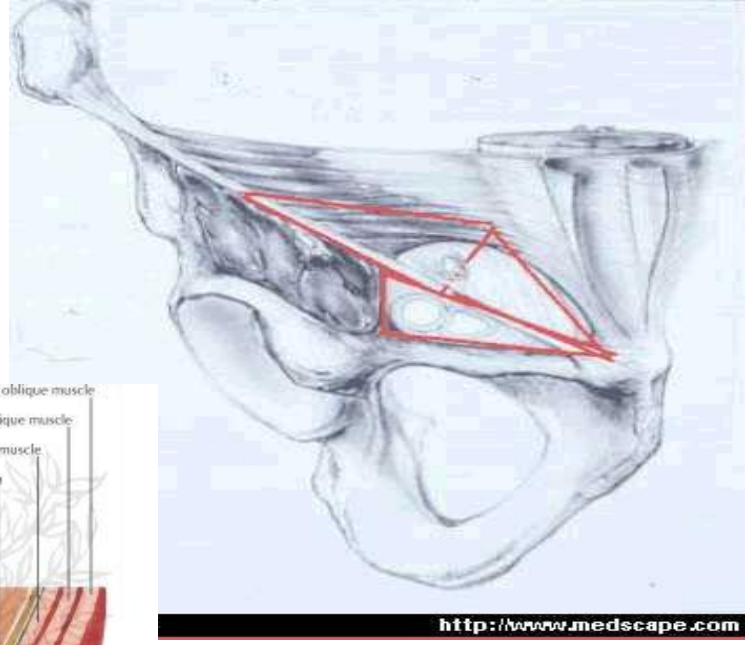
1. **Lacunar ligament:**
   a. Present at the medial edge of femoral ring
   b. Part of the inguinal ligament
   c. attached to the pubic ramus and pectineal line
2. Attached to pectineal line of pubis.
3. Passes through it the spermatic cord.

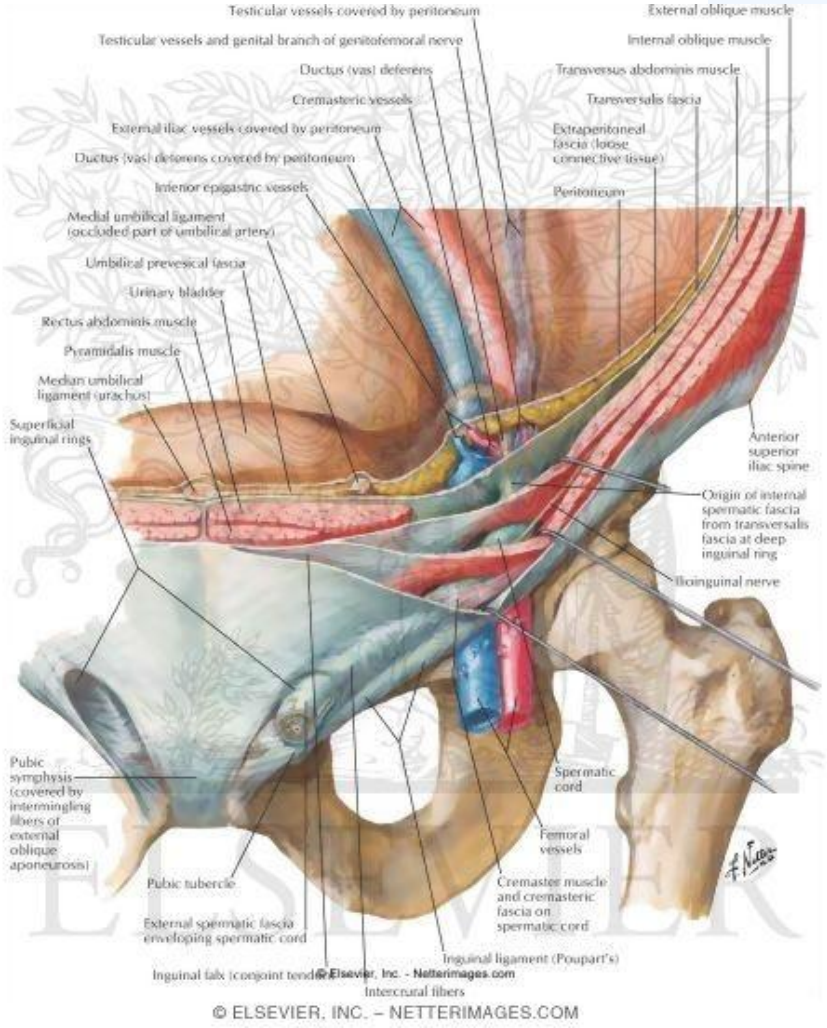


Inguinal ligament

1- folded backward the lower border of aponeurosis of external muscle on itself.

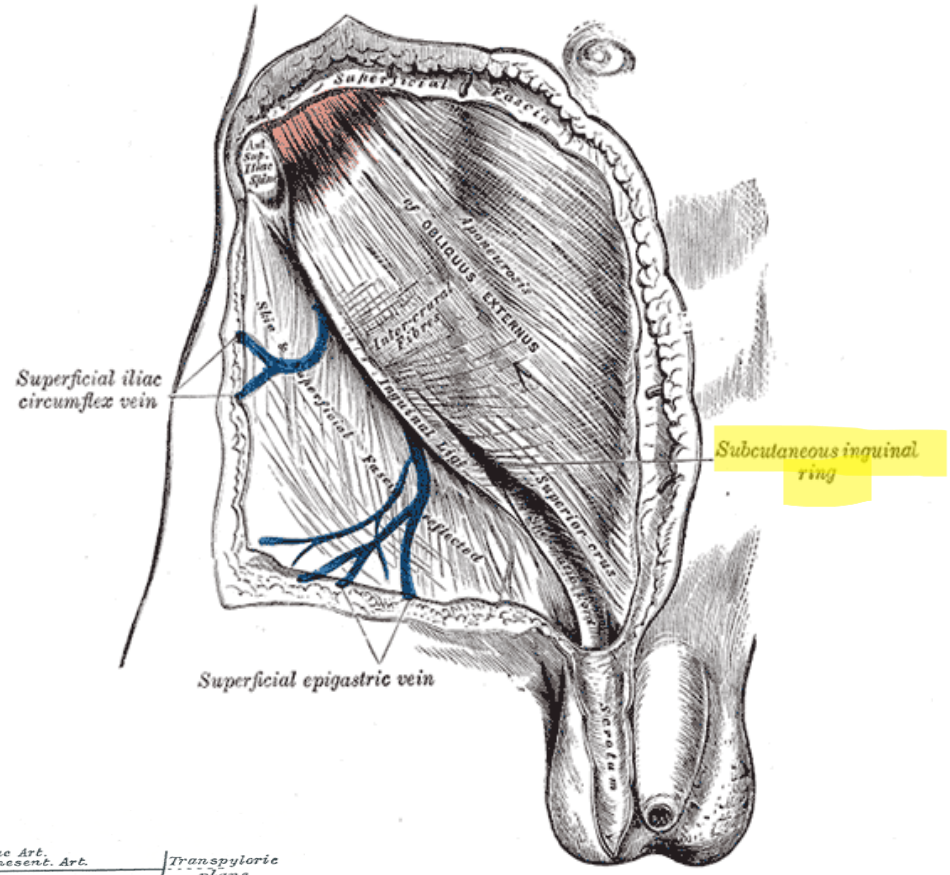
2- between ant.sup.iliac spine and the pubic tubercle.

