ANATOMY OF ANTERIOR ABDOMINAL WALL

James Mwangi

Introduction

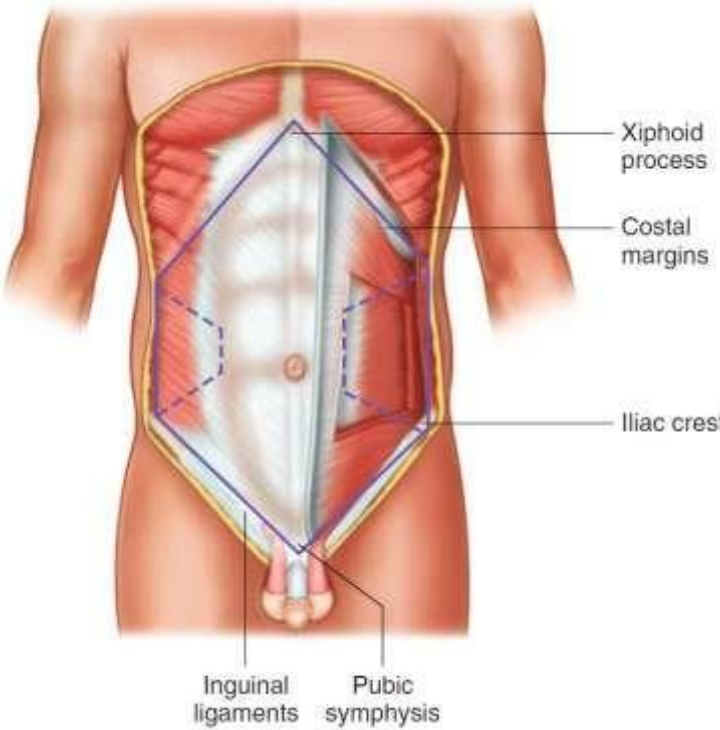
- **Anterior abdominal wall** is a musculo-aponeurotic structure confined to the anterior and lateral aspects of the abdomen.

- The anatomy of anterior abdominal wall is clinically important because:
  i. ***Physical examination***
  ii. ***Access to the abdomen and its contents*** *(the incisions)*
  iii. ***Abdominal hernias****.*

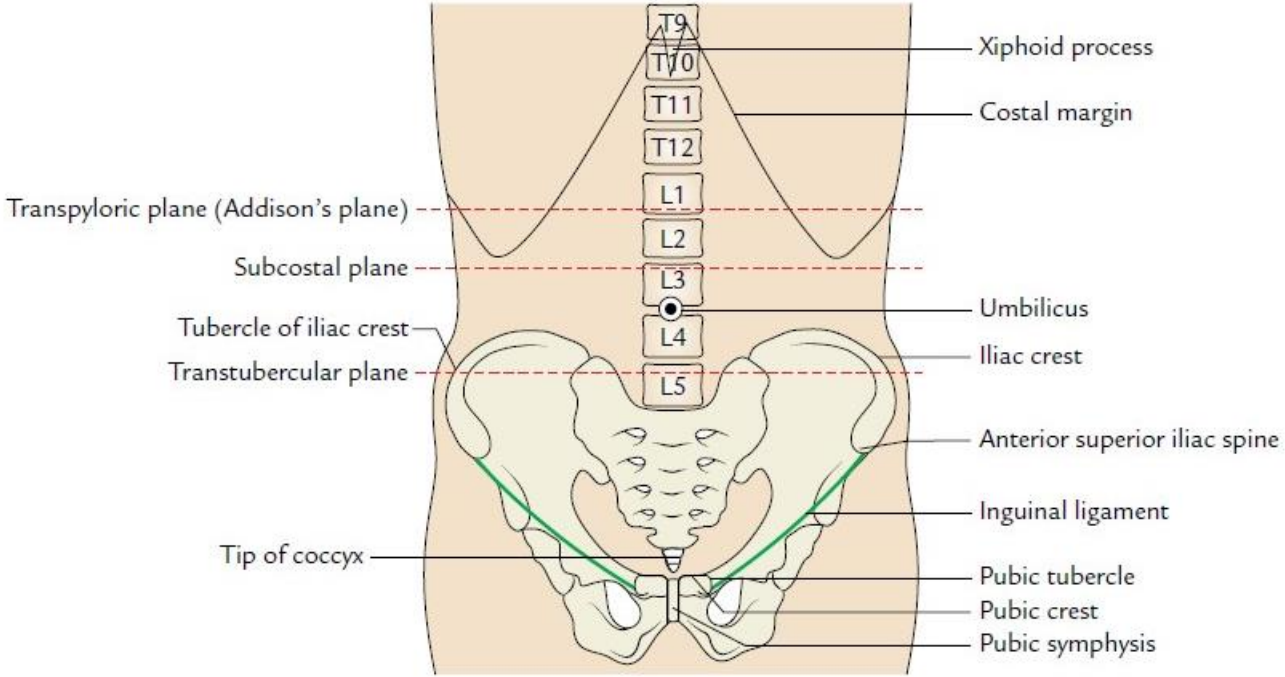
INTRODUCTION-The Extent

The anterior abdominal wall constitutes a hexagonal area

- **Superiorly** – by the costal margins and xiphoid process,
- **Laterally** – by the midaxillary line, and
- **Inferiorly** – by the iliac crests, pubis and pubic symphysis.

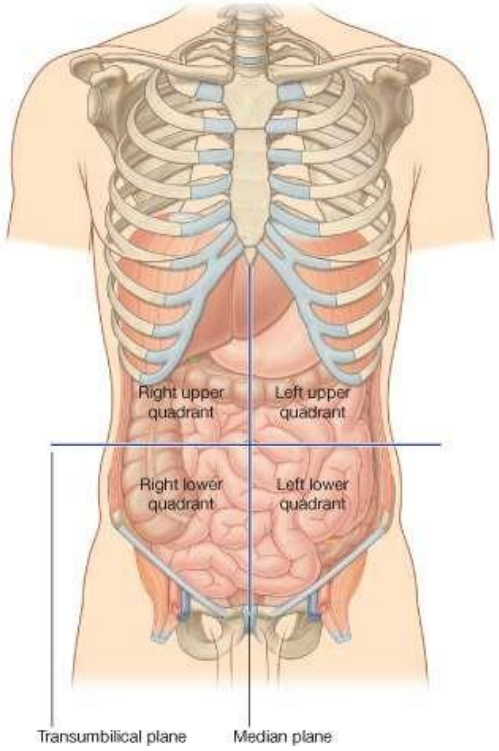


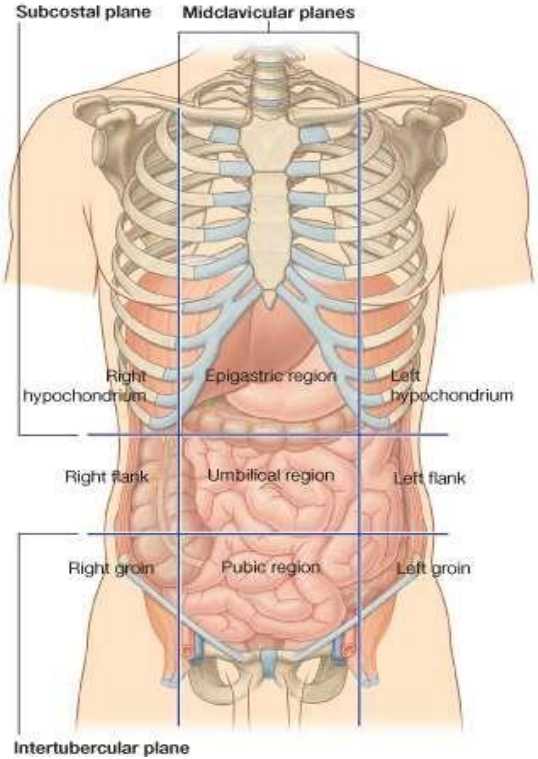
Bony landmarks and plane of abdomen



Bony landmarks and planes of the abdomen.

SURFACE TOPOGRAPHY





- Four-quadrantpattern
- Nine-region organizational description

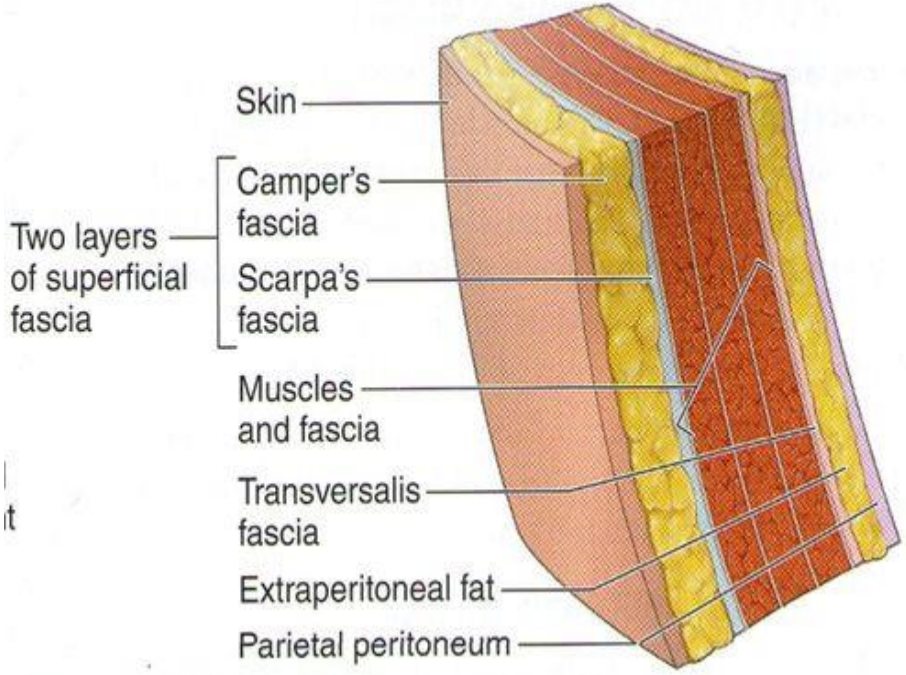
LAYERS OF THE ABDOMINAL WALL

The wall is firm and elastic and is consists of 6 layers.
From superficial to deep, these are:

1. Skin.
2. Superficial fascia.
3. Muscular layer
   - i. External oblique
   - ii. Internal oblique.
   - iii. Transversus abdominis

   → anterolateral
   - iv. Rectus abdominis.
   - v. pyramidalis

   → Anteromedial
4. Fascia transversalis.
5. Extraperitoneal tissue.
6. Parietal layer of peritoneum

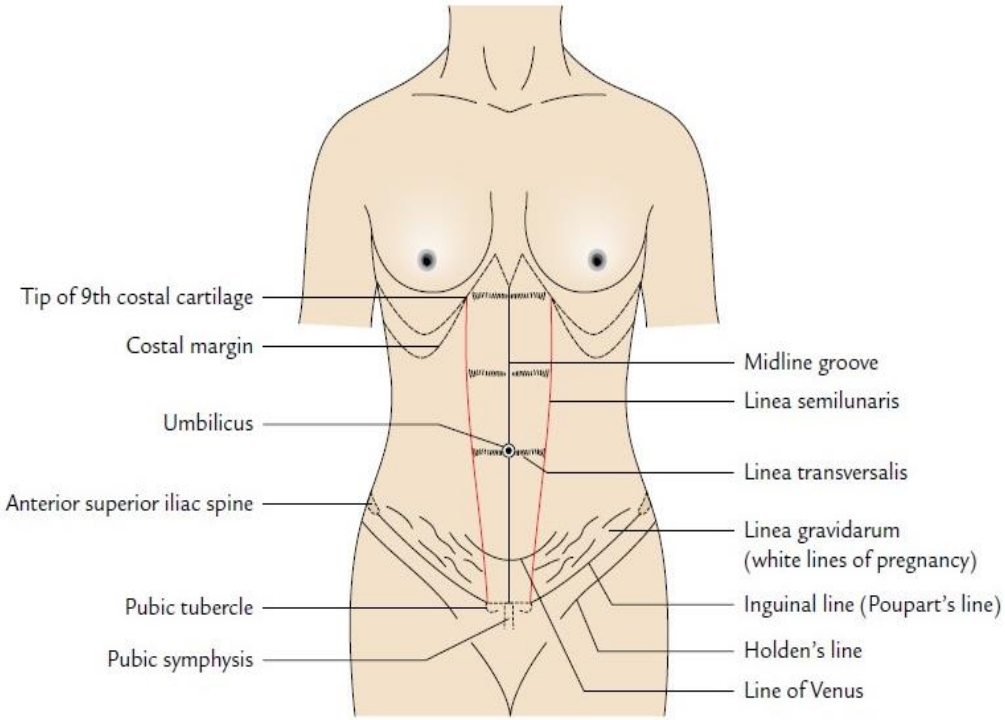


1. The Skin

- The skin is thinner and more sensitive than the skin of the posterior abdominal wall.

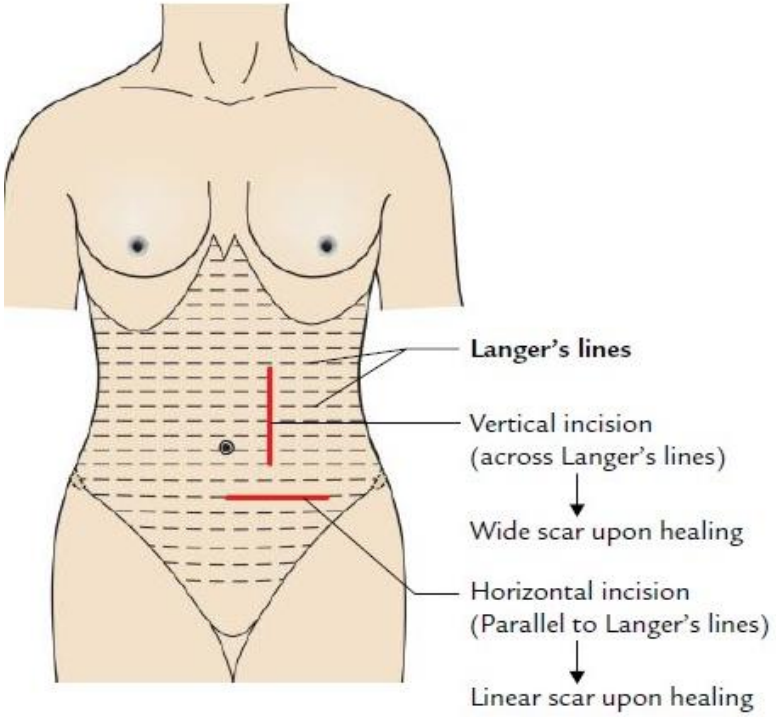
Visible Skin Creases/Lines on the Anterior Abdominal Wall

1. *Midline furrows/groove*
2. *Linea semilunaris*
3. *Transverse furrows*: *linea transversalis*
4. *Line of Venus*:
5. *Linea gravidarum*