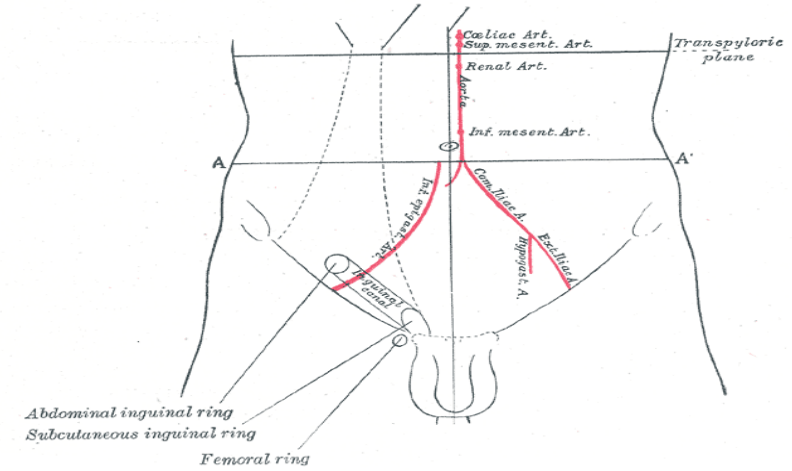


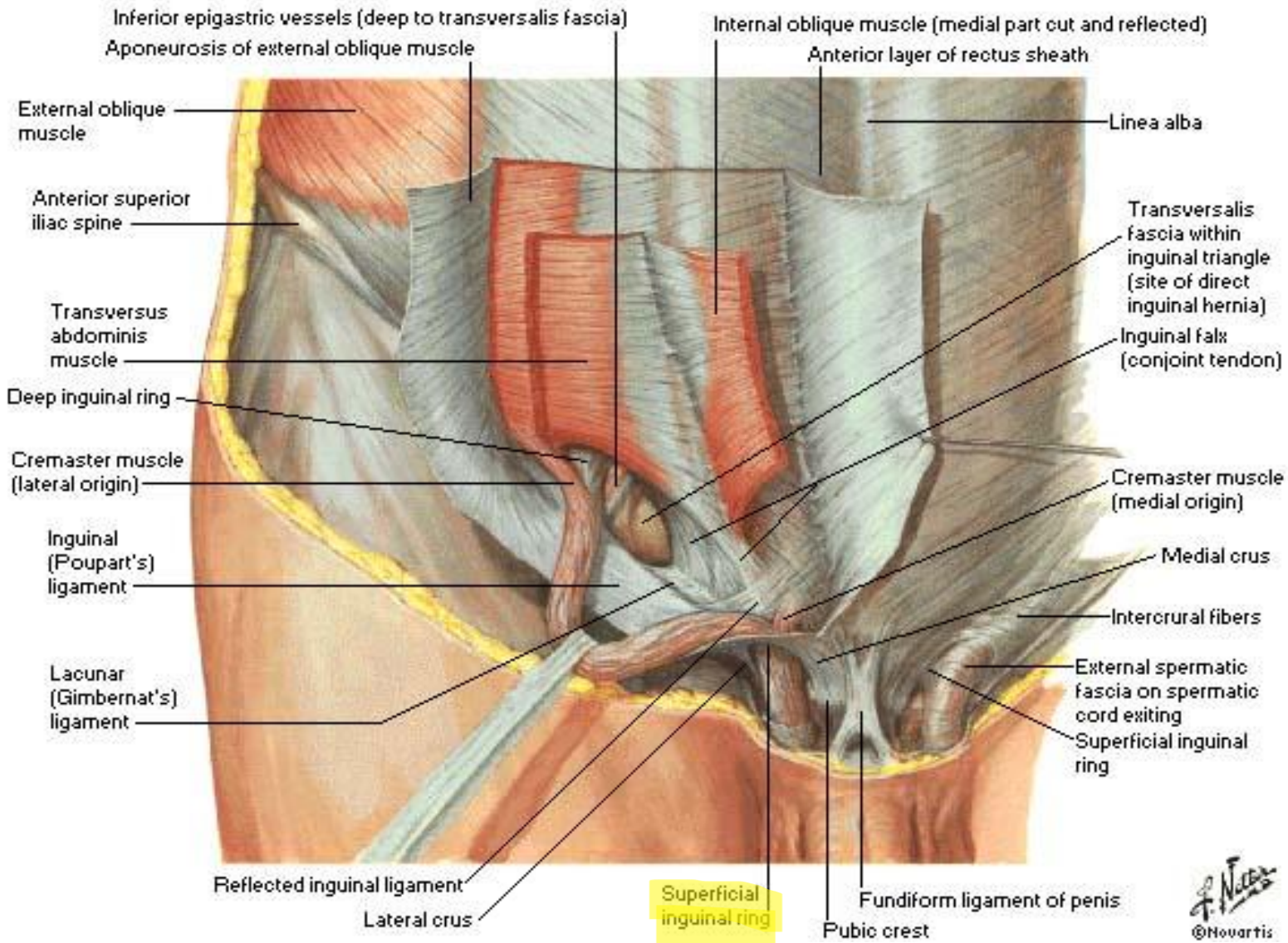


Superficial inguinal ring.

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 **to the labia majora.**





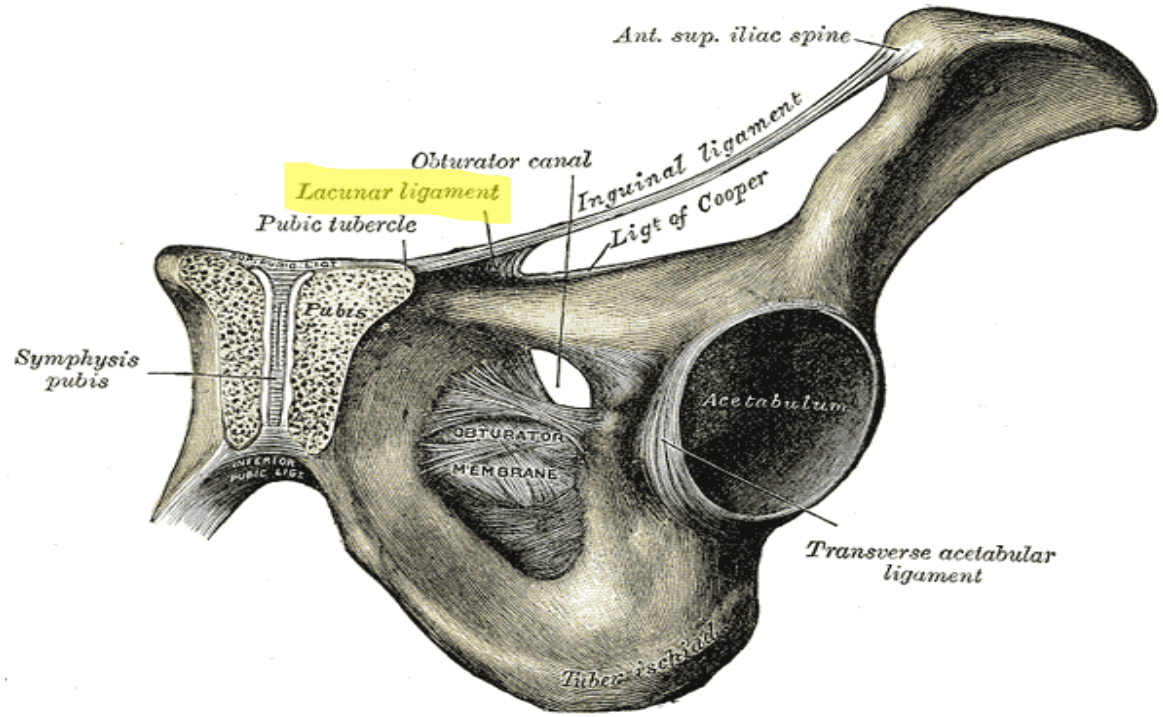

Inferior epigastric vessels (deep to transversalis fascia)
Aponeurosis of external oblique muscle
Internal oblique muscle (medial part cut and reflected)
Anterior layer of rectus sheath
External oblique muscle
Linea alba
Anterior superior iliac spine
Transversalis fascia within inguinal triangle (site of direct inguinal hernia)
Transversus abdominis muscle
Inguinal falx (conjoint tendon)
Deep inguinal ring
Cremaster muscle (lateral origin)
Cremaster muscle (medial origin)
Inguinal (Poupart's) ligament
Medial crus
Intercrural fibers
Lacunar (Gimbernat's) ligament
External spermatic fascia on spermatic cord exiting
Superficial inguinal ring
Reflected inguinal ligament
Lateral crus
Superficial inguinal ring
Pubic crest
Fundiform ligament of penis
©Novartis

Lacunar ligament

1- extension of aponeurosis of external muscle backward and upward to the pectineal line

2- on the superior ramus of the pubis **and attached to pectineal line**

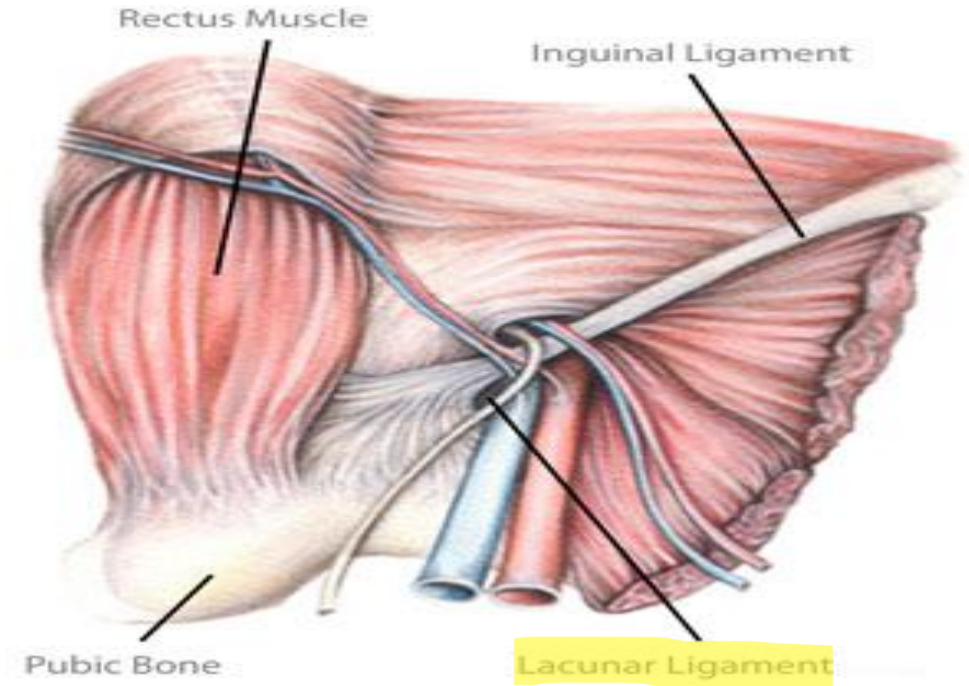
3- its sharp, free crescentic edge forms the medial margin of the femoral ring



Pectineal ligament

1- Continuation of the lacunar ligament at pectineal line

2- Continuation with a thickening of the periosteum



Internal Oblique

✓ **Direction:**

upward forward medially

✓ **Origin**

Lumbar Fascia, Ant 2/3 iliac crest,

lateral two thirds of inguinal ligament.

✓ **Insertion**

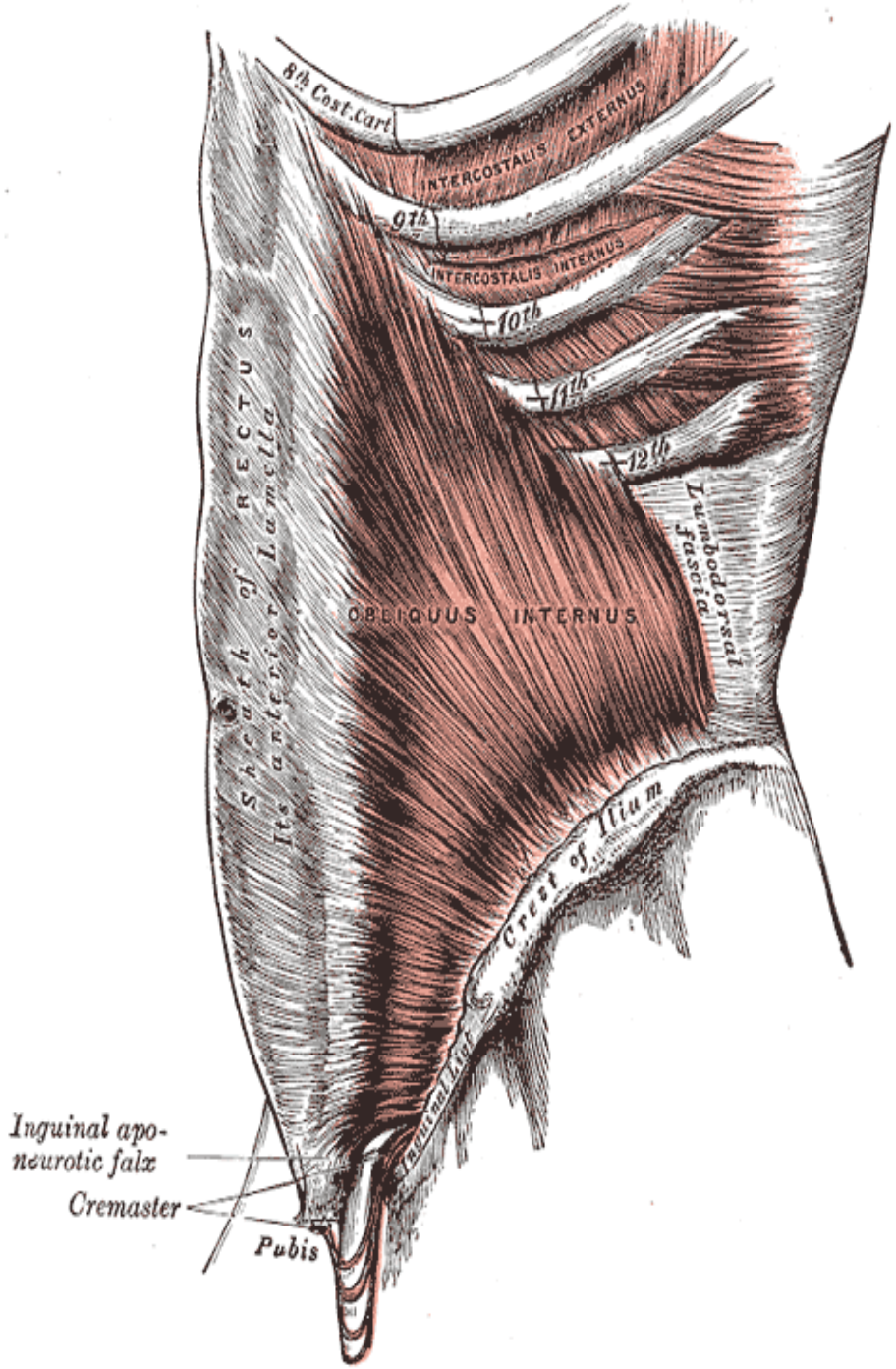
- Lower three ribs& costal cartilage, Xiphoid process, Linea alba, symphysis pubis.

-

✓ **Nerve Supply**

Lower 6th thoracic nerves,

iliohypogastric n & ilioinguinal n→L1.



Internal oblique muscle – Cont.

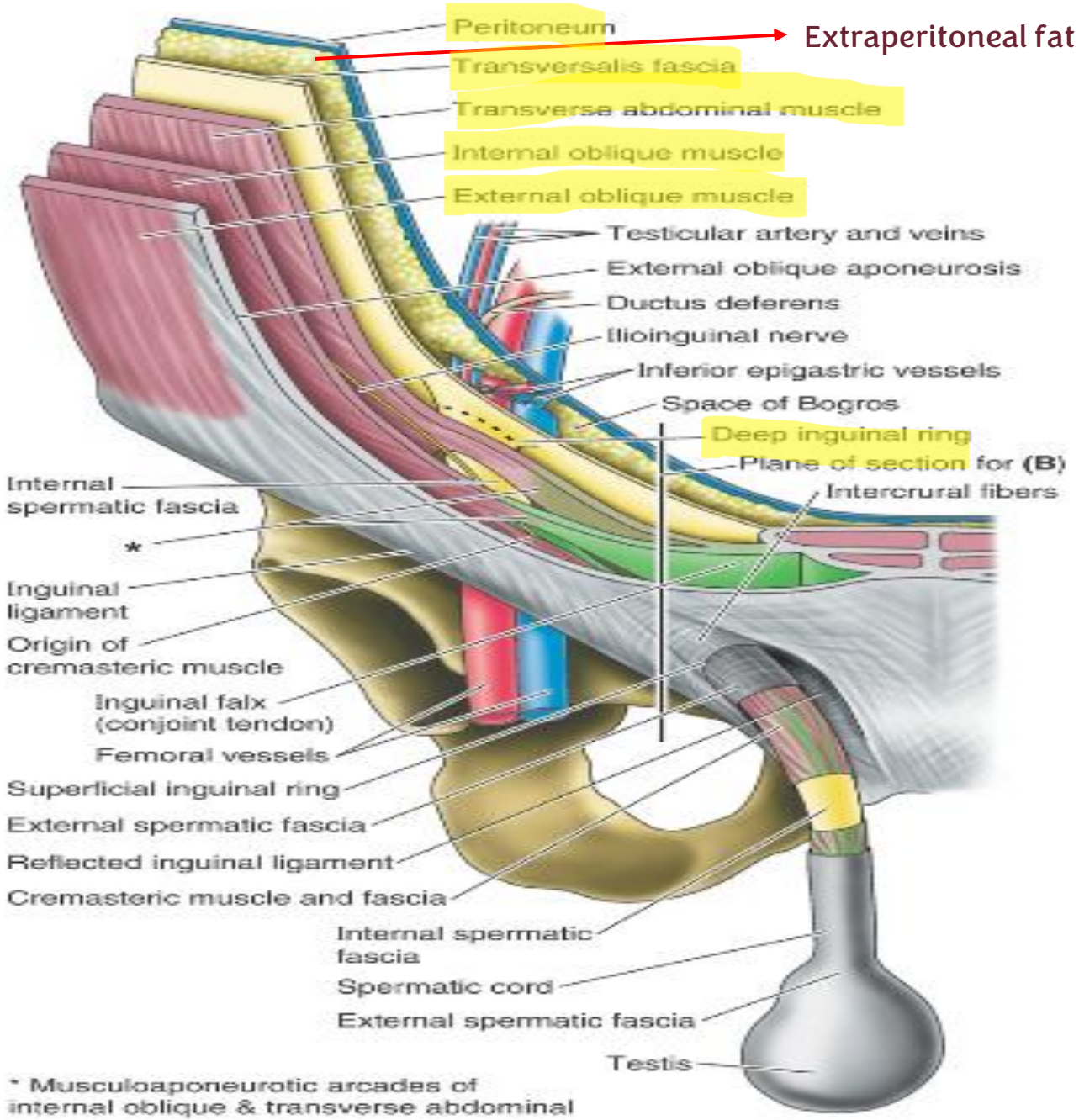
❖ Conjoint tendon

- The lowest tendinous fibers of internal oblique which joins with transversus abdominis and attached to the pubic bone
- Attach medially to linea alba
- Support the inguinal canal
- Has lateral free border
- Conjoint tendon is important as it's used as stiches for herniorrhaphy because it's a tough organ

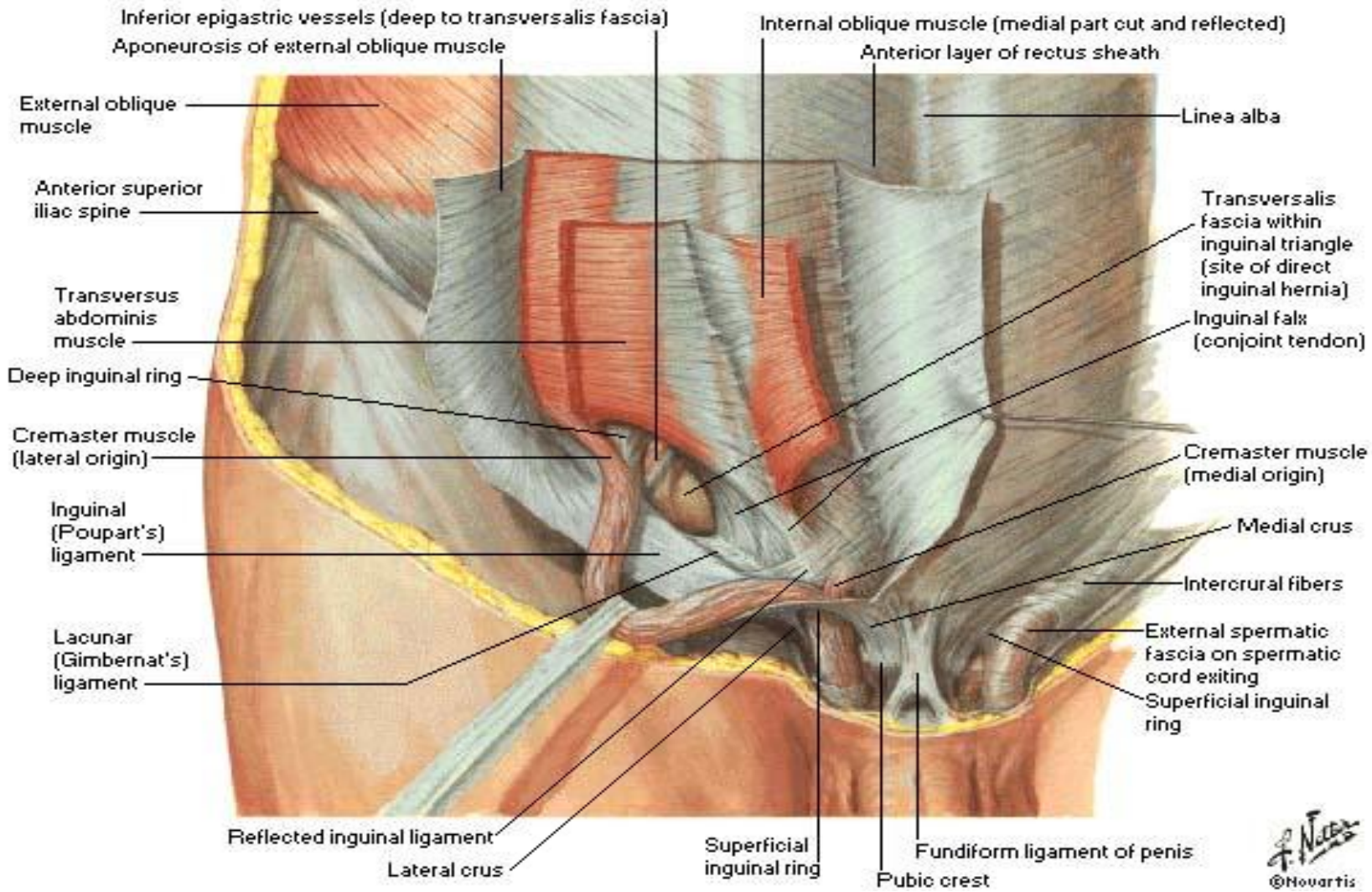
❖ Cremasteric fascia

Internal oblique has free lower border arches over the **spermatic cord** or **ligament of uterus** in the inguinal canal

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


Peritoneum
Extraperitoneal fat
Transversalis fascia
Transverse abdominal muscle
Internal oblique muscle
External oblique muscle
Testicular artery and veins
External oblique aponeurosis
Ductus deferens
Ilioinguinal nerve
Inferior epigastric vessels
Space of Bogros
Deep inguinal ring
Plane of section for (B)
Intercrural fibers
Internal spermatic fascia
*
Inguinal ligament
Origin of cremasteric muscle
Inguinal falx (conjoint tendon)
Femoral vessels
Superficial inguinal ring
External spermatic fascia
Reflected inguinal ligament
Cremasteric muscle and fascia
Internal spermatic fascia
Spermatic cord
External spermatic fascia
Testis
* Musculoaponeurotic arcades of internal oblique & transverse abdominal