1.The Skin..ctd

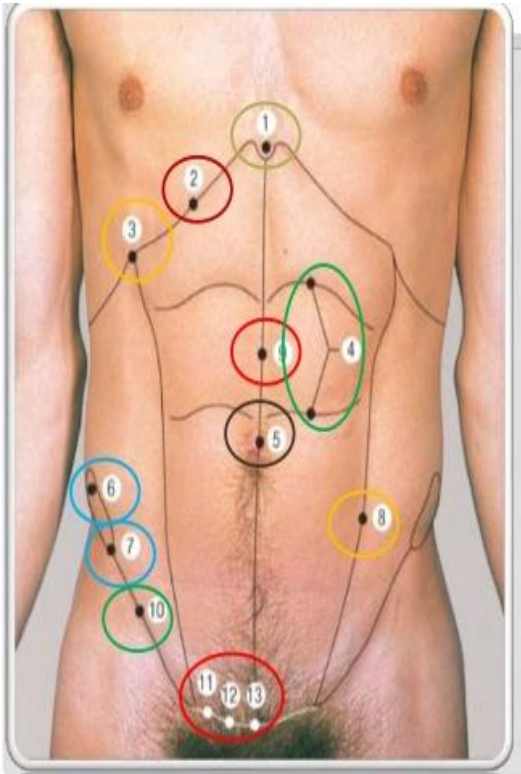
Cleavage line Anterior abdominal Wall



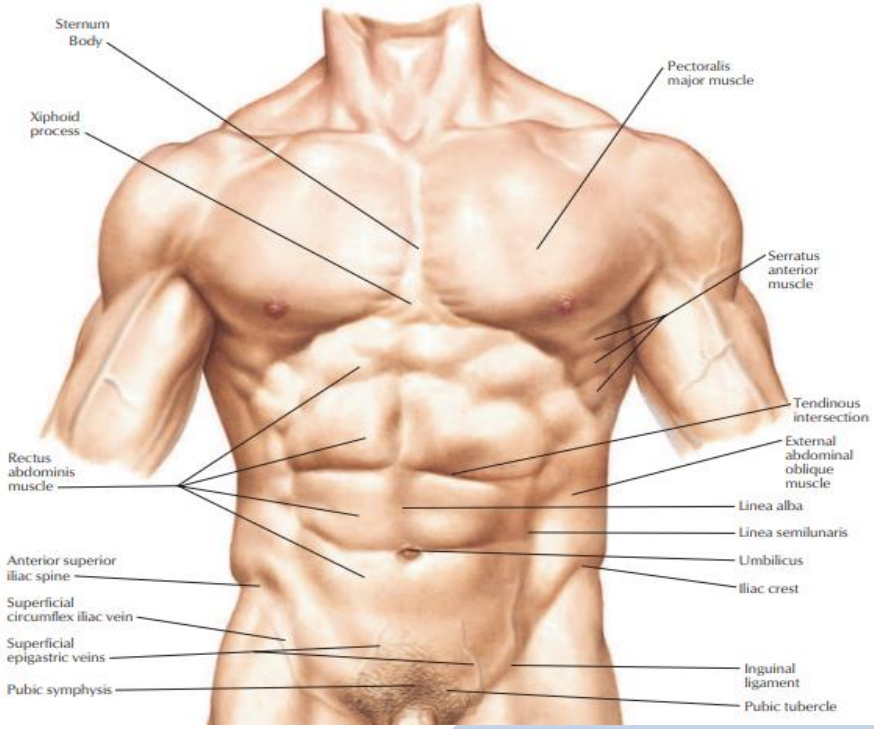
- Natural lines of cleavage in the skin are constant and run almost **horizontally around** the trunk
- An **incision along a cleavage line will heal as a narrow scar**, while **one that crosses the lines will heal as a wide scar**

1.The Skin..ctd

Soft tissue landmarks on the front of abdomen

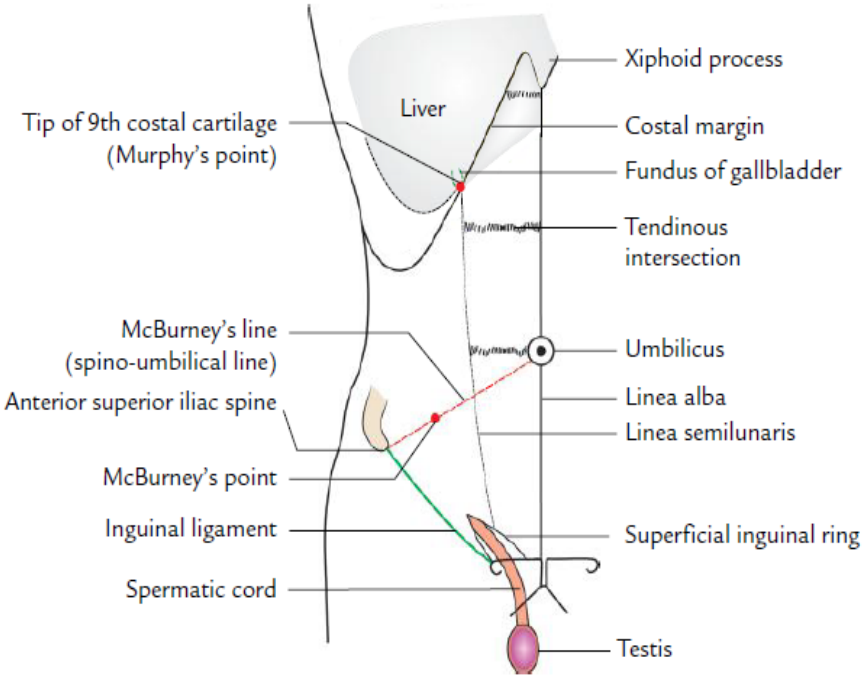


1. Xiphoid process.
2. Costal margin.
3. Tip of the ninth costal cartilage.
4. Tendinous intersections.
5. Umbilicus.
6. Iliac crest.
7. Anterior superior iliac spine.
8. Linea semilunaris.
9. Linea alba.
10. Inguinal ligament.
11. Pubic tubercule.
12. Pubic crest.



1.The Skin..ctd

Soft tissue landmarks of the abdomen

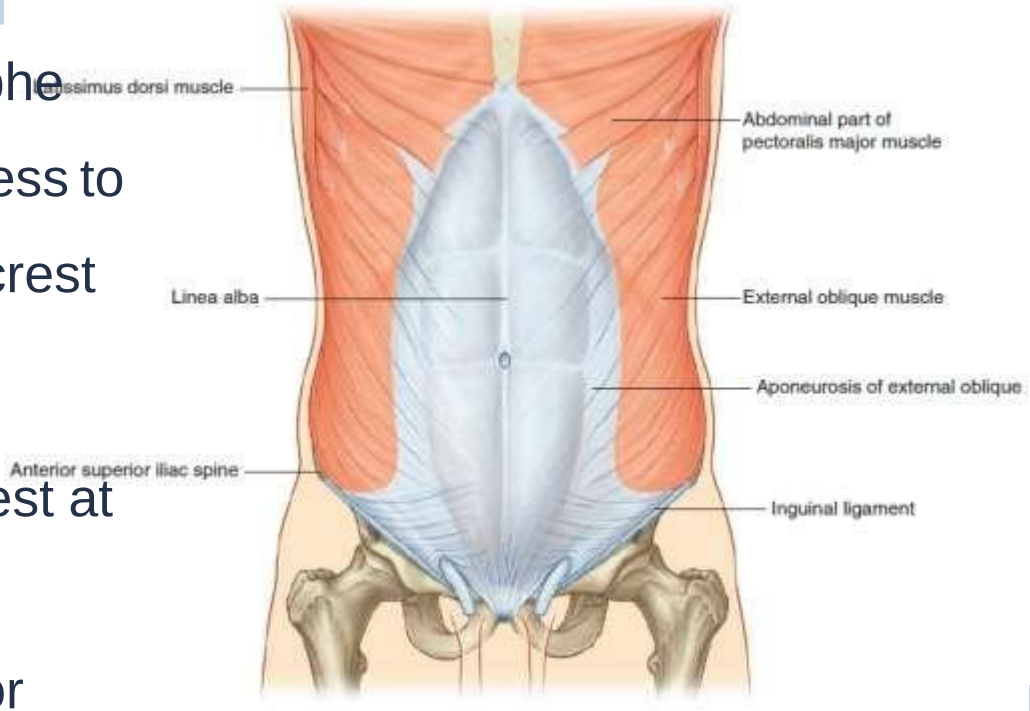


Soft tissue landmarks of the abdomen and their relationship with gallbladder, appendix, and spermatic cord.

1.The Skin..ctd

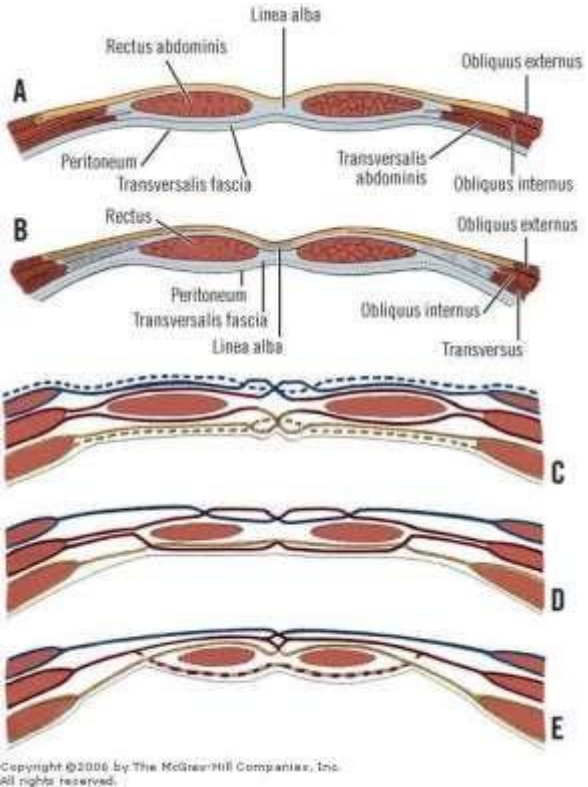
Linea Alba (*the white line)*

- The linea alba is a tendinous raphe extending from the xiphoid process to the pubic symphysis and pubic crest
- lies between the two recti
- 15–22 mm along its course, widest at or just above the umbilicus and narrowing at superior and inferior extremes



1.The Skin..ctd

Linea Alba (*the white line*)



- completely avascular – preferred location for incision and intra-abdominal access
- lack of muscular coverage leads to weakness and the formation of the majority of de novo ventral hernias
- Ultimately, the goal of abdominal wall reconstruction remains to restore linea alba by bringing the paired rectus muscles back to the midline

1.The Skin..ctd

Umbilicus

The position of umbilicus is variable:

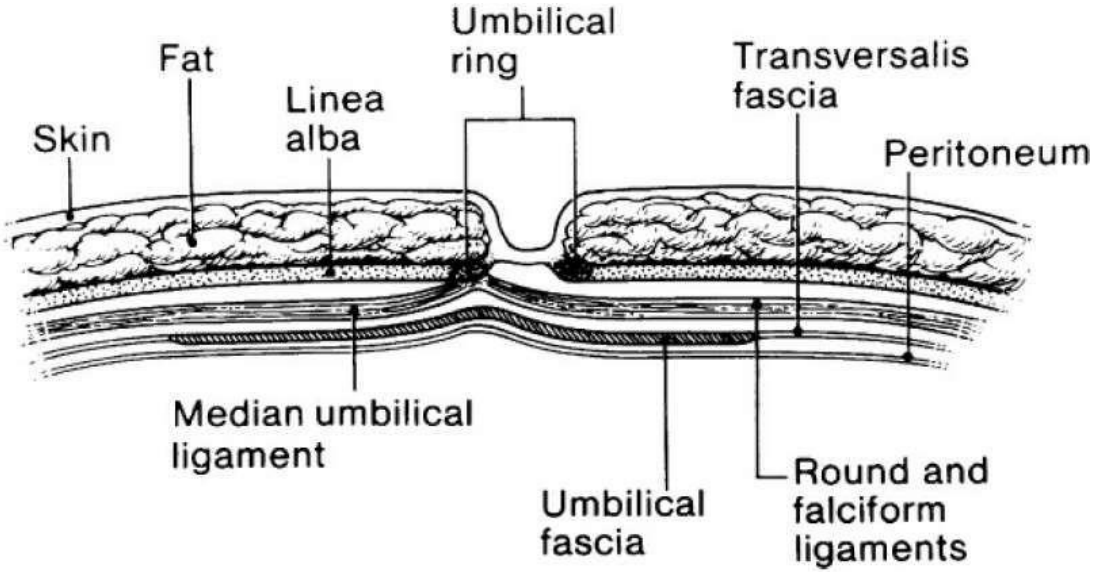
1. *In adult,* it lies at the level of intervertebral disc between L3 & L4 vertebrae.
2. *In newborn,* it is slightly at a lower level due to poorly developed pelvic region.
3. *In old age,* it comes down to lower level due to diminished tone of the abdominal muscles.

Anatomical Significance

1. Serves as water-shed line for venous and lymphatic drainage.
2. Indicates the level of T10 dermatome
3. One of the important sites of portocaval anastomosis.

1.The Skin..ctd

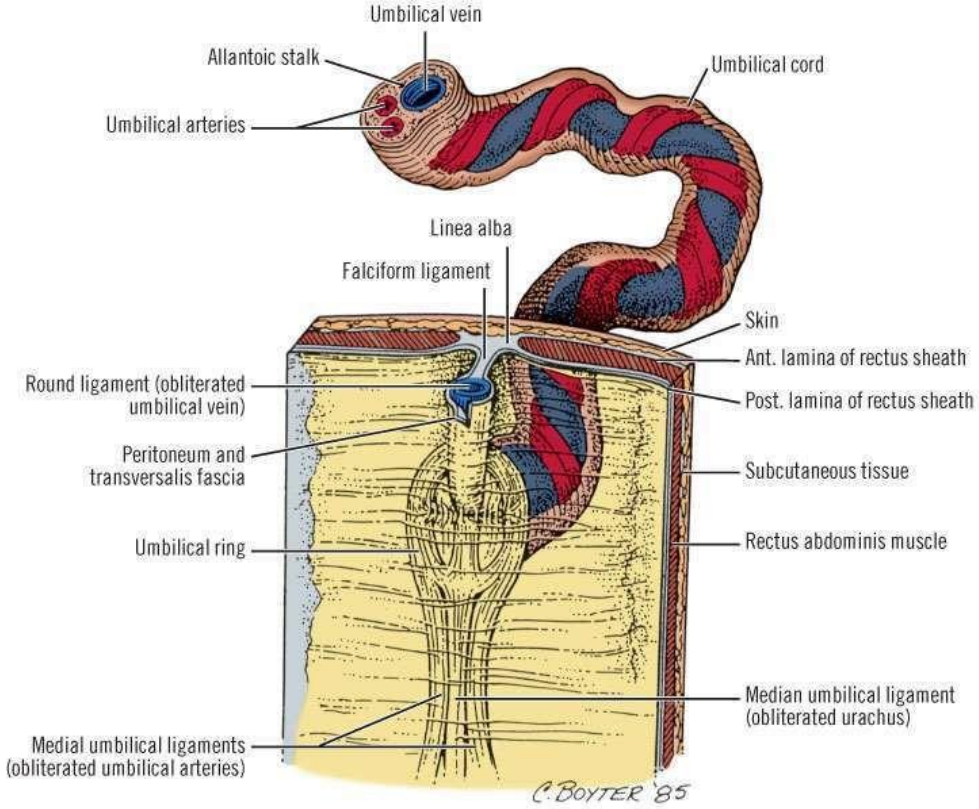
Umbilical Region

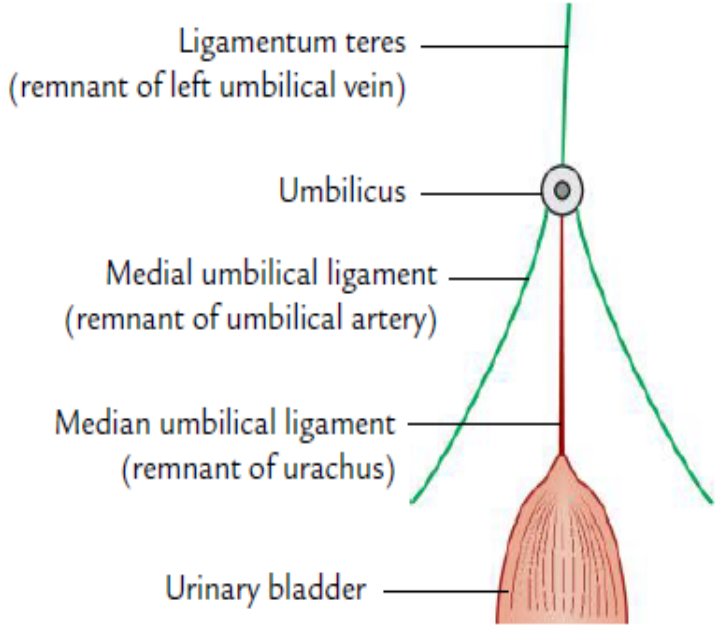


- It consists of skin, a fibrous layer (representing the area of fusion between the round ligament of the liver, the median umbilical ligament, and two medial umbilical ligaments), the transversalis fascia, the umbilical fascia surrounding the urachal remnant, and peritoneum