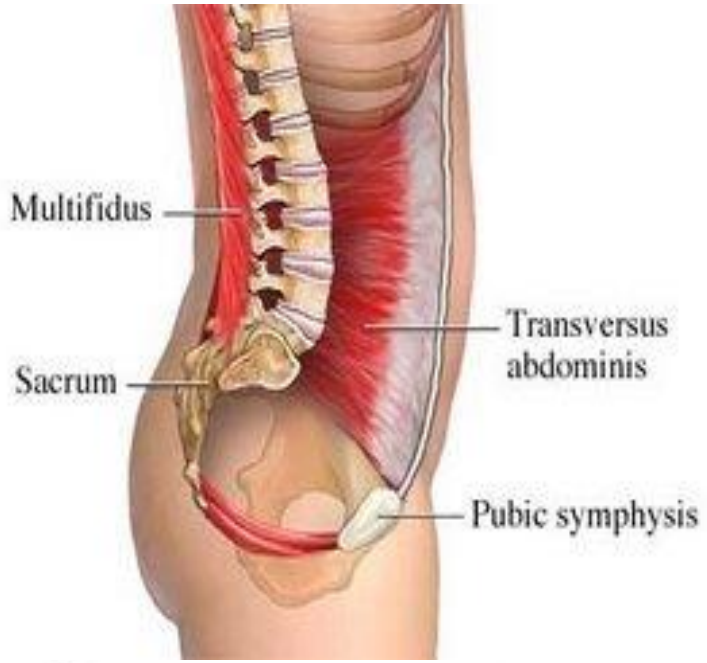
Conjoint tendon & Cremasteric fascia



❖ Transversus Abdominis

✓ Direction

- Its fibers run horizontally forward under the internal oblique



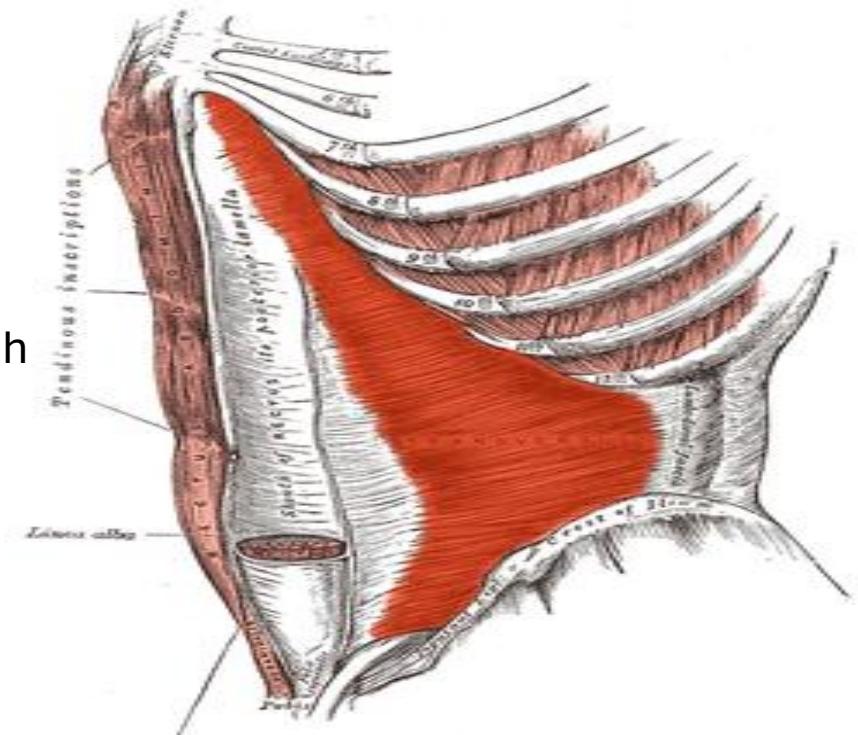
✓ Origin

- **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:**

Symphsis pubis, pubic crest

✓ **Insertion:**

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

✓ **Nerve Supply**

Lower 6^{th} thoracic nerves

Notice that L1 here doesn't assist in the innervation because it's inside the rectus sheath and L1 doesn't pass the rectus sheath

Rectus abdominis muscle……cont

- Linea alba (midline)
- Linea semilunaris (at the edge)
- Tendinous intersection (at anterior wall) :

Lines & Land marks of the Anterior Abdominal Wall:

- Linea alba:

- Located along the midline.

-Between the xiphoid process & symphysis pubis

- Formed by the fusion of aponeurosises of three abdominal wall(Ex.In,Tran. Abd.muscle)

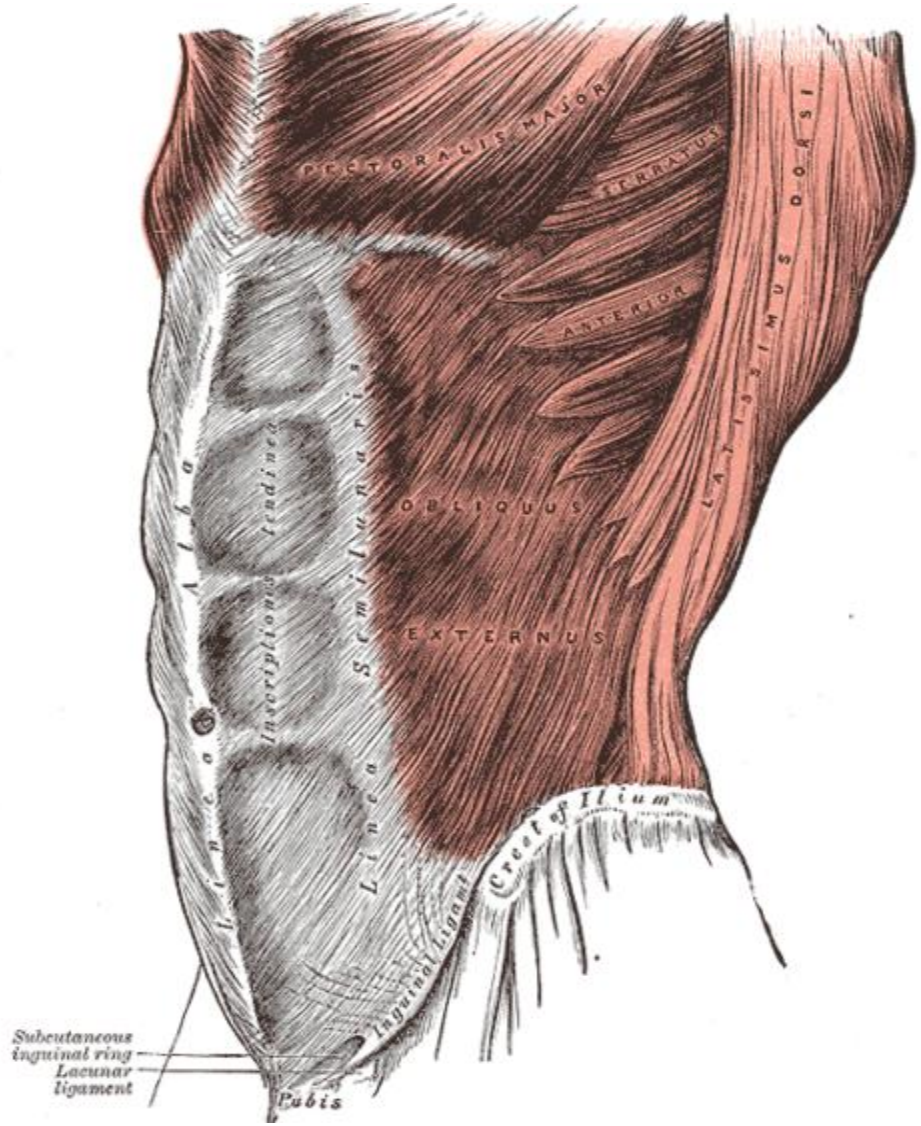
-Importance : it is the targeted site of wide field abdominal surgery (midline incision)

Advantage : minimal bleeding because it's a fibrous tissue

Disadvantage : very poor healing

- 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 (sometimes can be 4)
- 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

-Origin

Ant. Surface of the pubis

-Insertion:

Linea alba

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

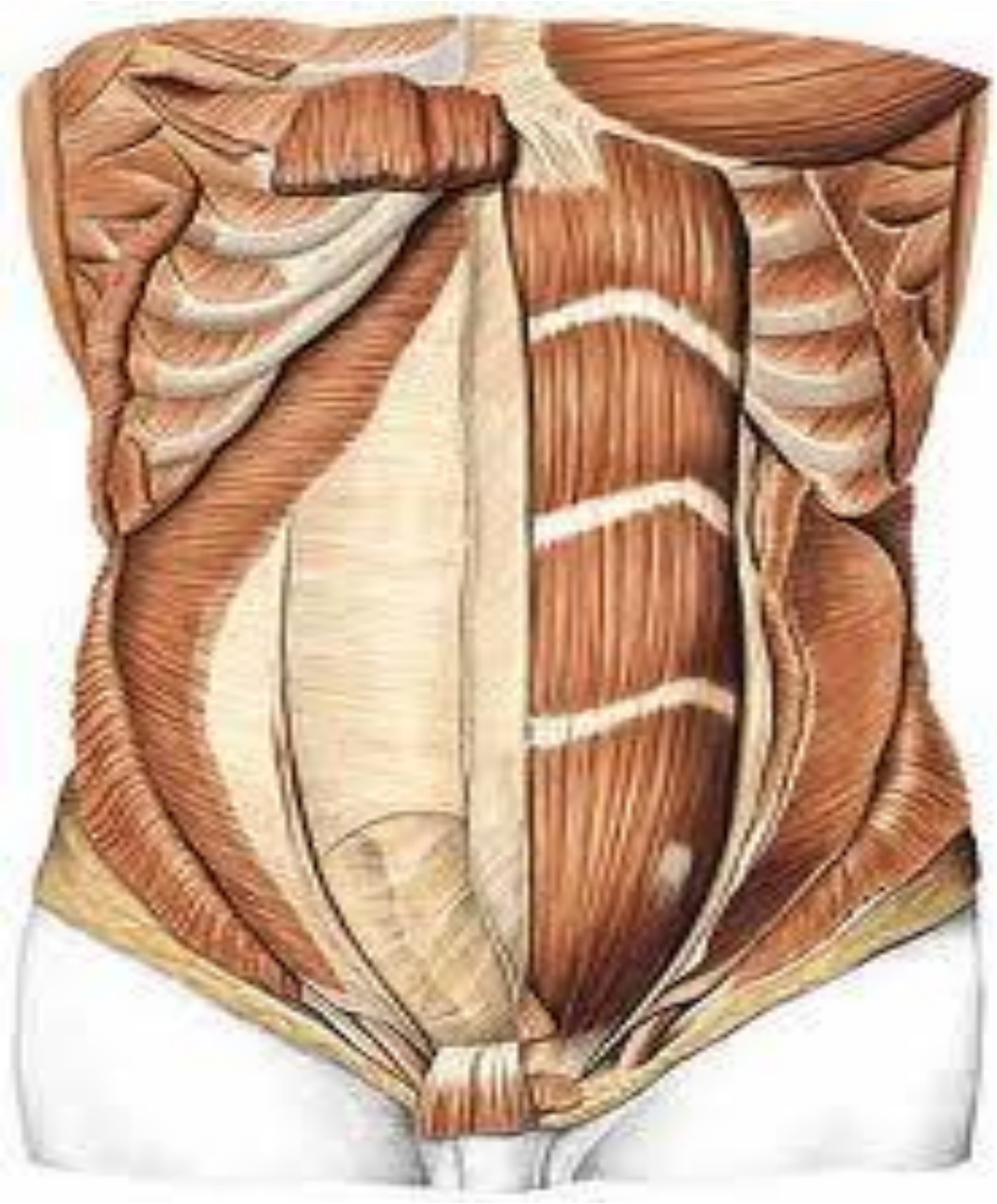
-Nerve supply

12th subcostal nerve

-Action :

pulls the linea alba downward .