1.The Skin..ctd

Umbilical Region





1.The Skin..ctd

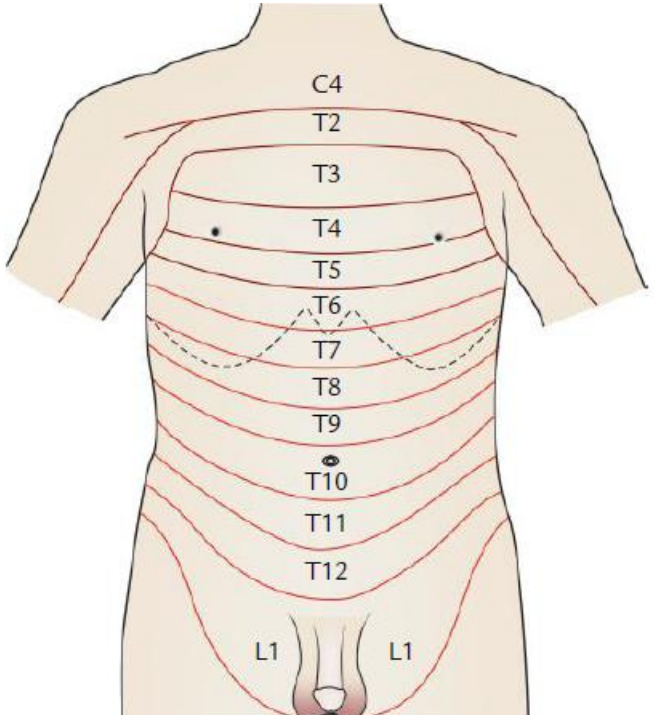
Clinical correlation congenital anomalies umbilicus

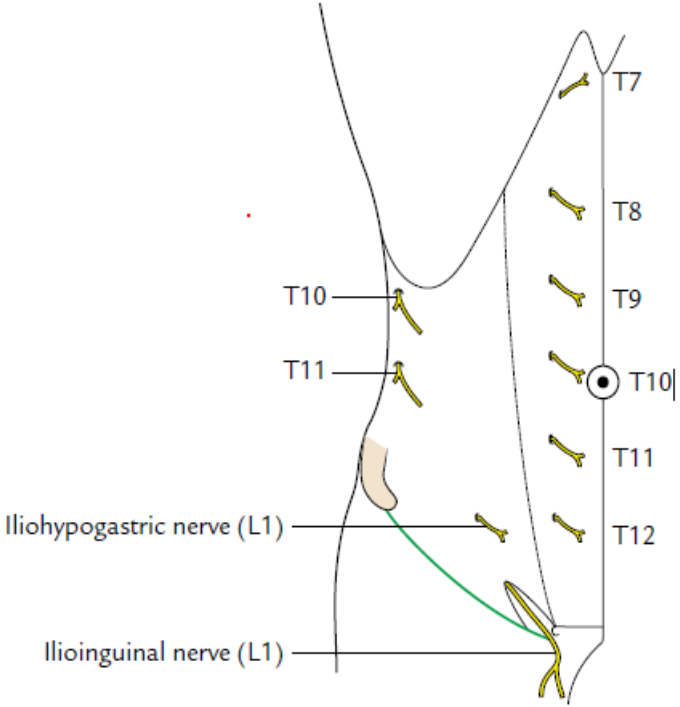
a) **Faecal fistula:** Failure of vitello-intestinal duct to obliterate
b) **Urinary fistula:** Failure of urachus to obliterate
c) **Exomphalos (or omphalocele):** Failure of midgut loop to return in the abdominal cavity
d) **Congenital umbilical hernia**

*NB: The umbilicus is therefore considered as **hot-bed of embryology** by the clinicians.*

1.The Skin..ctd

Dermatomes & cutaneous nerves on the anterior abdominal wall





Innervation of the anterior ab.wall

Nerves of the anterior abdominal wall Can be divided into two groups lateral and anterior groups

The lateral group includes:

1. The lower three intercostal nerves,
2. The subcostal nerve,
3. The iliohypogastric nerve (L1)
4. Ilioinguinal nerve (L1).

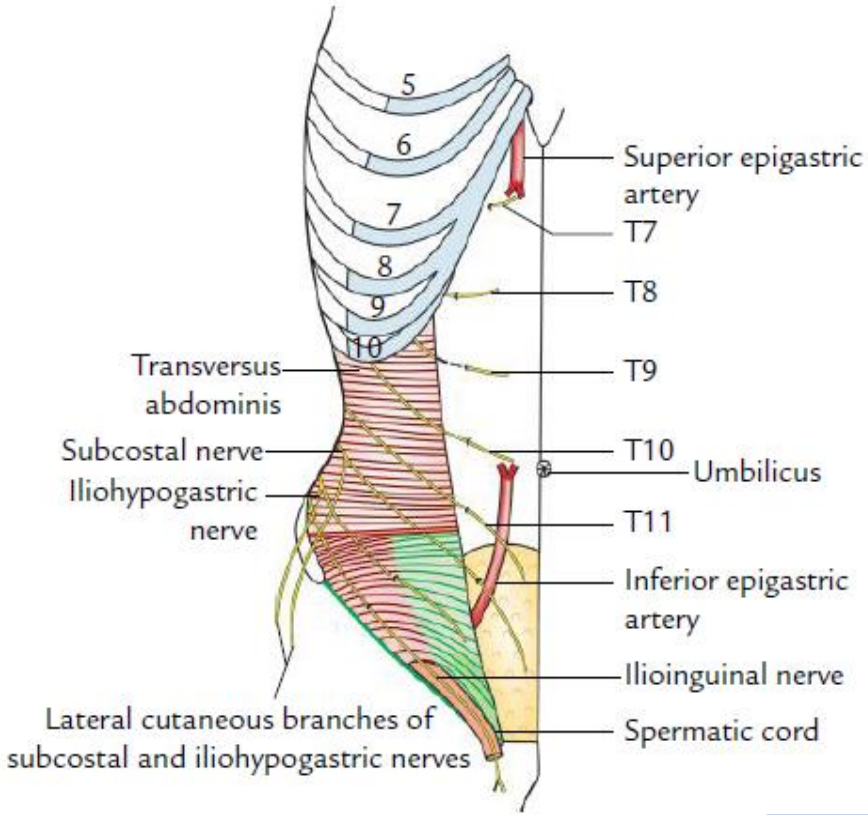
The anterior group includes:

1. The lower five intercostals nerves
2. The subcostal nerve only.

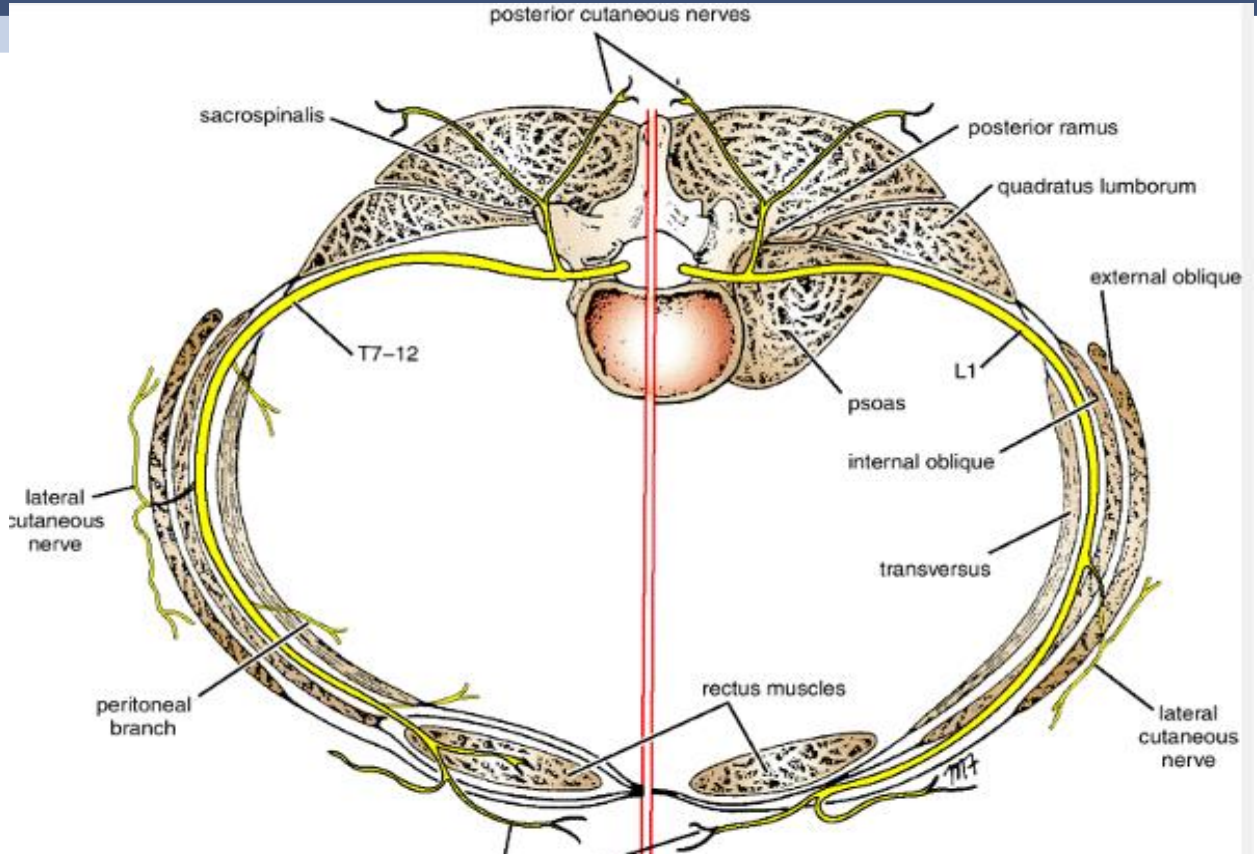
The 10^{th} nerve supplies the area around the umbilicus while the suprapubic area is supplied by the 12^{th} (subcostal) nerve

NERVES SUMMARY

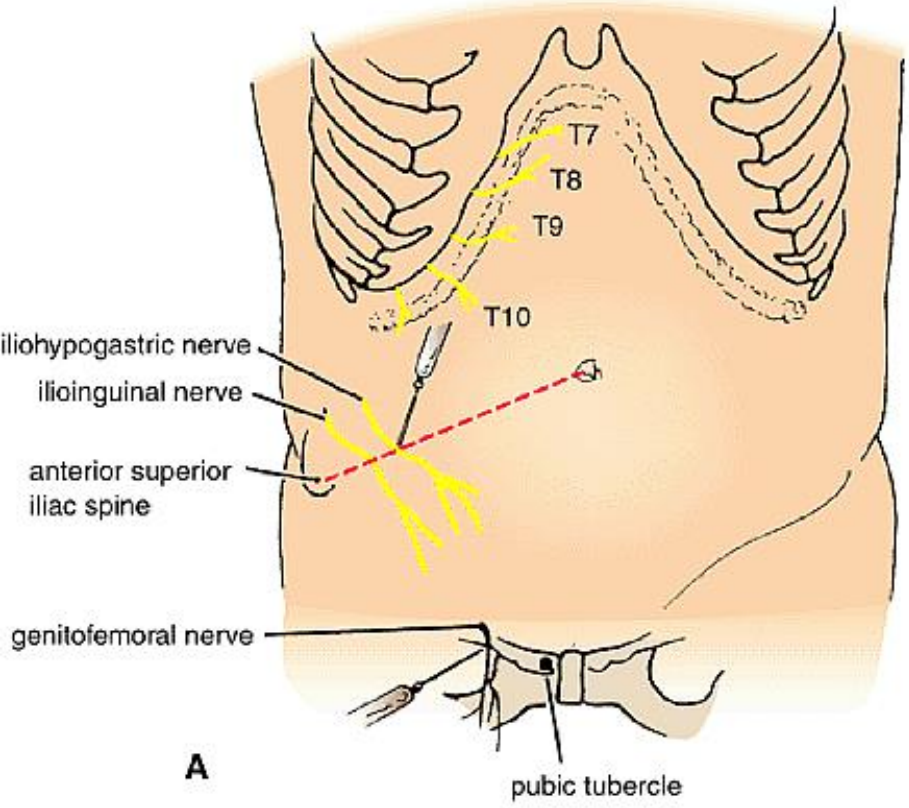
i. Lower 5 intercostals.
ii. Sub costal
iii. Iliohypogastric (LI)
iv. Ilioinguinal.(L1)



Schematic arrangement of a typical abdominal nerve



Nerve blocs in lower abdomen



Blood supply and lymphatics .

BLOOD VESSELS;

- Superior epigastric arteries
- Inferior epigastric artery- from external illiac artery
- Lower 5 intercostals artereis.
- Sub costal artery.
- Superficial branches of femoral artery(superficial inferior epigastric artery, external superficial pundedal, superficial circumflex illiac vessels).
- Branches from deep arteries:- deep circumflex illac vessels, deep external pundedal

.

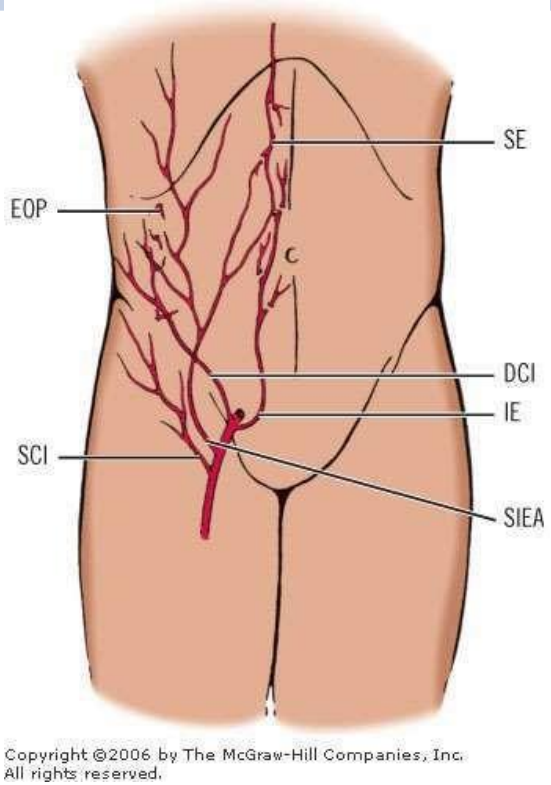
VEINS

The veins accompany the arteries and terminate superiorly into the azygos vein which ends in the superior vena cava, and inferiorly into the great saphenous vein and to the femoral vein ending finally into the inferior vena cava. So, they connect the superior with inferior vena cava.

LYMPHATIC DRAINAGE.

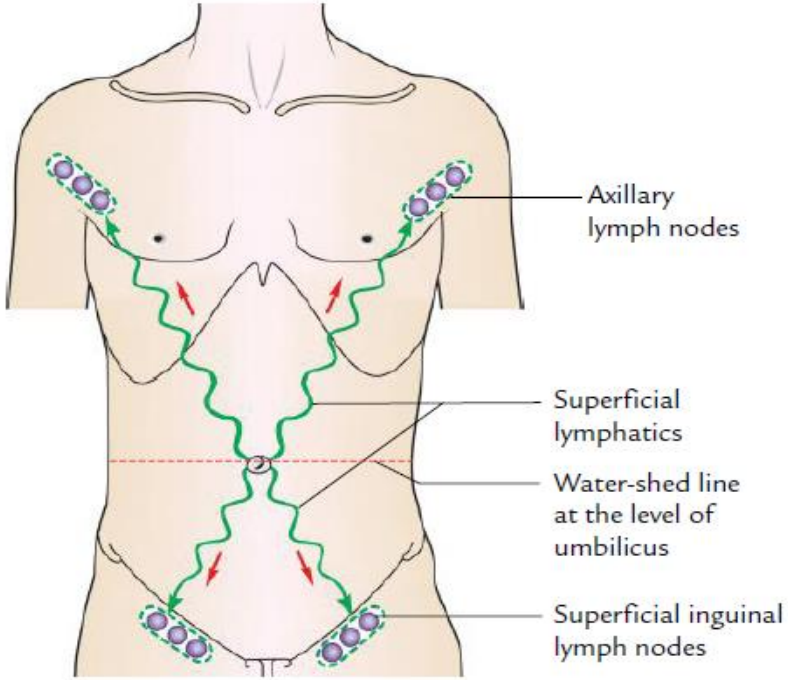
Above umbilicus-into axillary lymph nodes.
Below umbilicus-inguinal lymph nodes.
Around umbilicus-to LN of porta hepatis of liver along the ligamentum teres.

Blood supply



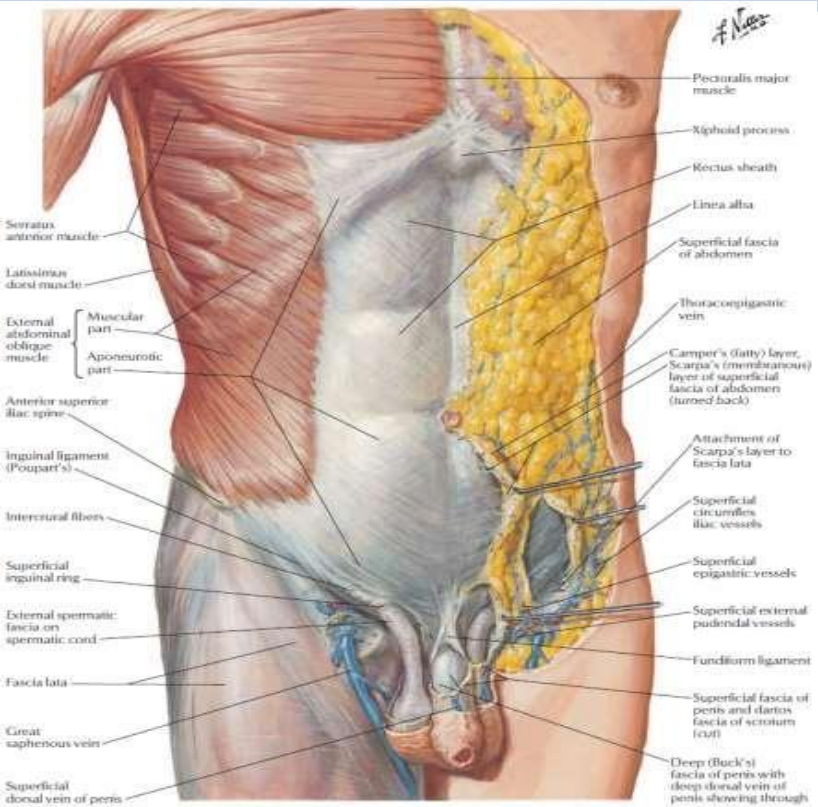
- **EOP**- Ext Oblique Perforators
- **SCI**- Superficial Circumflex Iliac
- **SE**- Superior Epigastric
- **DCI**- Deep Circumflex Iliac
- **IE**- Deep , inferior Epigastric Artery
- **SIEA**- Superficial inferior Epigastric artery

Cutaneous (Superficial) Lymph Vessels



- Superficial lymphatics above the umbilicus pass in a superior direction to the **axillary nodes**,
- below the umbilicus passes in an inferior direction to the **superficial inguinal nodes.**

2.Superficial fascia



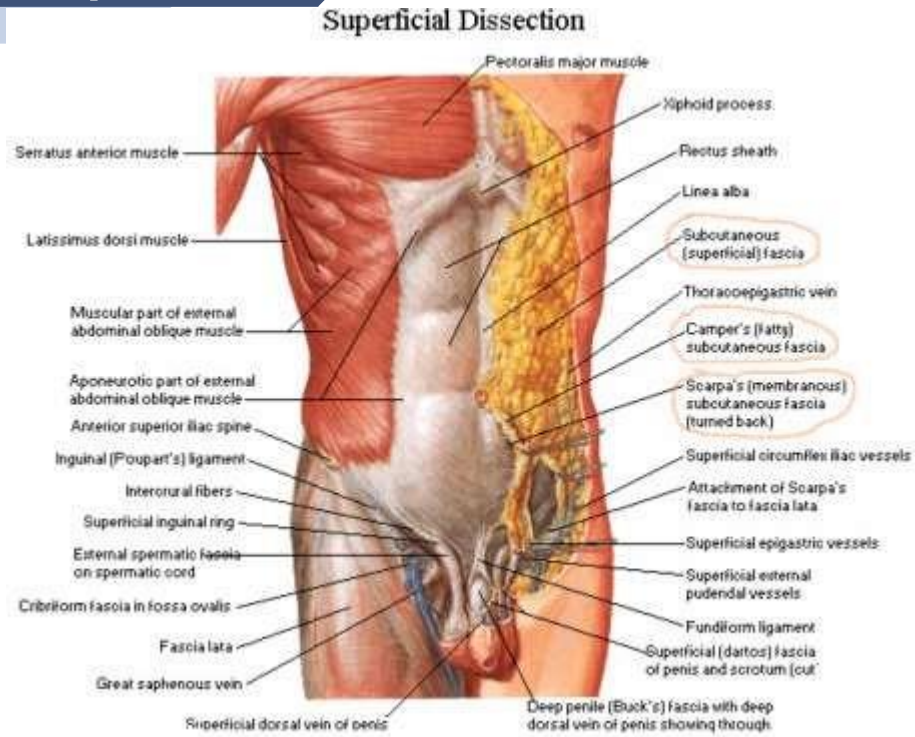
- Superficial fascia is between dermis and the muscles
- Has 2 layer

1. The superficial fatty layer (Camper's fascia)
2. The deep membranous layer (Scarpa's fascia).

2.Superficial fascia..ctd

SUPERFICIAL LAYER (Camper's fascia)

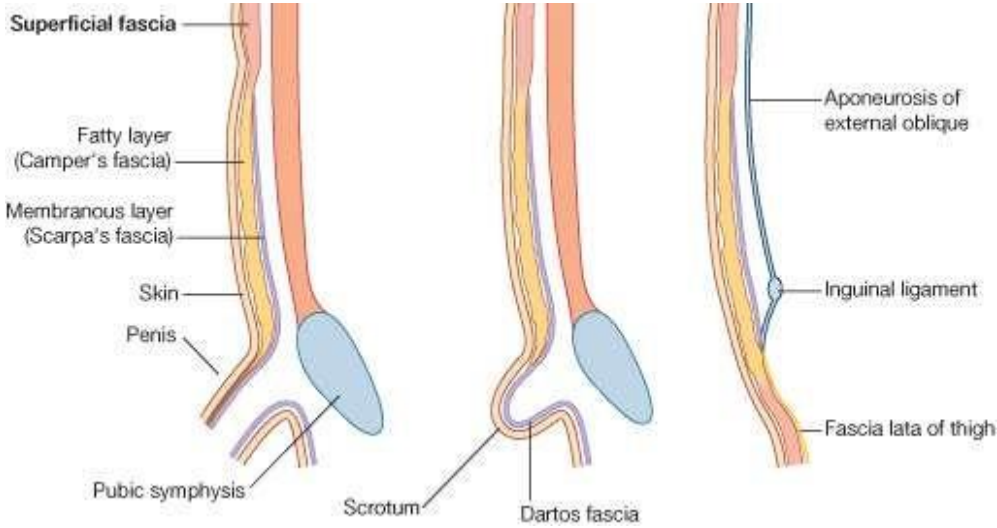
- It's continuous with superficial fat over the rest of the body.
- In the scrotum is modified as a thin smooth muscular layer called **dartos** muscle



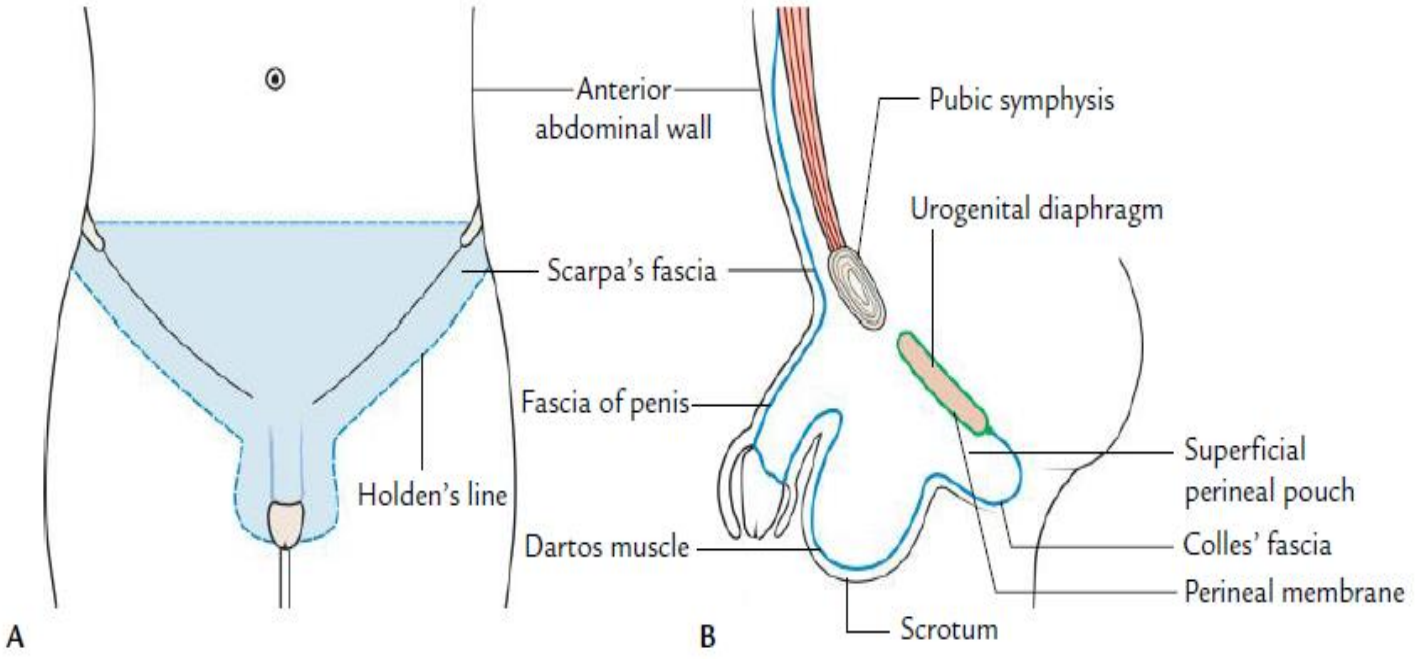
2.Superficial fascia..ctd

DEEP MEMBRANOUS LAYER (Scarpa's fascia)

- Measured histologically, it is between 0.5 and 1 mm thick.
- Superiorly, it is continuous with the superficial fascia over the remainder of the trunk
- In the midline, it is adherent to the linea alba and pubic symphysis

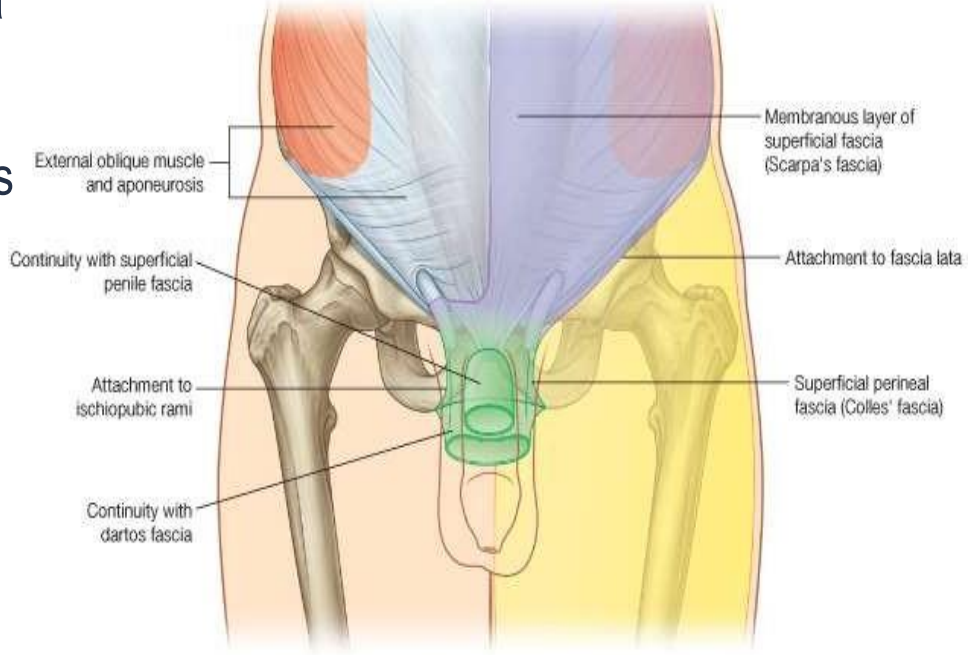


DEEP MEMBRANOUS LAYER (Scarpa's fascia)



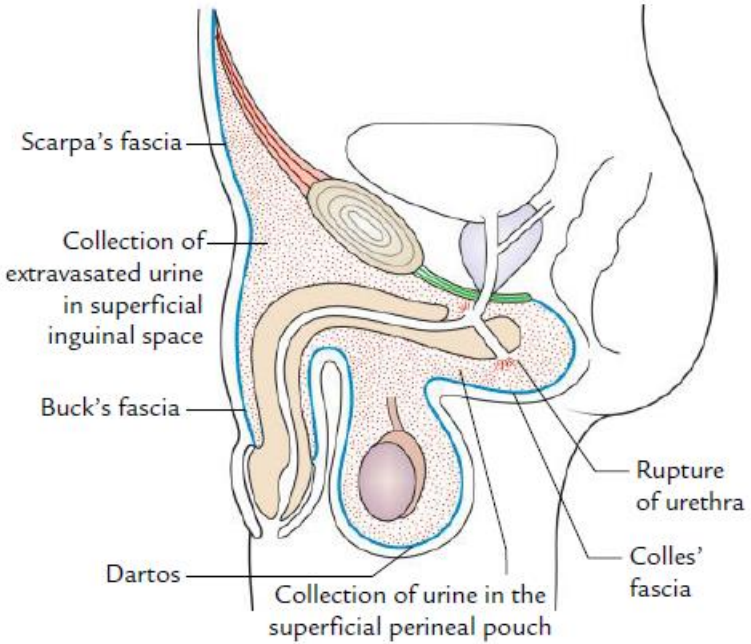
DEEP MEMBRANOUS LAYER (Scarpa's fascia)

- Inferiorly, it fuses with the iliaccrest & fascia lata at the inguinal flexure
- it also extends on to thescrotum & becomes continuous with the membranous layer of superficial fascia of the perineum (Colles' fascia)
- In the male, it extends on to the dorsum of the penis to form the **fundiform ligament of penis**



Continuity of membranous layer of superficial fascia into other areas.

Clinical significance of Scarpa's fascia



a) It serves as a firm unit for suturing the superficial fascia during closure of the anterior abdomen/ perineum after abdominal or pelvic surgery.

b) The attachments of Scarpa's and Colles' fasciae are such that they prevent the passage of extravasated urine due to urethral rupture backward into the ischiorectal fossae and downward into the thighs

Summary of Superficial Fascia

it is formed of a single layer of fatty tissue above the umbillicus and extends upwards.
At the level of the umbilicus it has two layers

The campers' fascia: is the external layer that extends down ward to bled with superficial fascia of the thighs. In the middle line it forms **dartos/fascia** muscle covering the scrotum and labia majora.

The scarpa's fascia:- the internal layer or the deep membranous layer that extends downwards and laterally into both lower limbs and in the middle to the perineum.