- **Can sometimes be absent**



Rectus sheath

Rectus sheath……cont

- The rectus sheath is a long fibrous sheath
- Formed mainly by the aponeuroses of the three lateral abdominal muscles.
- Found on both sides of the linea alba
- Bounded laterally by linea semilunaris (edge of rectus abdominus)

- **Contents – important –**

  - Rectus abdominis muscle

  - Pyramidalis muscle (if present)

  - The anterior rami of the lower six thoracic (intercostal) nerves (they originate from the thorax between 2 muscles : transversus abdominis and internal oblique and then arrives the rectus sheath from lateral to medial and supply the rectus abdominus and terminate finally as anterior cutaneous nerves to the abdomen)

  - The superior and inferior epigastric vessels

  - Lymphatic vessels.

Rectus sheath.....cont

- Description the rectus sheath is considered at three levels.

1- Above the costal margin ***(at the xiphoid and costal cartilage)***

2- Between the costal margin and *the level of the anterior superior iliac spine* ***(above and below the umbilicus)***

3- *Between the level of the anterosuperior iliac spine and the pubis* the anterior wall (**below *anterior superior iliac spine)***

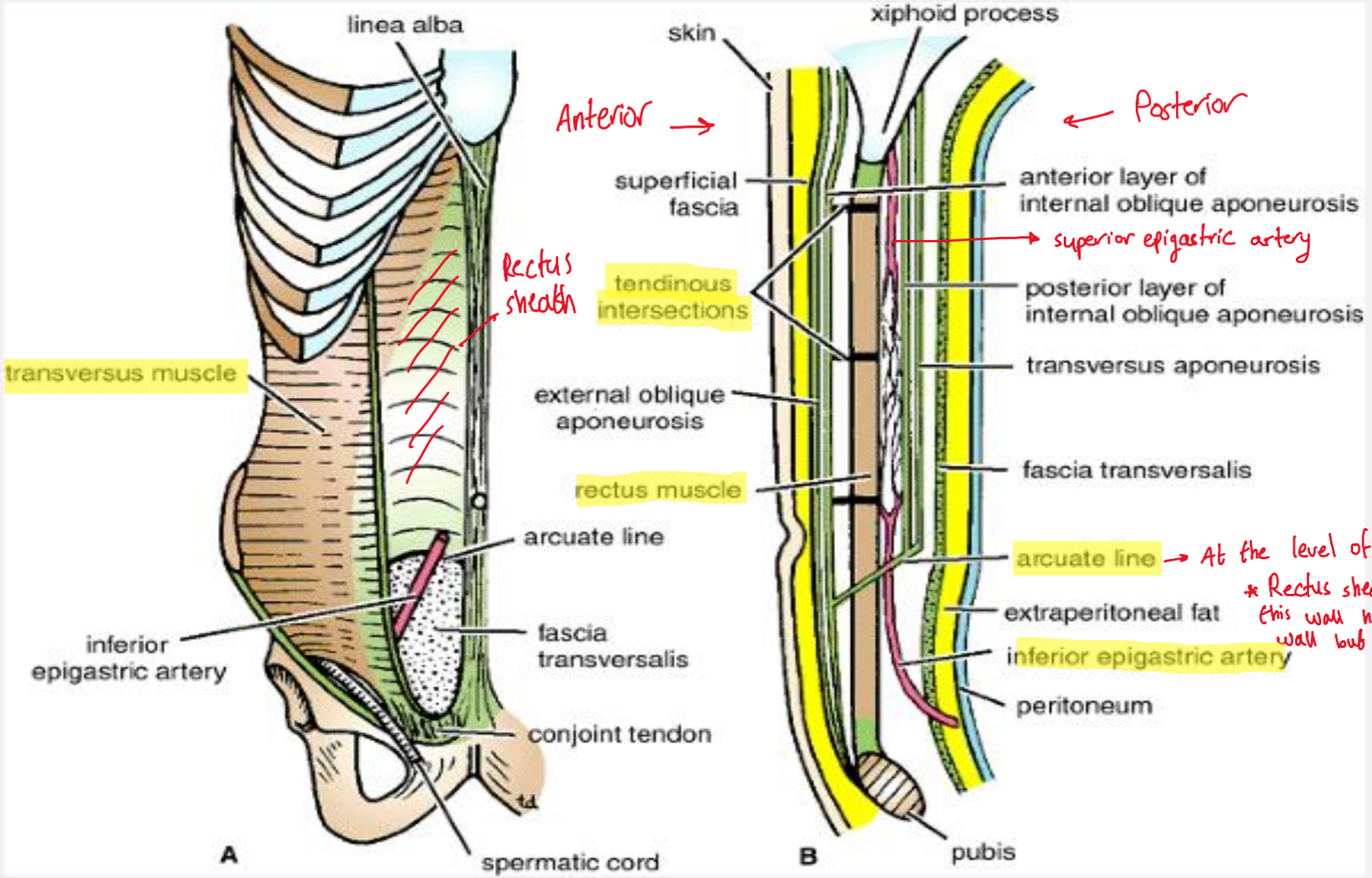
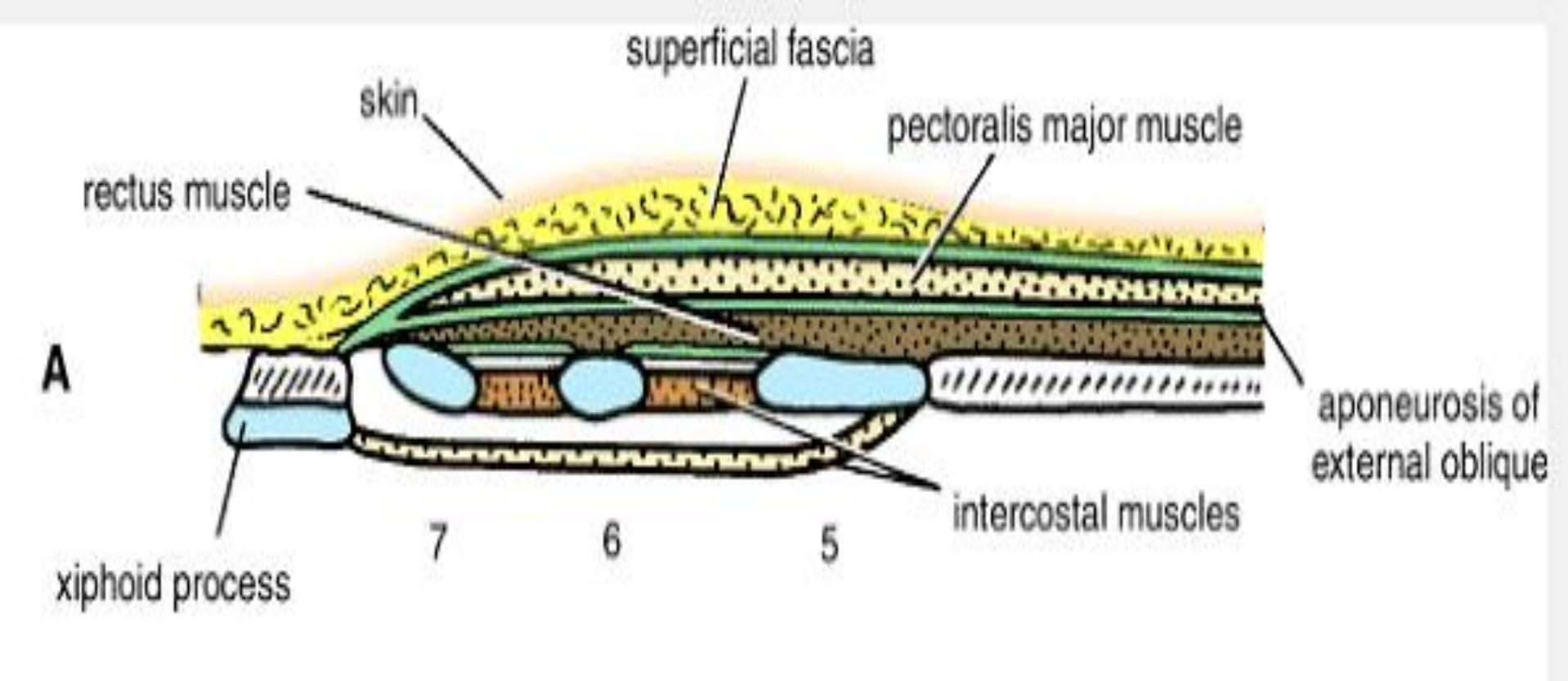


Figure 4-10 Rectus sheath in anterior view **(A)** and in sagittal section **(B)**. Note the arrangement of the aponeuroses forming the rectus sheath.

This slide is just a quick overview to help you picture things better. We'll go through everything in detail soon.



Dr said that you should know what lies anterior and posterior on each level.

Hint: by observing the image you could easily memorize them.

Above the costal margin, first level :

- **Anterior wall #** Skin → superficial fascia → deep fascia → pectoralis muscle → aponeurosis of the external oblique.

- **Posterior wall #** xiphoid process , thoracic wall that is, the fifth, sixth, and seventh costal cartilages and the intercostal spaces, intercostal muscles.

Between the costal margin and the level of the anterior superior iliac spine *(above and below the umbilicus)*
second level :

- The aponeurosis of the internal oblique splits to enclose the rectus muscle → giving one layer at the anterior and the other at posterior .

- the external oblique aponeurosis is directed in front of the muscle

- the transversus aponeurosis is directed behind the muscle.