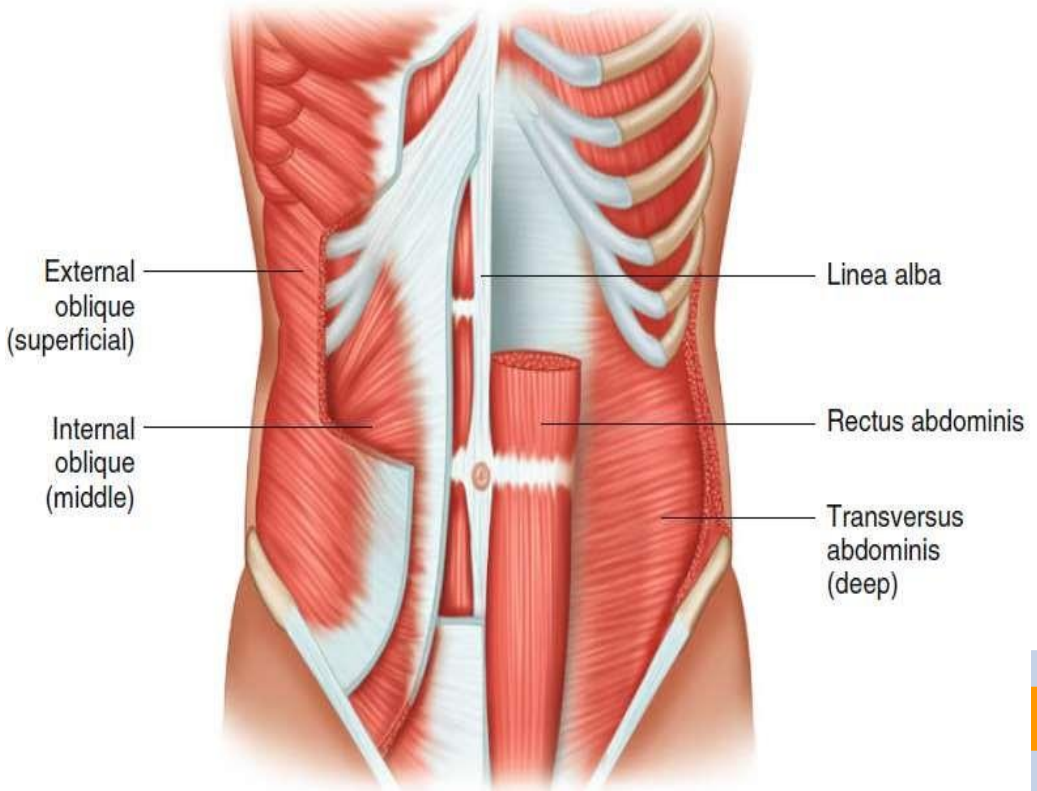
In the lower limbs it fuses with the fascia lata one inch below and parallel to the inguinal ligament.

In between the two buttocks it passes to the perineum, encloses the genital organs, and then passes below the perineal membrane to fuse with the sides of the pubic arch and with the posterior border of the membrane forming an anteriorly opened pouch named superficial perineal pouch

3. THE MUSCLES

5 Muscles

- **3 flat muscles**
  - *External Oblique*
  - *Internal Oblique*
  - *Transersus abdominis*
- **2 vertical muscles**
  - *Rectus abdominis*
  - *Pyramidalis*

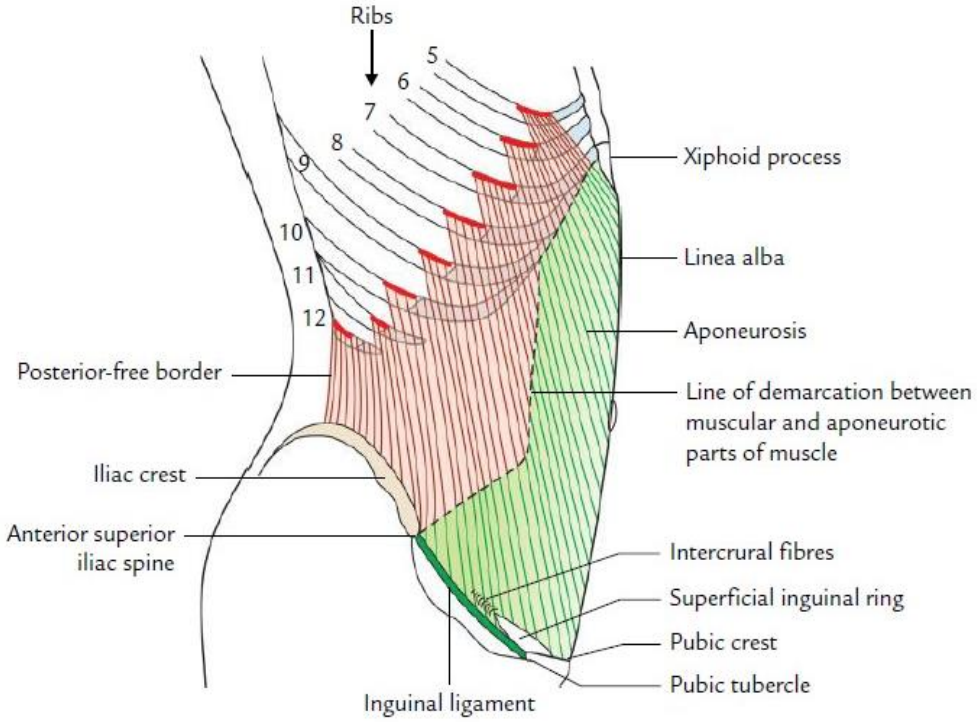


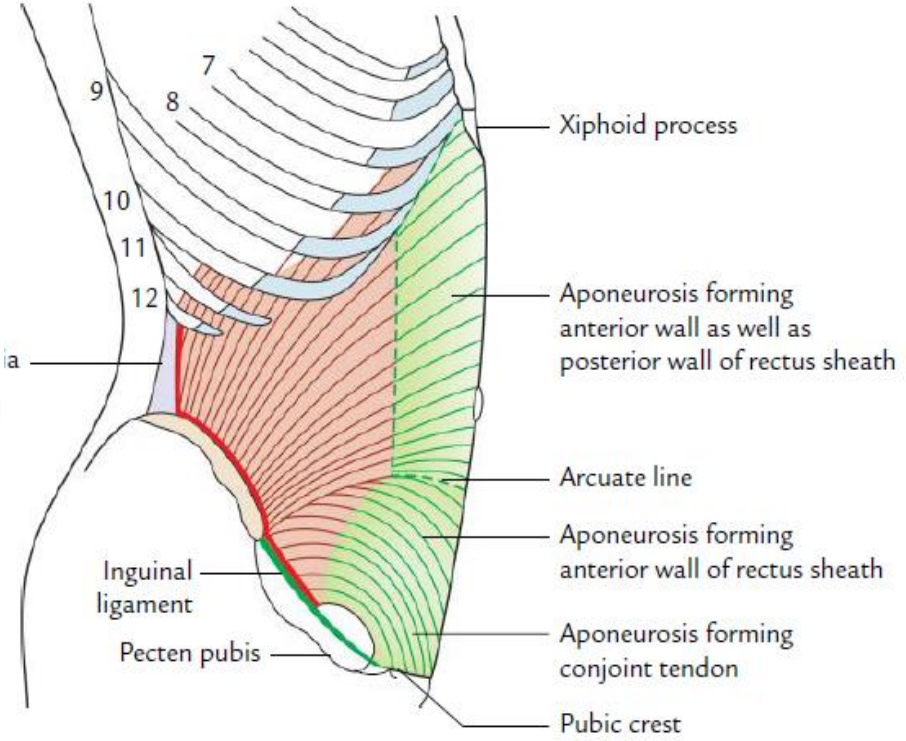
Flat muscles of anterior abdominal wall

Muscles	Origin	Insertion	Nerve supply
Flat muscles			
• External oblique	By eight fleshy slips from the outer surfaces of lower eight ribs (the upper four slips interdigitate with serratus anterior, and the lower four slips with latissimus dorsi)	(a) By fleshy fibres into the anterior 2/3rd of the outer lip of iliac crest (b) By aponeurosis into xiphoid process, linea alba, pubic symphysis, pubic crest, and the pectineal line	Lower six thoracic spinal nerves (anterior rami of T7–T12)
• Internal oblique	Fleshy origin from: (a) Lateral 2/3rd of the inguinal ligament (b) Anterior 2/3rd of the intermediate area of iliac crest (c) Thoraco-lumbar fascia	(a) By fleshy fibres into the inferior border of lower 3rd or 4th ribs and their cartilages (b) By aponeurosis into 7th, 8th, and 9th costal cartilages, xiphoid process, linea alba, pubic crest, and pectineal line of pubis	Lower six thoracic and first lumbar spinal nerves (anterior rami of T7–T12; L1)
• Transversus abdominis	Fleshy origin from: (a) Lateral 1/3rd of the inguinal ligament (b) Anterior 2/3rd of the inner lip of iliac crest (c) Thoraco-lumbar fascia (d) Inner surfaces of the lower six costal cartilages (these fibres interdigitate with diaphragm)	By aponeurosis into xiphoid process, linea alba, pubic crest, and pectineal line	Lower six thoracic and first lumbar spinal nerves (anterior rami of T7–T12; L1)

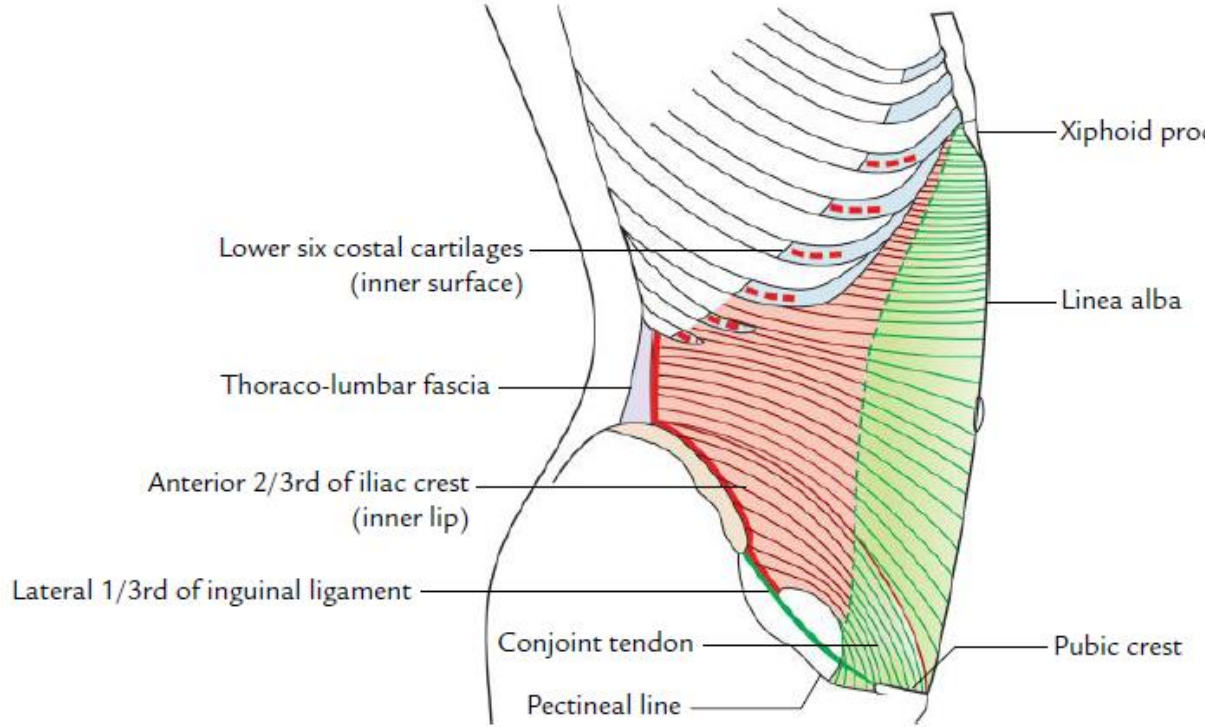
EXTERNAL OBLIQUE

INTERNAL OBLIQUE





Transversus Abdominis



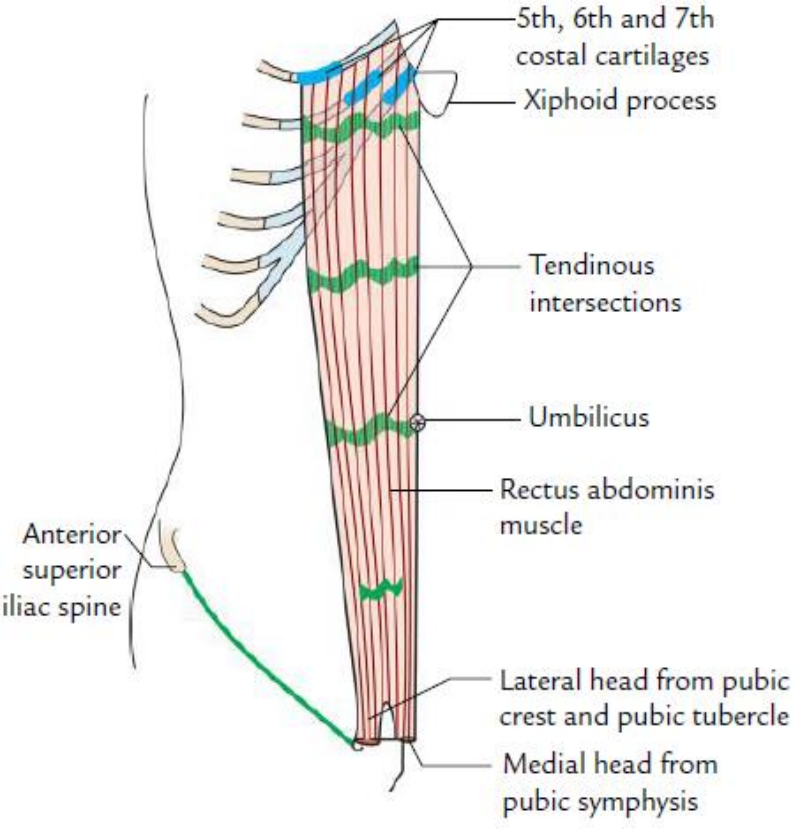
***N.B.* An important fact for students to remember:**

- *external oblique lies superficial to the lower ribs*
- *internal oblique attaches to the costal margin*
- *transversus abdominis muscle lies deep to the lower ribs.*

Vertical Muscles of Anterior Abdominal Wall

Vertical muscles			
• Rectus abdominis	By two tendinous heads: (a) *Lateral head* from lateral part of the pubic crest (b) *Medial head* from anterior surface of the pubic symphysis	(a) 5th, 6th, and 7th costal cartilages (along a horizontal line) (b) Xiphoid process	Lower six or seven thoracic nerves (anterior rami of T7–T12)
• Pyramidalis	(a) Anterior surface of the body of pubis (b) Anterior pubic ligament	Into linea alba	Subcostal nerve (T12)

Rectus Abdominis Muscle



FUNCTIONS OF THE ANTERIOR ABDOMINAL MUSCLES

i. Provides strong & expandable support for the abdominal viscera against gravity and protect them from injury.

ii. Compresses the abdominal contents to increase the intra-abdominal pressure and thus help in expulsive and expiratory acts.

iii. To move the trunk to maintain the posture

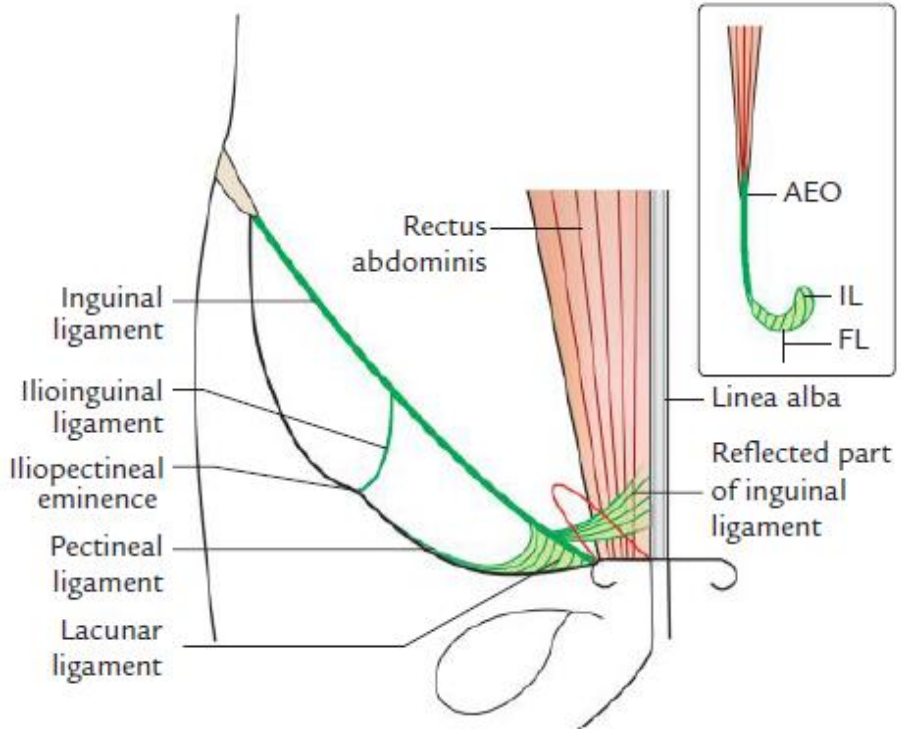
STRUCTURES DERIVED FROM FLAT MUSCLE

i. Inguinal ligament.

ii. Conjoint tendon.

iii. Cremaster muscle

1. INGUINAL LIGAMENT



- It is a thick, fibrous band extending from ASIS to the pubic tubercle.
- Formed by lower-free border of external oblique aponeurosis
- It lies beneath the fold of groin.

2. COJOINT TENDON

- formed by the fusion of lower aponeurotic fibres of:
    - **internal oblique**
    - **transversus abdominis muscles (**which arches over the spermatic cord)
- It is attached on to the pubic crest and medial part of the pectineal line (pectin pubis).

The important features of the conjoint tendon are as follows:

i. Forms the medial half of the posterior wall of the inguinal canal and strengthens the anterior abdominal wall of the canal opposite the superficial inguinal ring.

ii. Medially - it blends with the anterior wall of the rectus sheath.

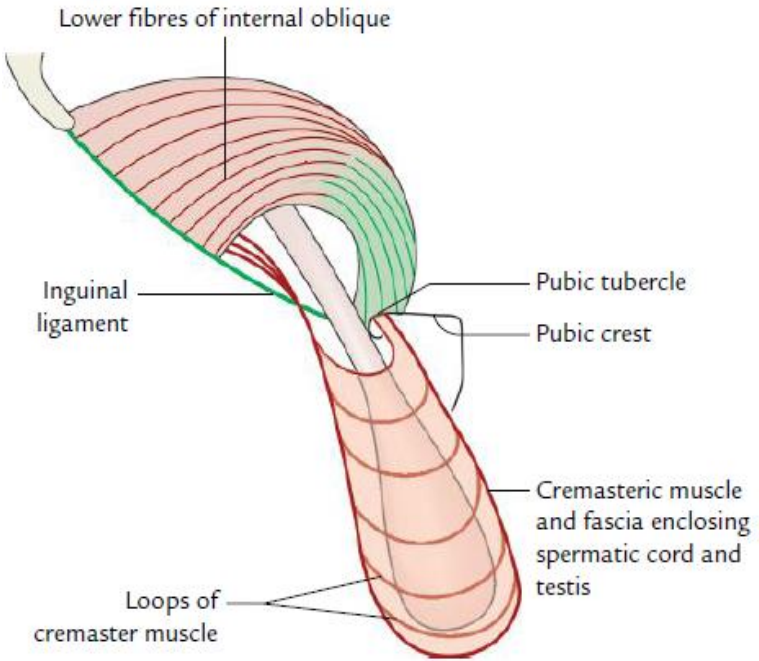
iii. Laterally - it may extend occasionally up to the ***interfoveolar ligament***, a thickening in the fascia transversalis along the medial border of deep inguinal ring.

The interfoveolar ligament extends from the lower border of transversus abdominis to the superior ramus of the pubis.

Clinical correlate: Cojoint tendon

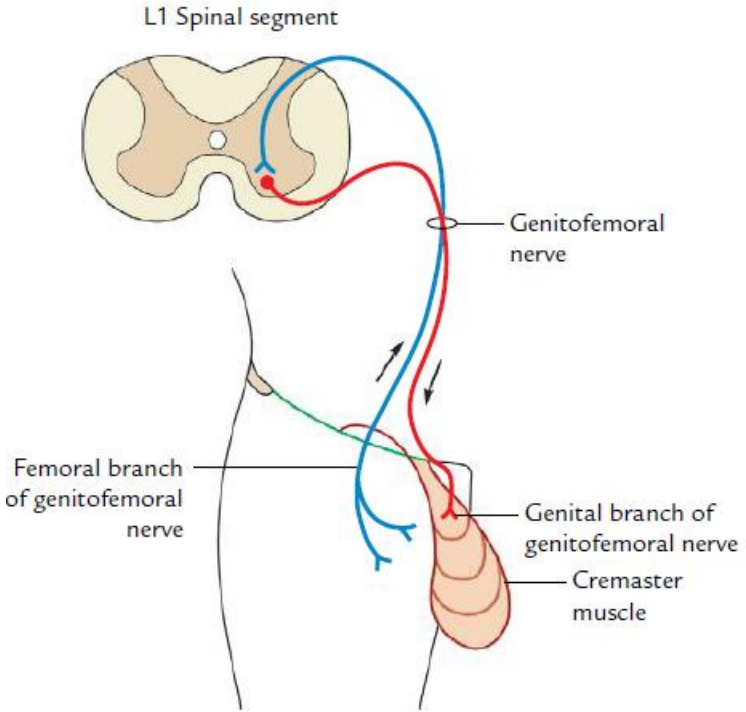
- The weakening of conjoint tendon due to **old age** or injury of i**liohypogastric** and **ilioinguinal nerves** predisposes the occurrence of direct inguinal hernia

3. Cremasteric Muscle



- It is consists of a series of **loops of skeletal**
- **muscle fibres** joined by loose areolar tissue, the **cremaster fascia**.
- The loops of cremaster muscle and fascia form the covering around the spermatic cord and testis.
- These muscle loops are derived from **lower arched fibres of internal oblique.**
- The medial ends of loops are attached to the pubic tubercle, pubic crest, and conjoint tendon..

Ctd' 3. Cremasteric Muscle



Neural pathway for cremasteric reflex

- It is supplied by sympathetic fibres from L1 and L2 spinal segments thro' the genital branch of genitofemoral nerve and hence not under voluntary control

- ***Cremasteric reflex :*** *Upon stroking the skin of the upper medial aspect of thigh, there is reflex contraction of cremaster muscle leading to* ***reflex elevation of the testis.***
- *The reflex is more brisk in children.*

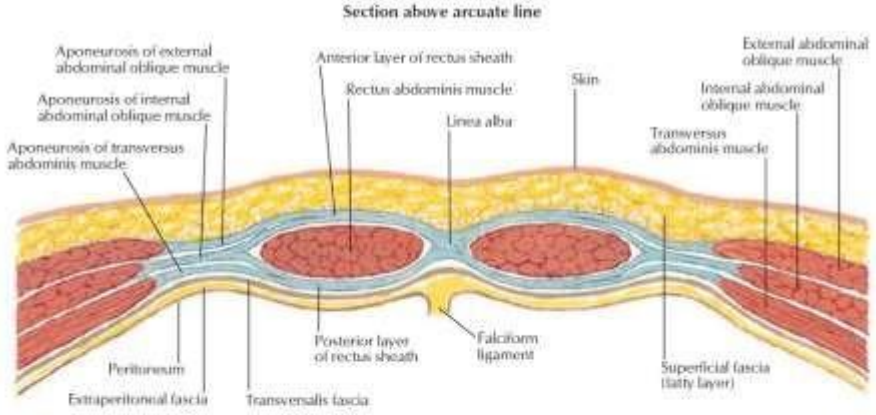
Rectus Sheath

- It is an aponeurotic sheath enclosing the rectus abdominis muscle (and pyramidalis muscle if present) on either side of the linea alba.
- It is derived from the aponeuroses of flat muscles of the anterior abdominal wall.

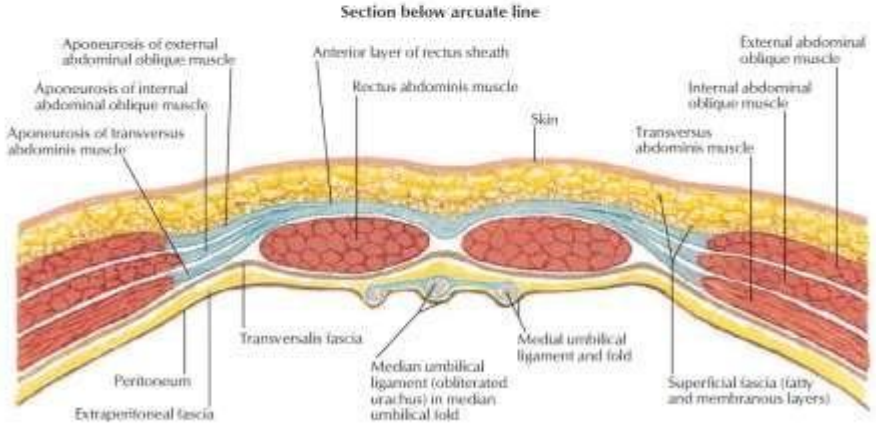
The **functions of rectus sheath** include:

i. Checking the bowing of rectus abdominis muscle during its contraction and hence increasing its efficiency.

ii. Maintaining the strength of the anterior abdominal wall



Aponeurosis of internal abdominal oblique muscle splits to form anterior and posterior layers of rectus sheath. Aponeurosis of external abdominal oblique muscle joins anterior layer of sheath; aponeurosis of transversus abdominis muscle joins posterior layer. Anterior and posterior layers of rectus sheath unite medially to form linea alba.



Aponeurosis of internal abdominal oblique muscle does not split at this level but passes completely anterior to rectus abdominis muscle and is fused there with both aponeurosis of external abdominal oblique muscle and that of transversus abdominis muscle. Thus, posterior wall of rectus sheath is absent below arcuate line, leaving only transversalis fascia.

Rectus Sheath

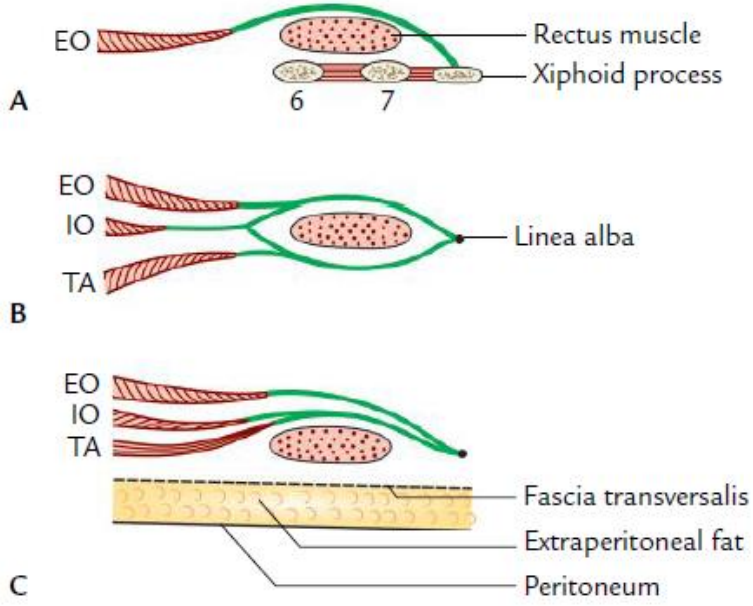
- Rectus abdominis on each side is enclosed by a fibrous sheath
- formed from the a**poneuroses of all three lateral abdominal muscles**
- anterior portion fuses with periosteum and ligaments at sites of the muscle's attachments

The formation of rectus sheath

Differs from above downward as follows:

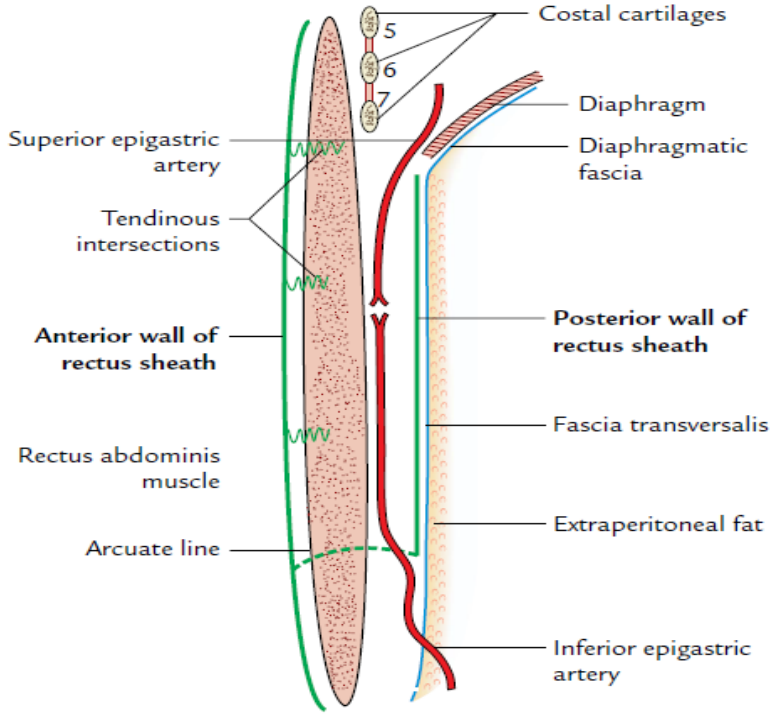
1. ***Above the level of costal margin:***
   - ***(a)*** ***Anterior wall*** is formed by the aponeurosis of external oblique only
   - ***(b)*** ***Posterior wall*** is deficient and muscle lies directly on the 5^{th} , 6^{th} , and 7^{th} costal cartilages
2. ***Between costal margin and arcuate line:***
   - ***a)*** ***Anterior wall*** is formed by the fusion of aponeurosis of external oblique with the anterior lamina of aponeurosis of internal oblique.
   - ***b)*** ***Posterior wall*** is formed by the fusion of aponeurosis of transversus abdominis with the posterior lamina of aponeurosis of internal oblique.
3. ***Below the level of arcuate line:***
   - ***a)*** ***Anterior wall*** is formed by the aponeuroses of all the three flat muscles
   - ***b)*** ***Posterior wall*** is deficient

Formation of Rectus sheath



A, above the costal margin;
B, between costal margin and arcuate line;
C, below the arcuate line
(EO = external oblique, IO = internal oblique,TA = transversus abdominis).