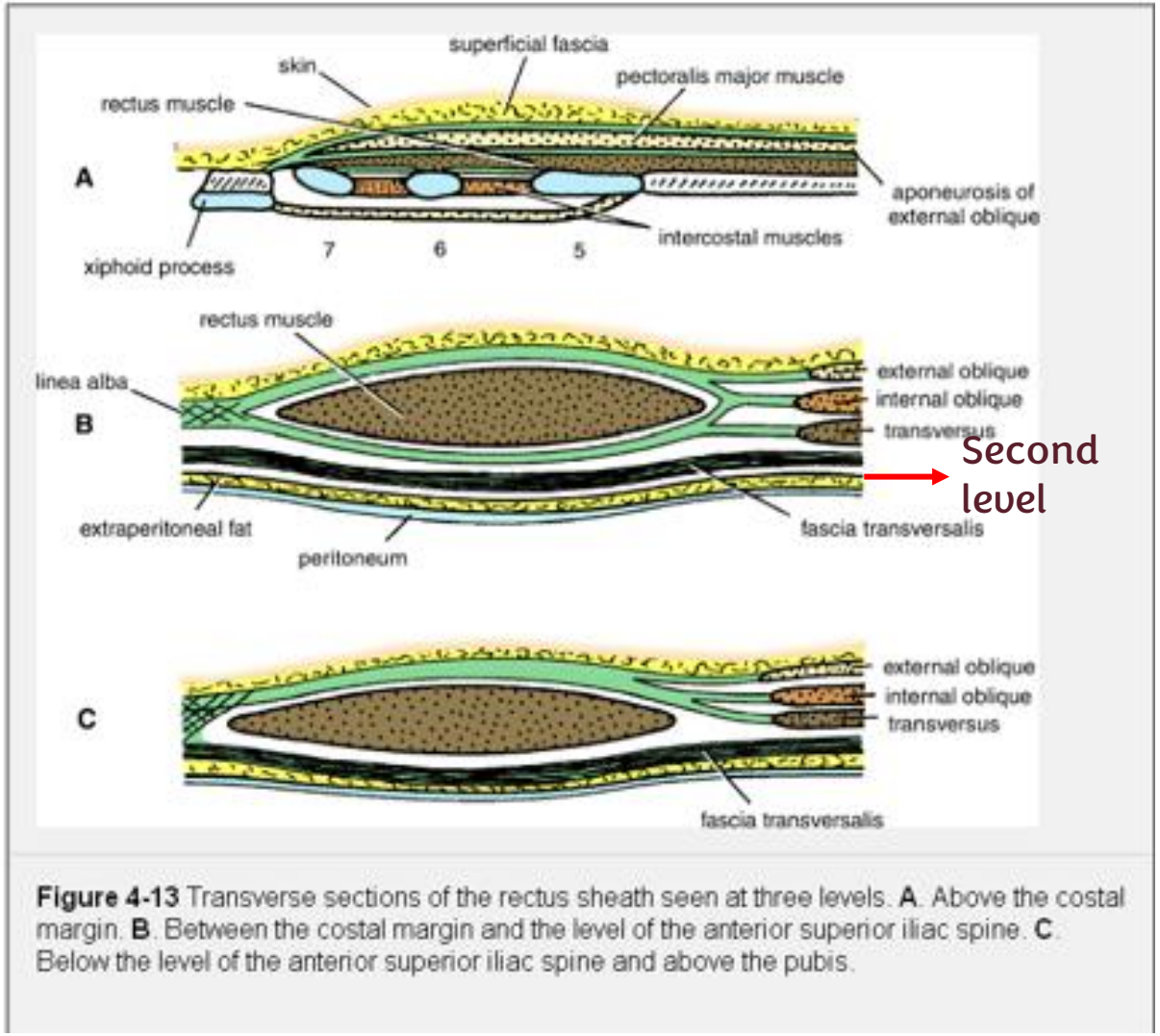


Figure 4-13 Transverse sections of the rectus sheath seen at three levels. **A**. Above the costal margin. **B**. Between the costal margin and the level of the anterior superior iliac spine. **C**. Below the level of the anterior superior iliac spine and above the pubis.

-**Anterior** : skin→ superficial fascia → aponeurosis of external oblique → ant. layer of internal oblique

-**Posterior** : post. layer of internal oblique → transversus abdominis → transversalis fascia → extraperitoneal fat → parietal peritoneum

Between the level of the anterosuperior iliac spine and the pubis (below ASIP)
Third level :

The anterior wall :skin → superficial fascia → the aponeurosis of all three muscles form.

The posterior wall is absent, and the rectus muscle lies in contact with the fascia transversalis. So:
transversalis fascia → extraperitoneal fat → parietal peritoneum

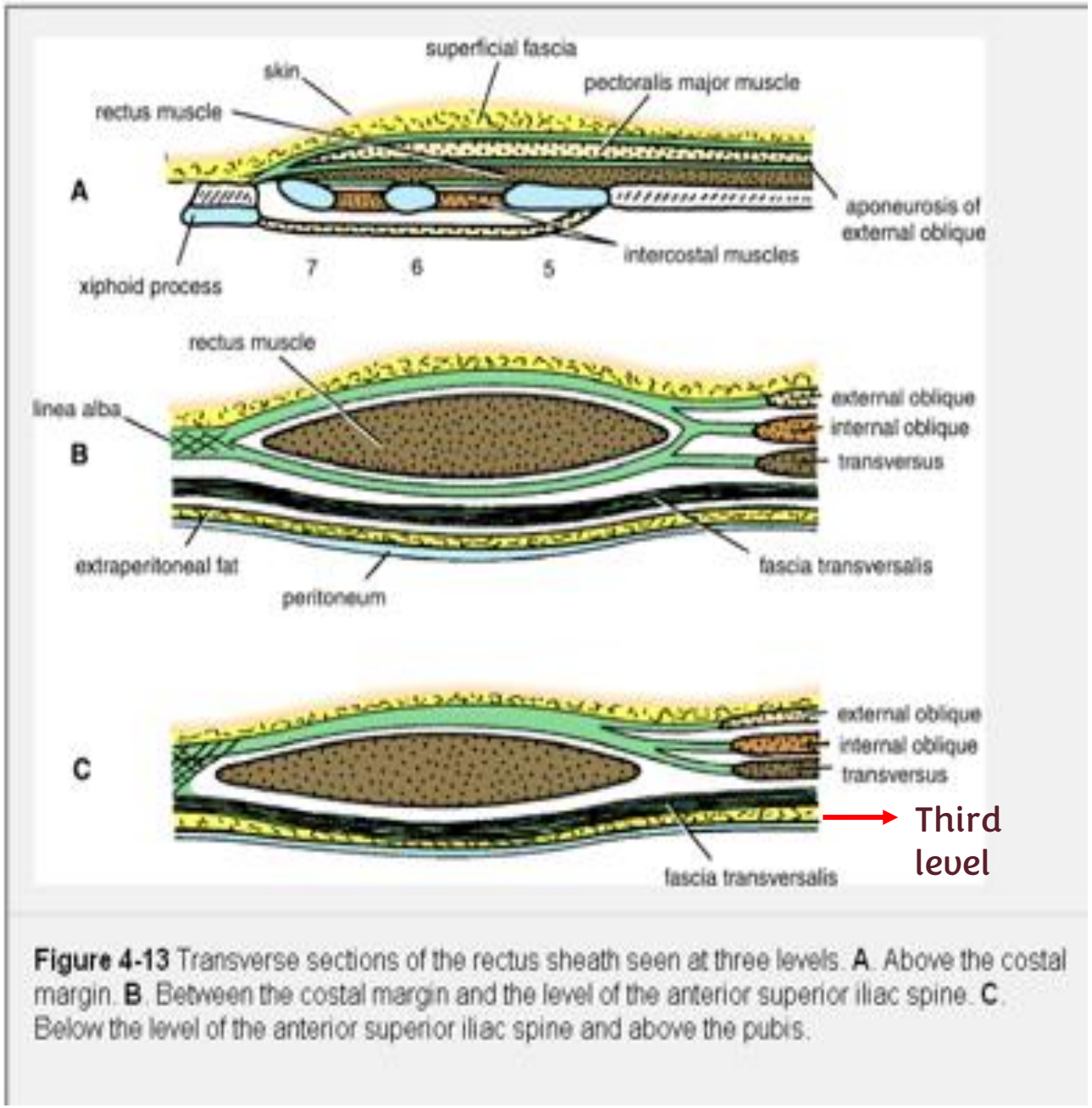


Figure 4-13 Transverse sections of the rectus sheath seen at three levels. **A**. Above the costal margin. **B**. Between the costal margin and the level of the anterior superior iliac spine. **C**. Below the level of the anterior superior iliac spine and above the pubis.

ASIP = anterior superior iliac spine

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.

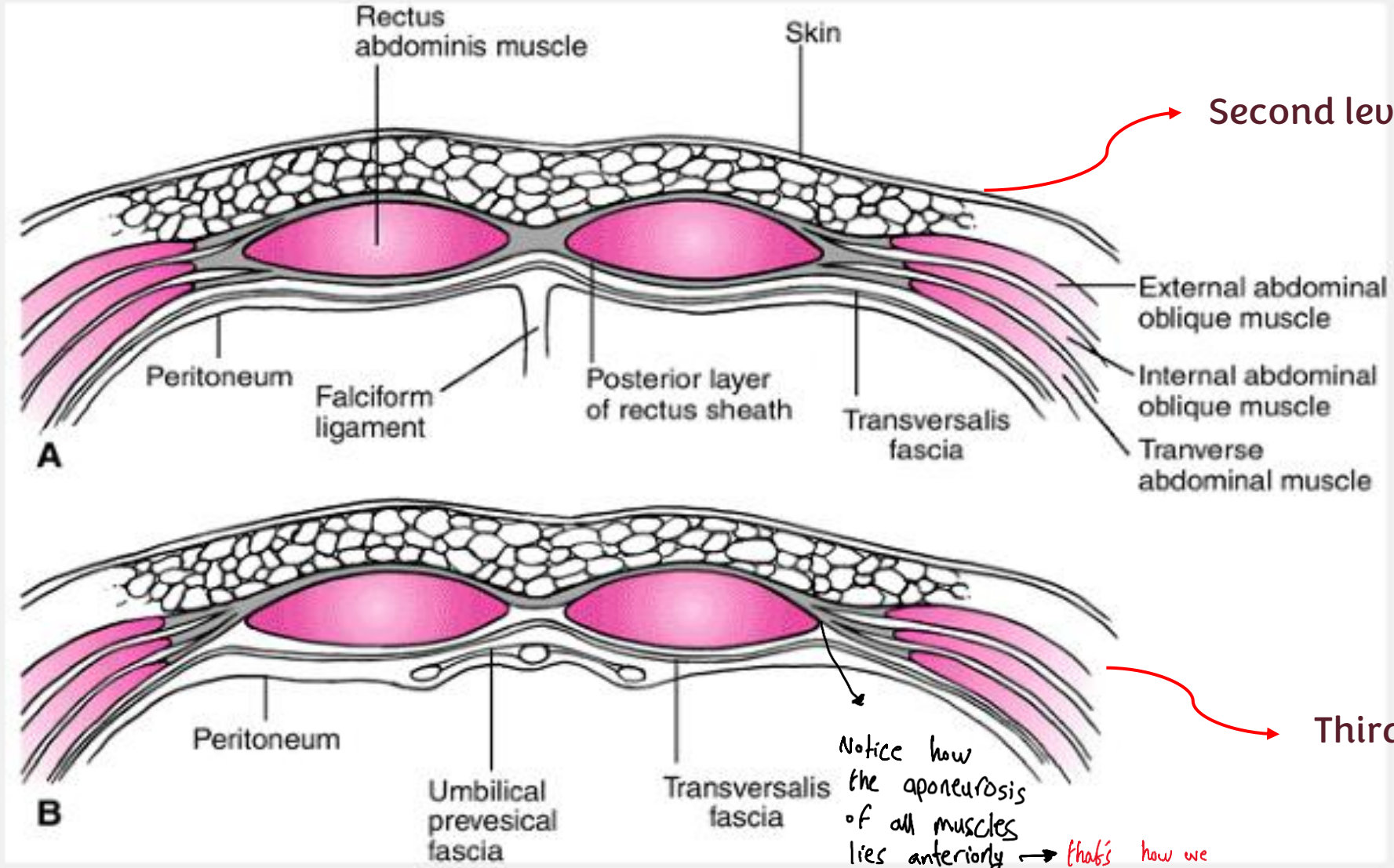


Figure 5-2 Arrangement of the rectus sheath above the umbilicus (upper) and below the arcuate line (lower).