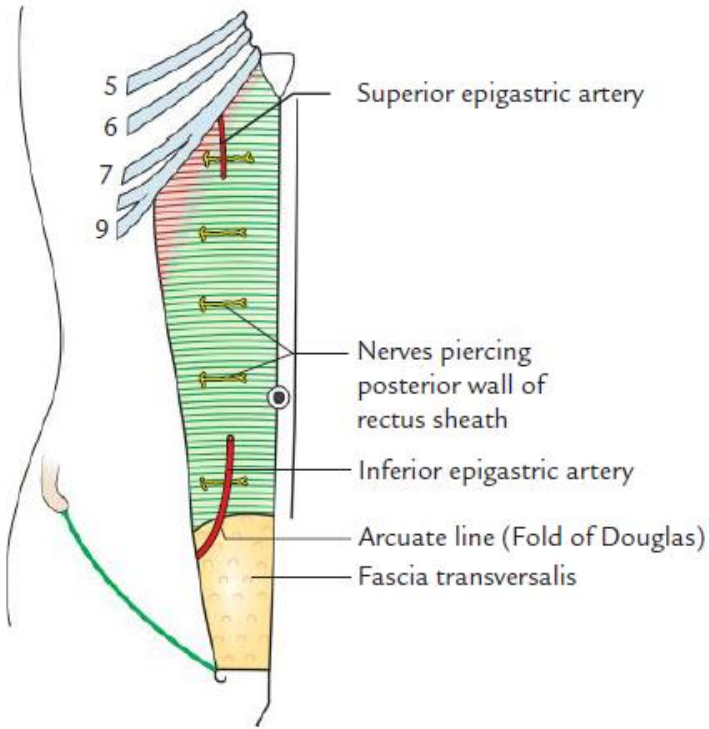
Anterior and posterior walls of rectus sheath as seen in sagittal section



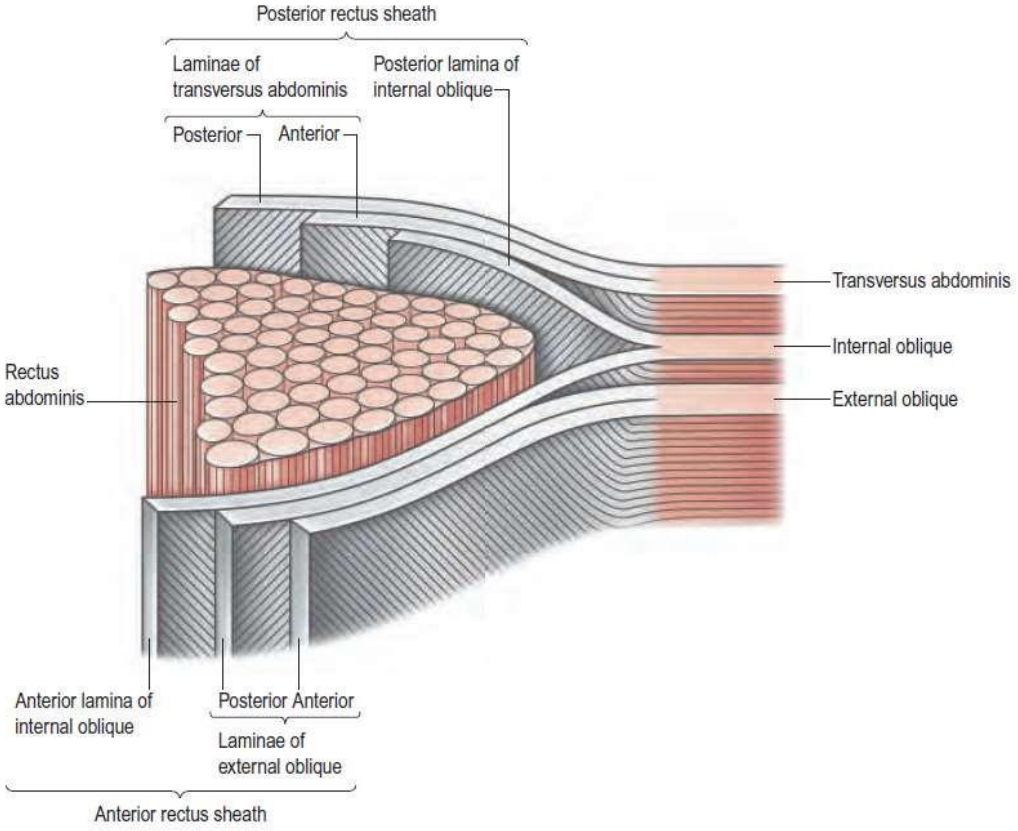
Comparison of upper and lower three-fourths of anterior abdominal wall

Upper Midline	Lower Midline
Linea alba well developed	Linea alba poorly developed
Right and left recti well separated	Right and left recti close together
Anterior and posterior layers of sheath present	Only anterior layer of sheath present
Aponeurosis of external oblique weak or absent	Aponeurosis of external oblique strong and well developed

Posterior wall of the rectus sheath.



Rectus Sheath

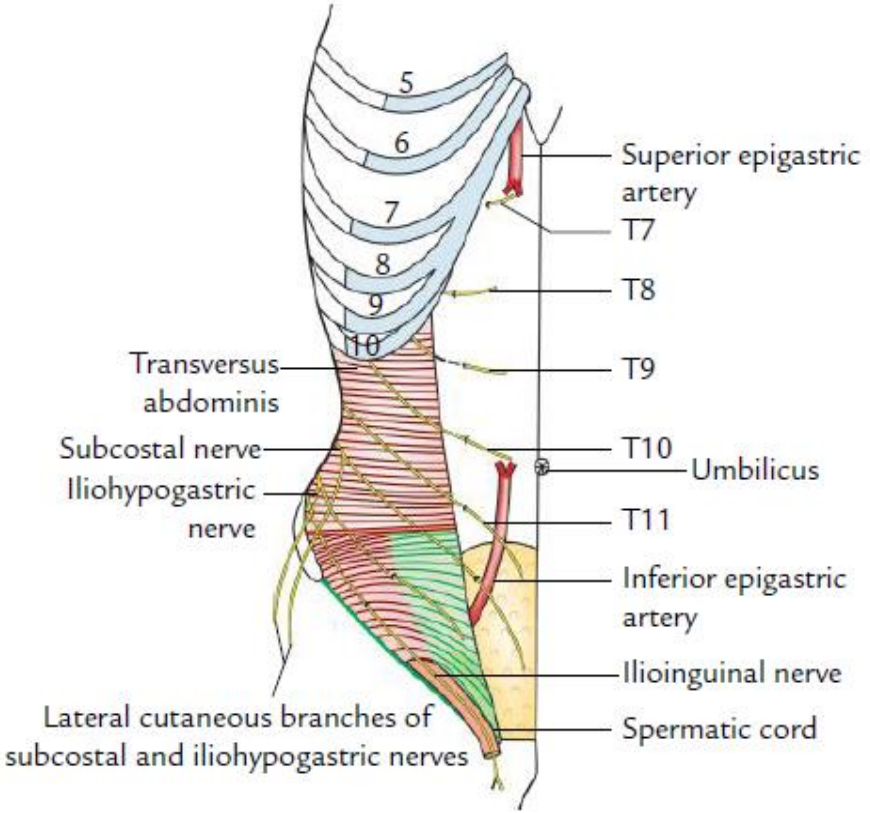


- Each aponeurosis is bilaminar
- anterior leaves run obliquely upwards
- Posterior leaves run obliquely downwards

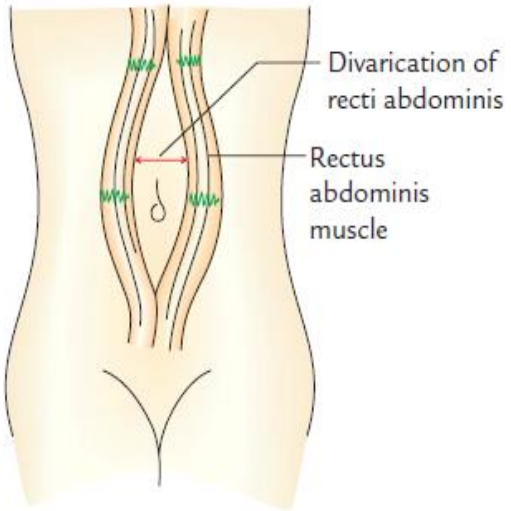
Contents of Rectus sheath

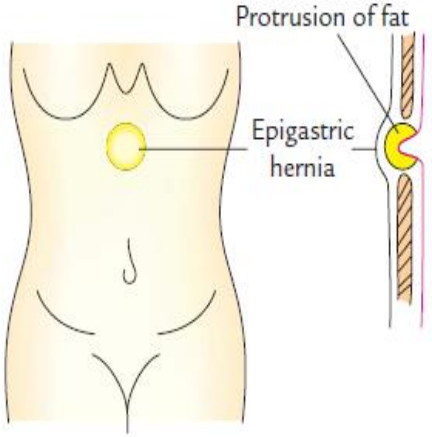
1) **Two muscles:** Rectus abdominis and pyramidalis (if present).
2) **Two arteries:** Superior epigastric and inferior epigastric.
3) **Two veins:** Superior epigastric and inferior epigastric.
4) **Six nerves:** Terminal parts of lower six thoracic nerves, including lower five intercostal nerves and subcostal nerve.

Nerves and arteries within the rectus sheath



Clinical Correlate of Rectus sheath





Hematoma of rectus sheath

TRANSVERSALIS FASCIA

It is a thin layer of fascia that lines the inner surface of the transversus abdominis muscle

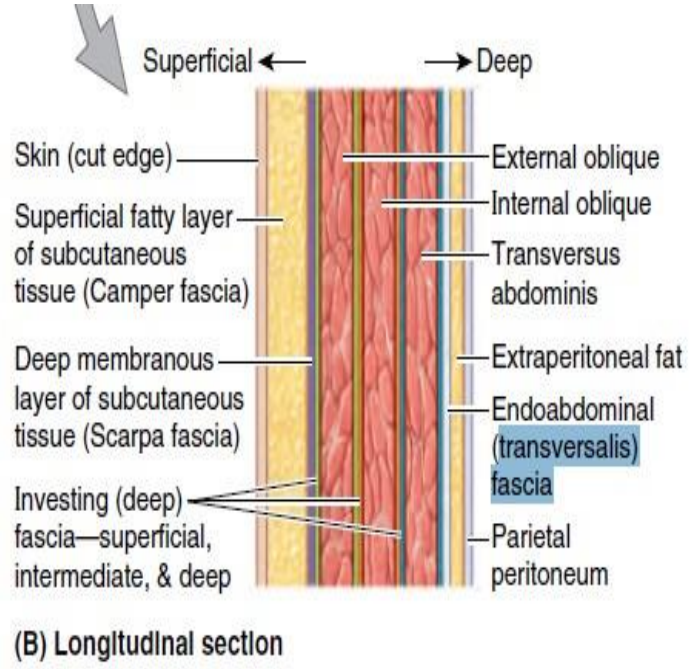
EXTENT

Superiorly, it is continuous with the inferior aspect of the diaphragm (*diaphragmatic fascia)*

Inferiorly with the fascia lining the iliacus muscle (*fascia iliaca)*.

Anteriorly, it extends up to the linea alba to which it becomes adherent

Posteriorly, it becomes continuous with the anterior layer of the thoraco-lumbar fascia.



(B) Longitudinal section

IMPORTANT FEATURES OF TRANSVERSALIS FASCIA

i. Presents **deep inguinal ring -** provides passage to the spermatic cord & round ligament.

ii. Forms a tubular prolongation around the spermatic cord (***internal spermatic fascia***).

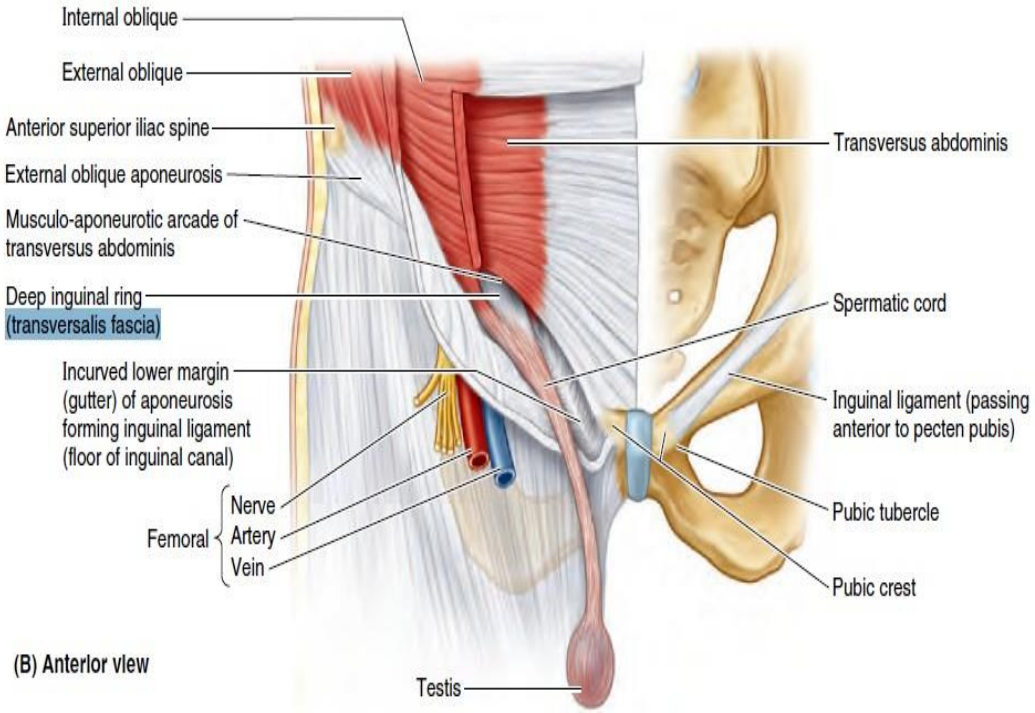
iii. Its prolongation into the thigh over the femoral vessels forms the anterior wall of the **femoral sheath**.

iv. All the *main arteries of the abdominal cavity* lie deep to the **fascia transversalis** whereas *main nerves lie outside it*.

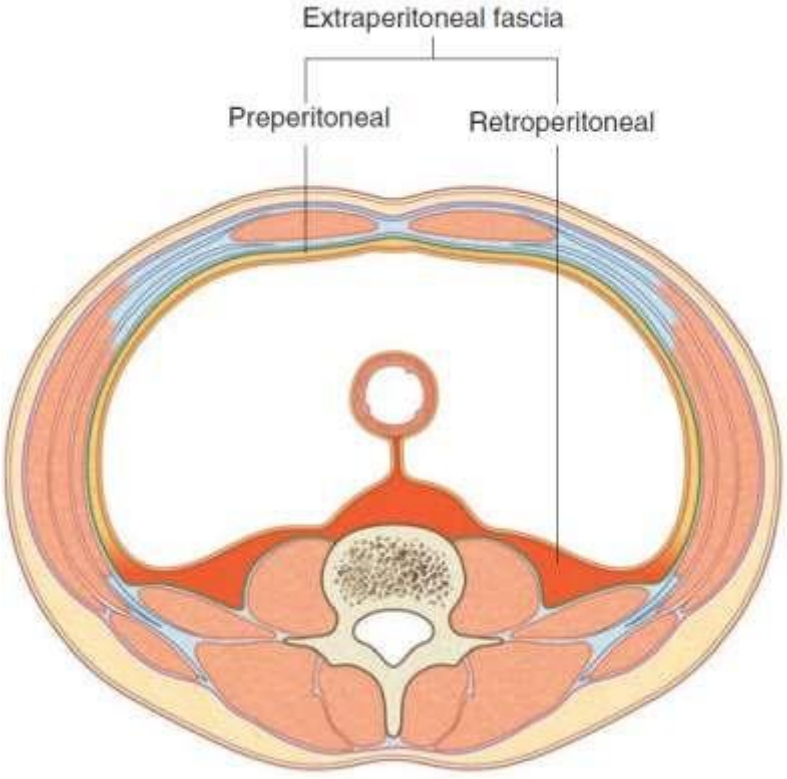
v. Forms **iliopubic tract,** which is the thickened inferior margin of the fascia transversalis in the inguinal region.

Transversalis Fascia

- Forms the **deep inguinal ring** and gives rise to the **femoral sheath** and the **internal spermatic fascia**.
- Is directly in contact with the **rectus abdominis** below the **arcuate line**.