Others fascia in the ant. abd.ominal wall

❖ Transversalis fascia

- a thin layer of fascia that lines the Transversus Abdominis muscle
- continue to diaphragm , iliac muscle & pelvis fascia
- contribute to femoral sheath
- Forms the posterior wall of the rectus sheath below the ASIS (as mentioned earlier)
- Forms deep ring of the inguinal canal

❖ 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.

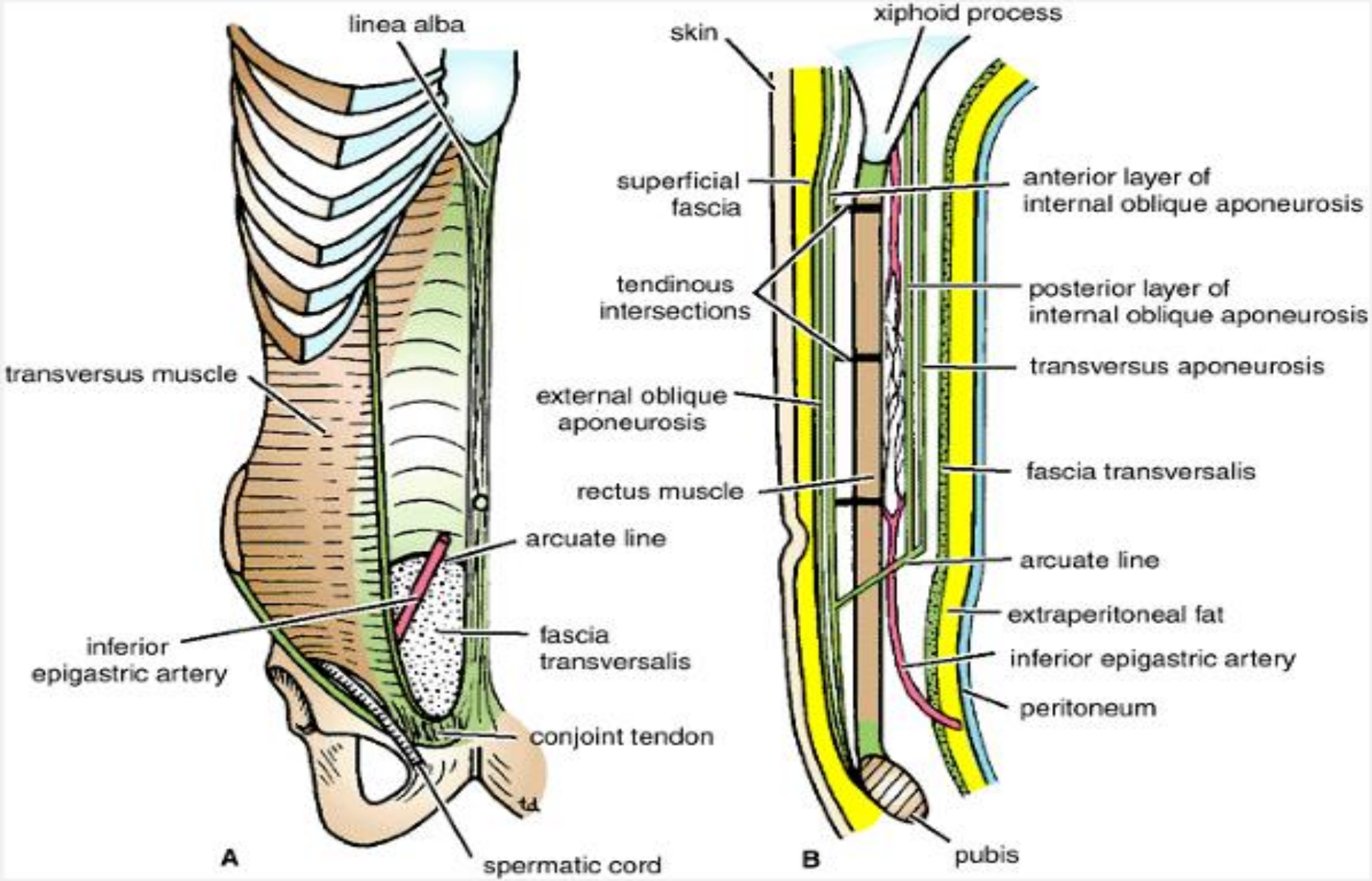


Figure 4-10 Rectus sheath in anterior view **(A)** and in sagittal section **(B)**. Note the arrangement of the aponeuroses forming the rectus sheath.

Action of the Ant. Abdominal muscle

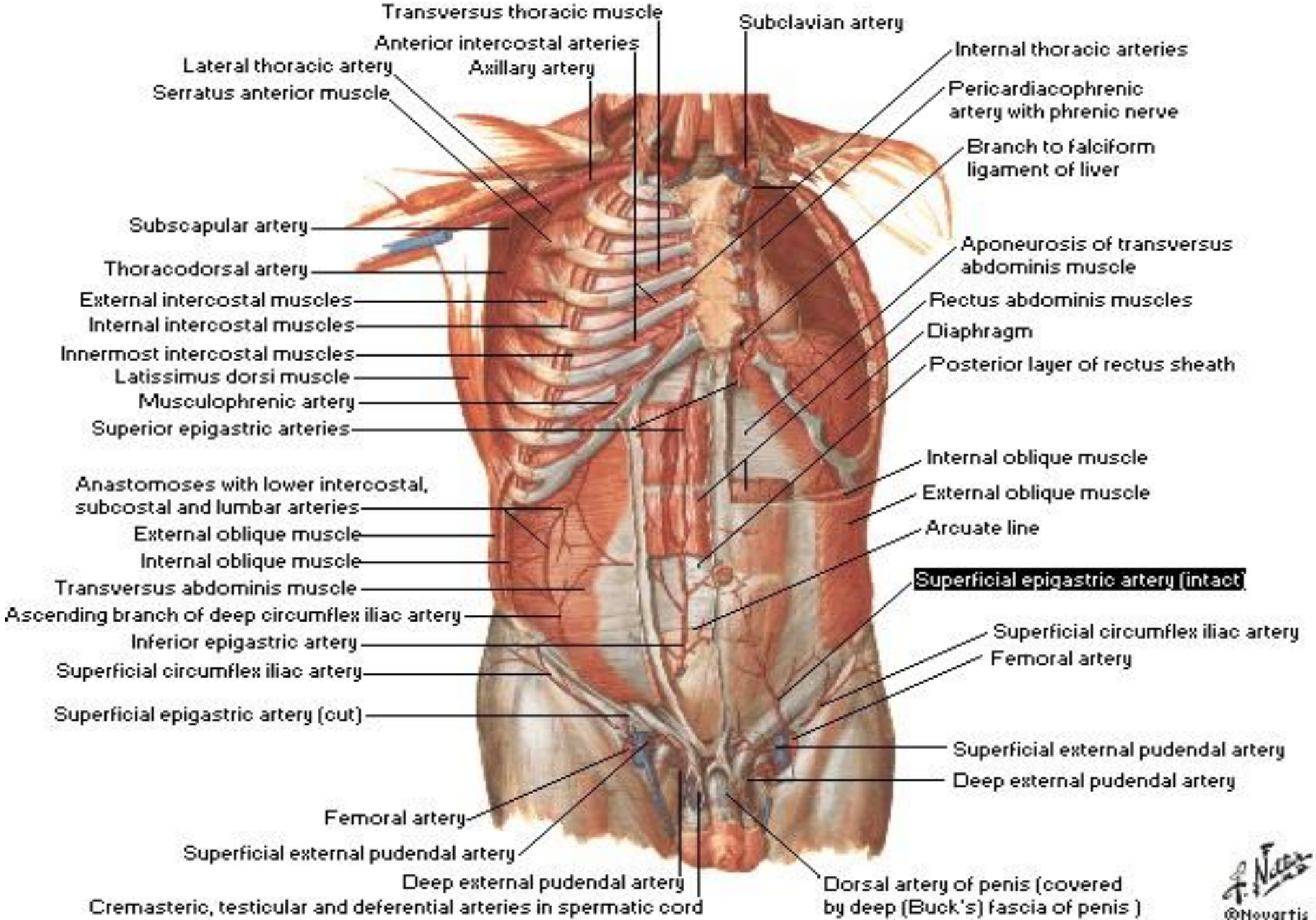
- Deep expiration
- Increase the intra abdominal pressure in
  - Vomiting
  - Cough
  - Defecation
  - Labour
- Protect viscera
- keep viscera in position
- Rectus abdominis → bends trunk forward

Blood supply of the ant. Abdominal wall

Arteries

- Sup. Epigastric artery → Inside the rectus sheath
- Inf. Epigastric artery
- Intercostal arteries (run along the nerves from the thorax)
- Lumbar arteries from abdominal aorta
- Deep circumflex artery

Arteries of Anterior Abdominal Wall



Blood supply……cont

Veins

1- Above the umbilicus

- Lat. Thoracic. vein.→ Axillary vein

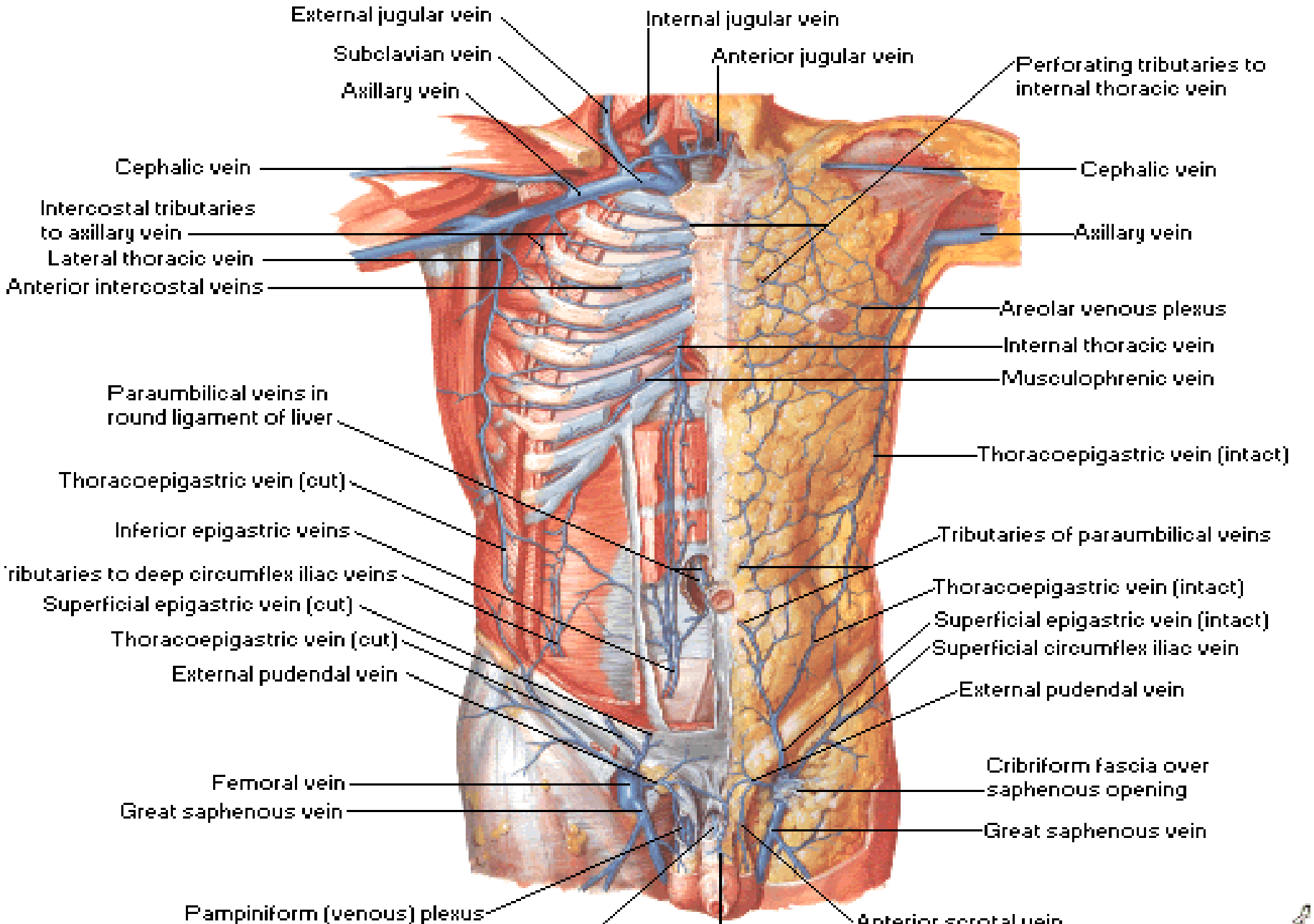
2- Below the umbilicus

- Inf. Epigastric → Femoral vein

3- Paraumbilica veins

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

Veins of Anterior Abdominal Wall



Nerve supply of the ant. Abdominal wall

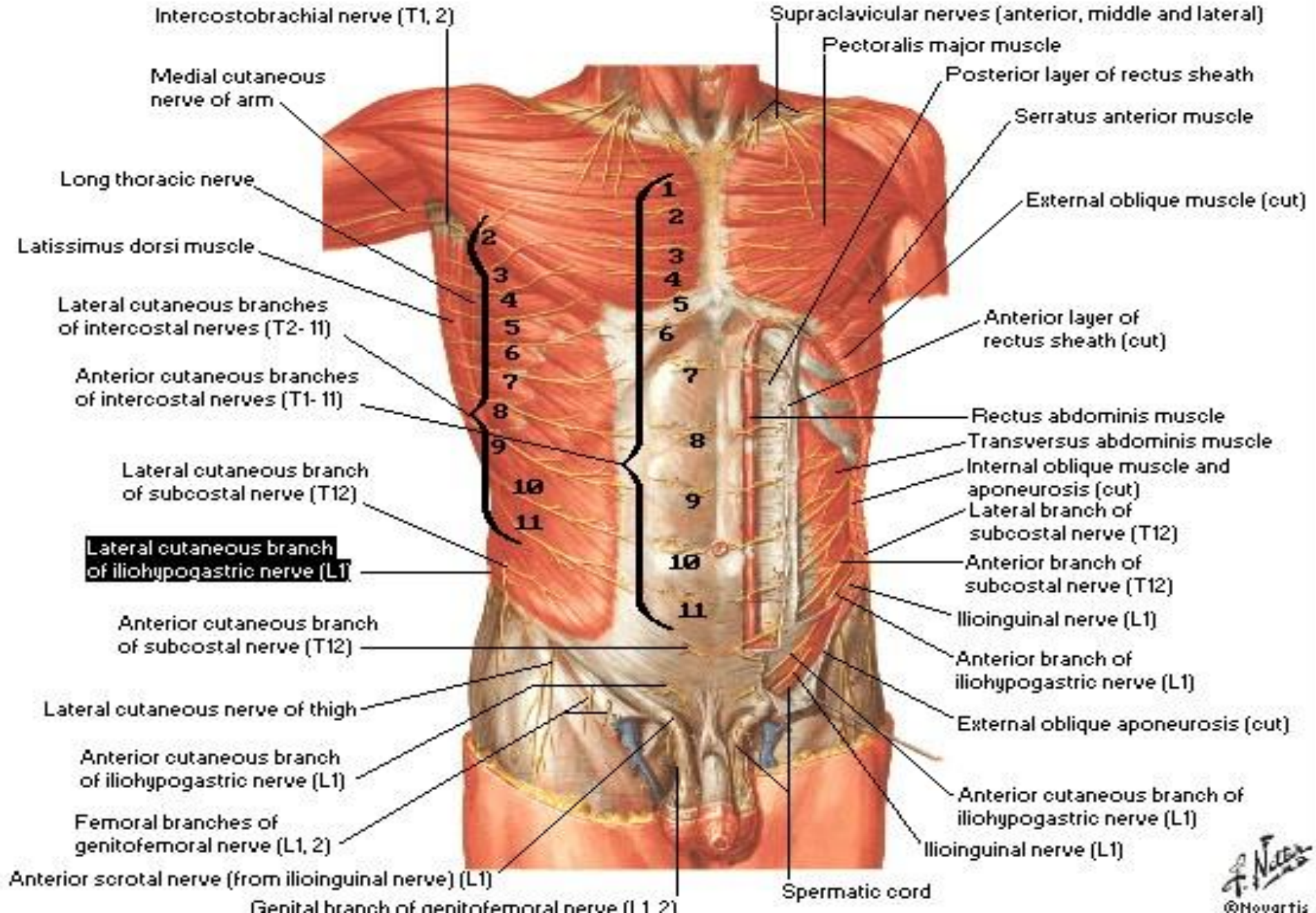
- **Thoracoabdominal nerve**: Lower 6th thoracic nerves & 12th subcostal nerve

- **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

- **LI nerve → for lower abdomen and scrotum**

- 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(subscapular L.N)
- Below the iliac crest→ Sup.inguinal L.N

L.N = lymph node

Clinical notes

Abdominal stab wounds

Surgical incision

The doctor briefly skimmed through the upcoming slides due to time constraints

Abdominal stab wounds

- Structures in the various layers through which an abdominal stab wound depend on the anatomical location :

- Lateral to rectus sheath
- Ant. To rectus sheath
- In the midline= Linea alba

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 aponeurosis 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

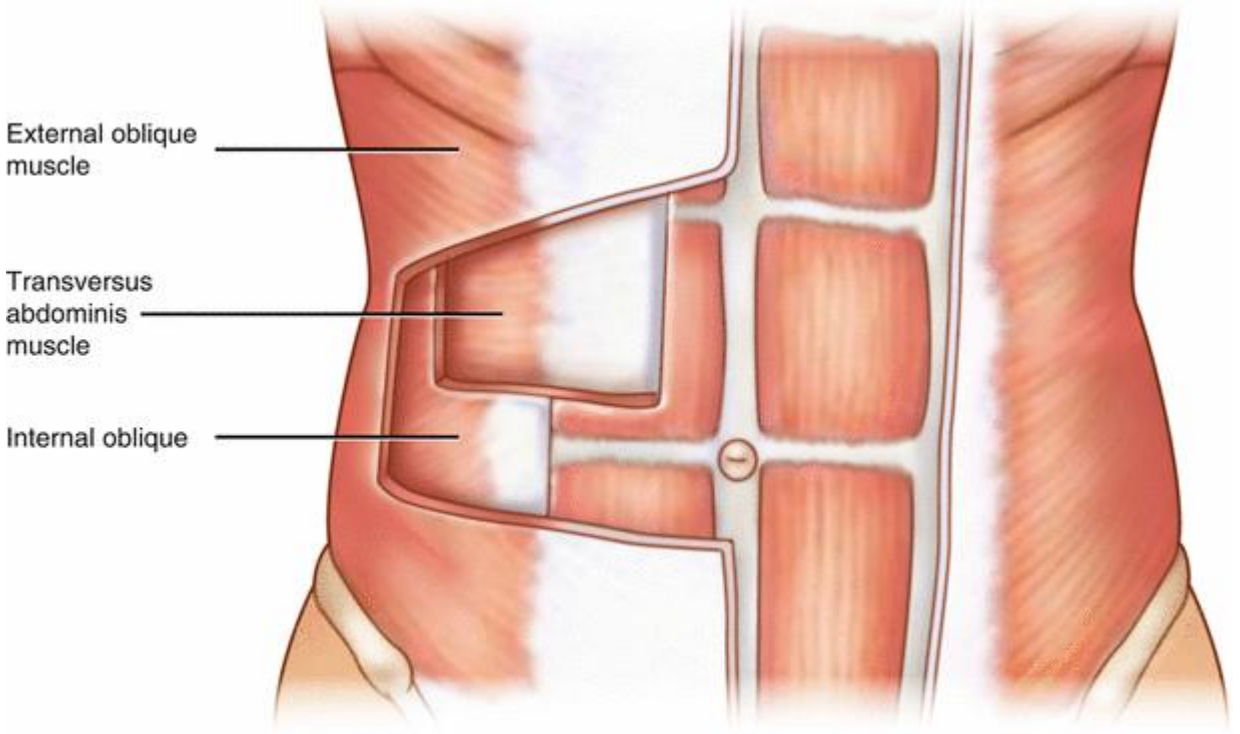
Incision through the rectus sheath

- 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

- Paramedian incision
- Pararectus incsion
- Midline incision
- Transrectus incision
- Transverse incision
- Muscle splitting
- Abdominothoracic incision

Quiz on this lecture



For any feedback, scan the code or click on it.

Corrections from previous versions:

Versions	Slide # and Place of Error	Before Correction	After Correction
V0 → V1	20	Incorrect order of numbers regarding the added info	Rearranged to match them correctly
V1 → V2			

رسالة من الفريق العلمي:

لما الكلية نزلت علامات الهستو في السنة الأولى في منتصف الليل.

- طبعا احدهم كان صاحي بس عاش الدور.