PERITONEUM



- The peritoneum lining the walls is the parietal peritoneum;
- The peritoneum covering the viscera is the visceral peritoneum

INNER SURFACE OF THE ANTERIOR ABDOMINAL WALL

Fossa

1. Supravesical Fossa
2. Medial Inguinal Fossa
3. Lateral Inguinal Fossa

Umbilical Folds or Ligaments

1. Median Umbilical Ligament or Fold
2. Medial Umbilical Ligament or Fold
3. Lateral Umbilical Fold

Transversalis Fascia

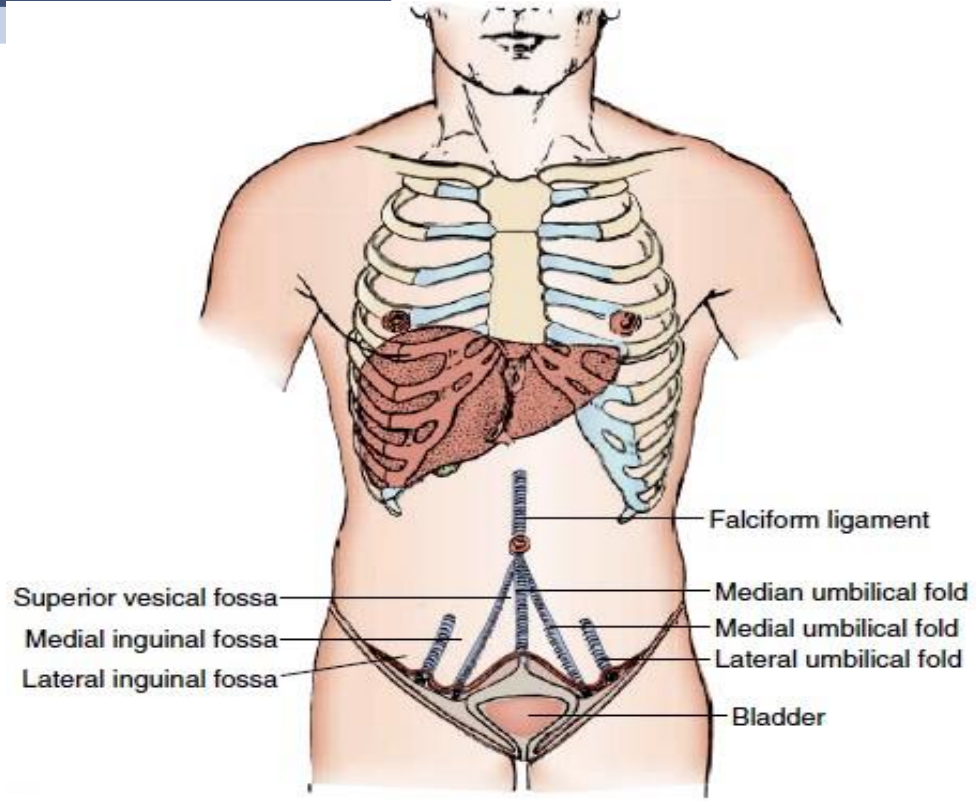
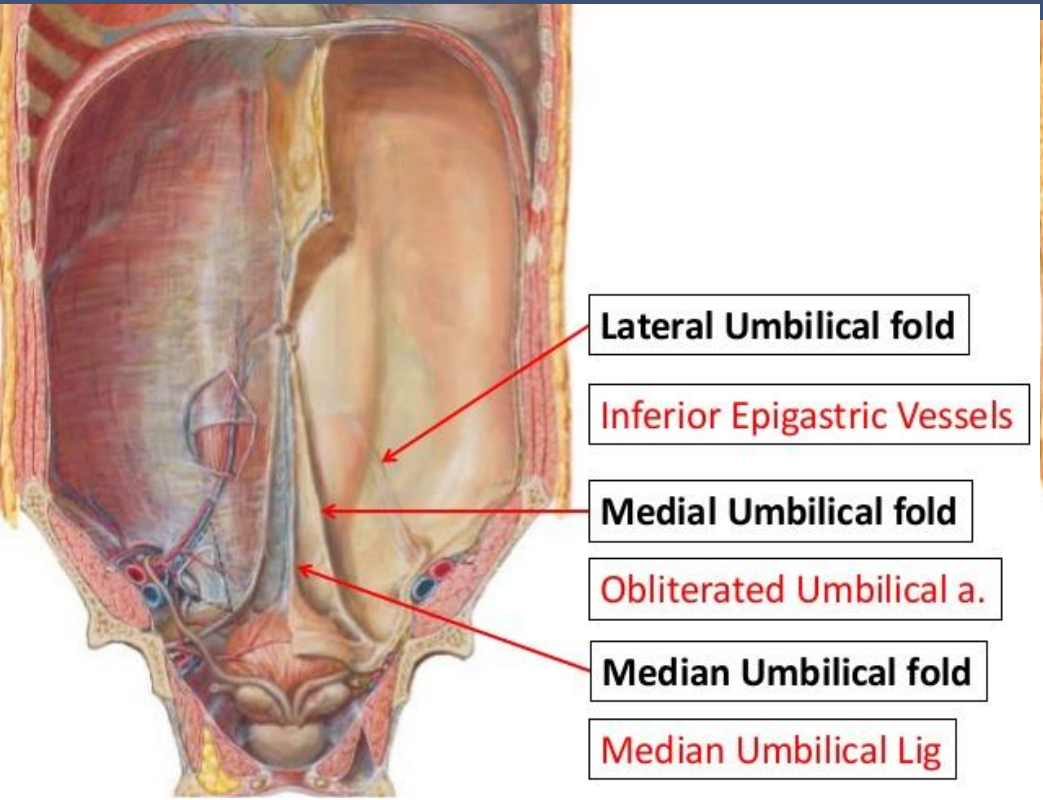
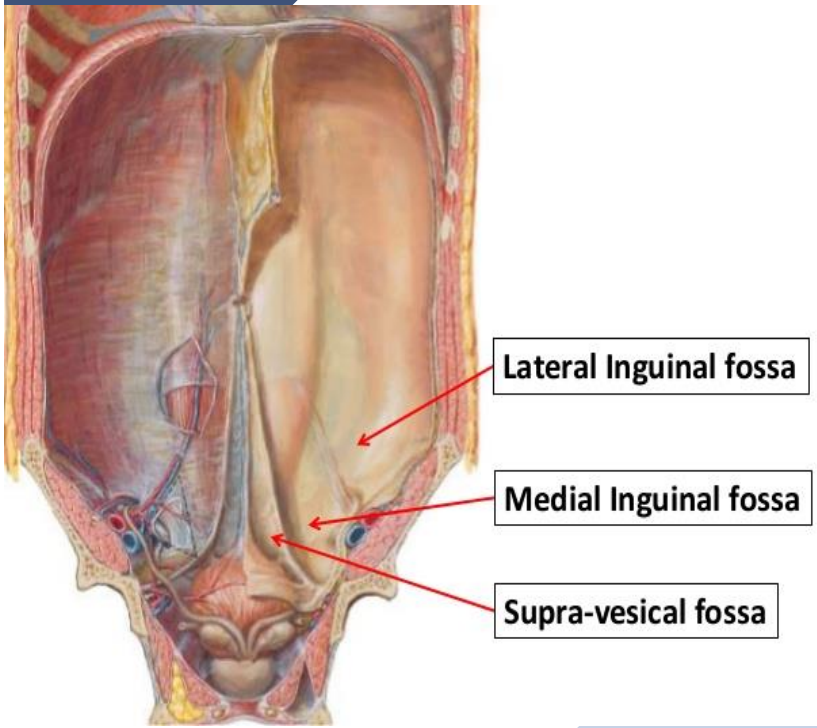


FIGURE 5-4. Umbilical folds over the anterior abdominal wall.

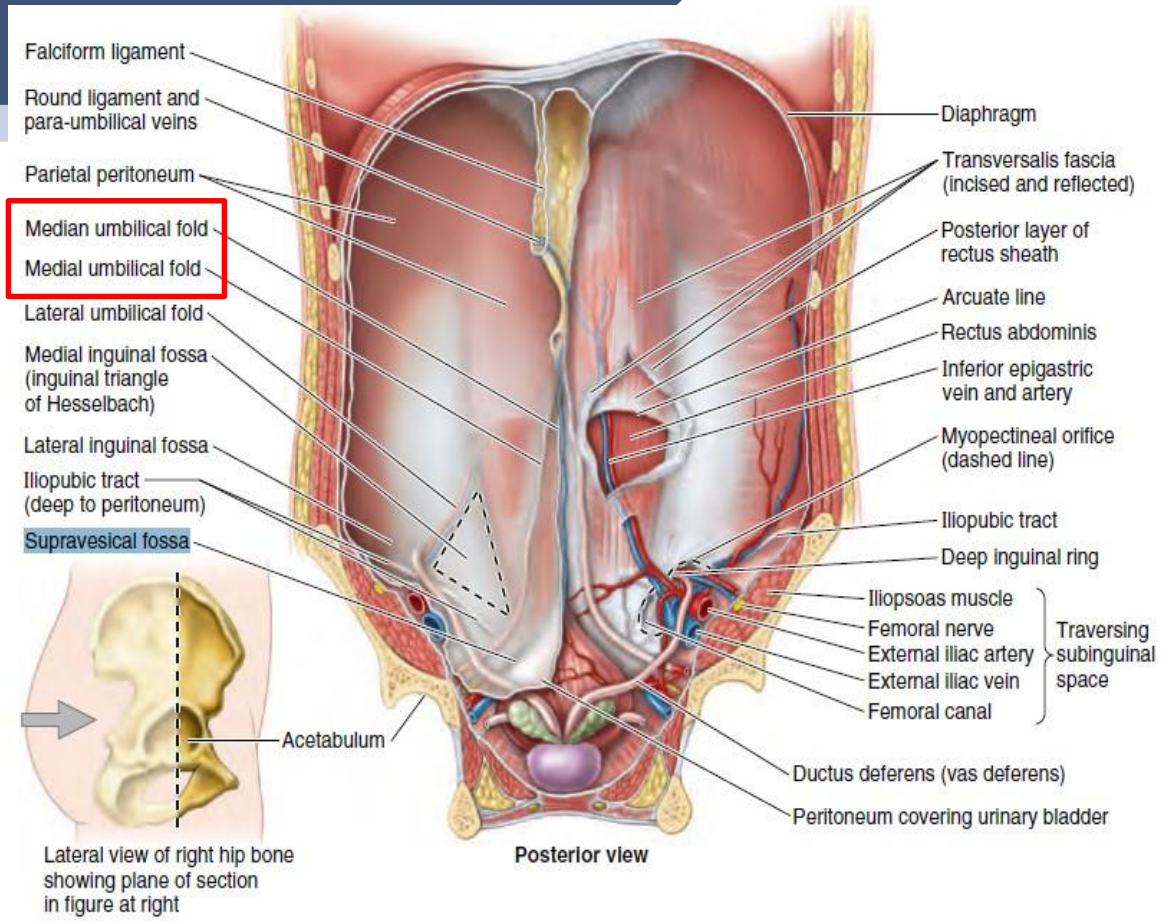
Folds and Fossa of Anterior abdominal wall





1. Supravesical Fossa

■Is a depression on the **anterior abdominal wall** between the **median** and **medial umbilical folds** of the peritoneum.

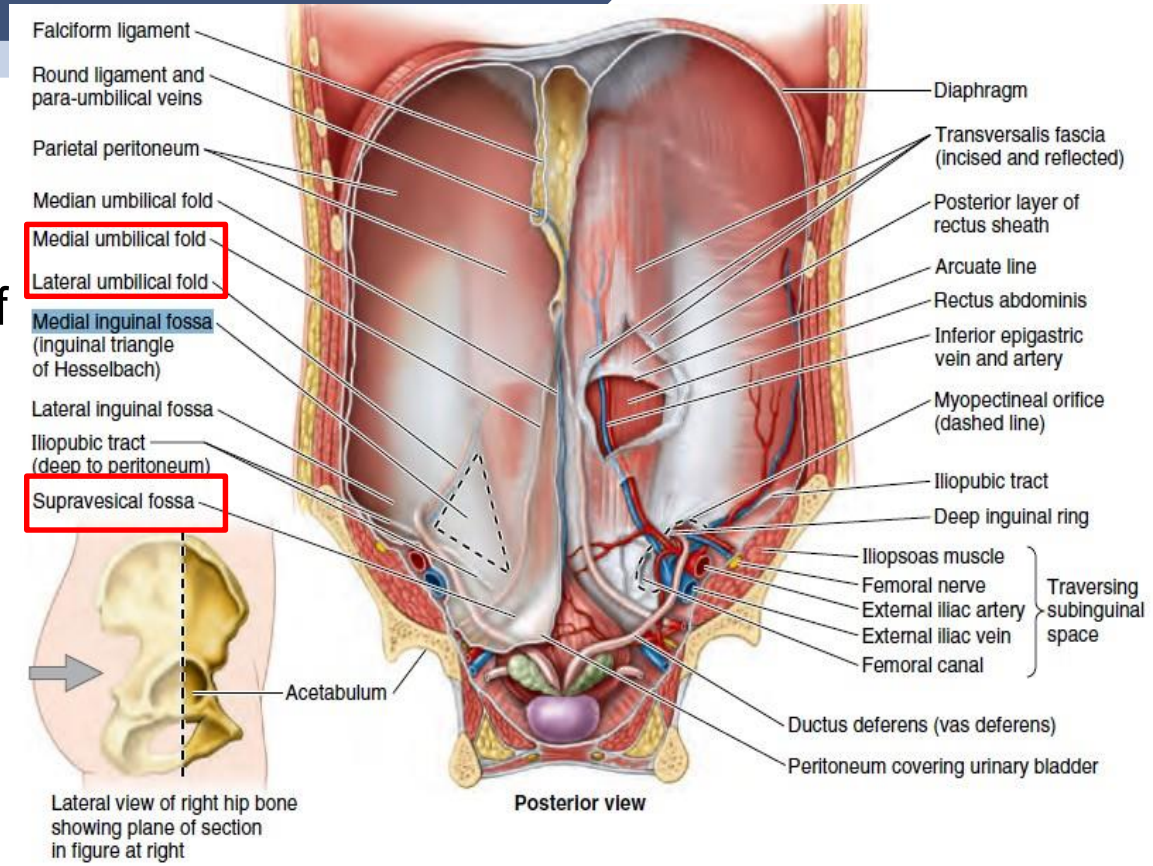


2. Medial Inguinal Fossa

- Is a depression on the **anterior abdominal wall** <u>between</u> the **medial** and **lateral** umbilical folds of the peritoneum.

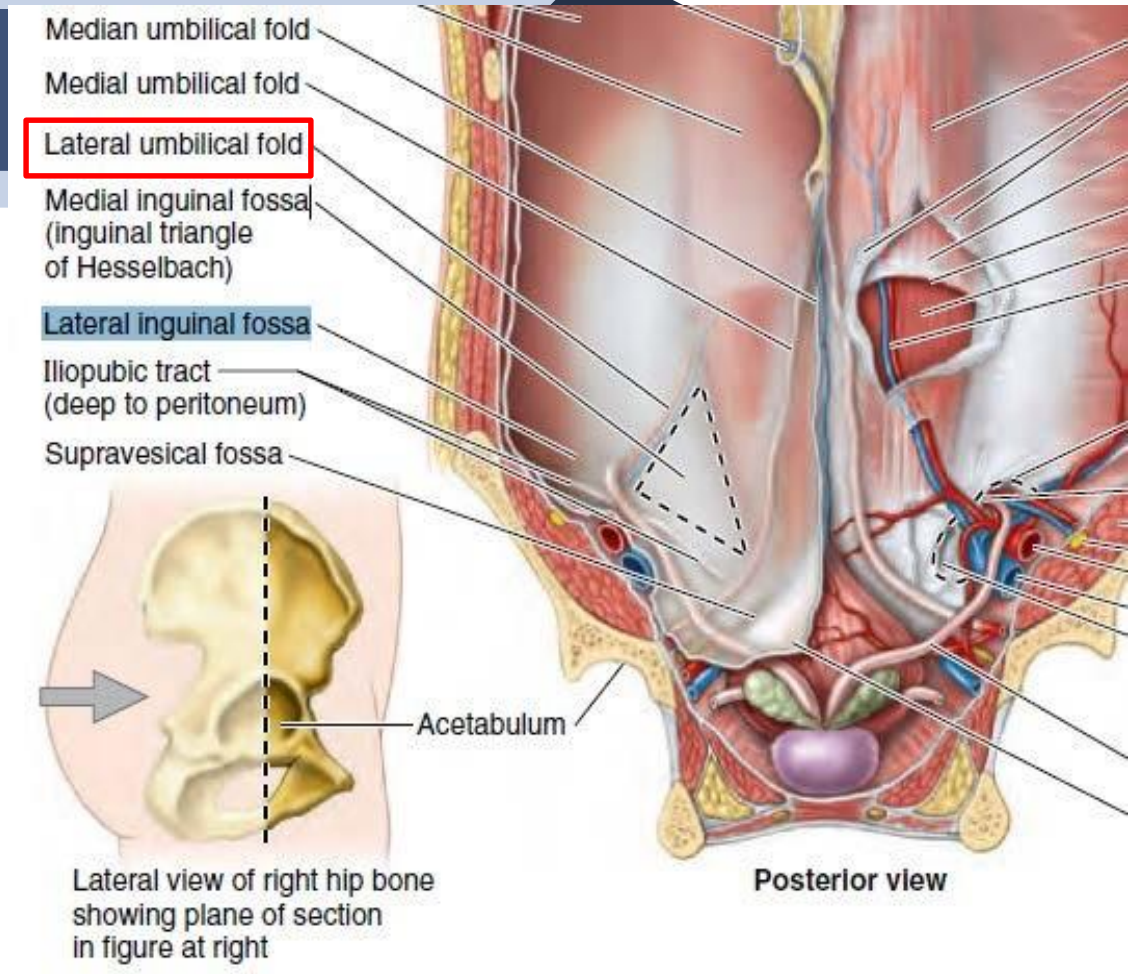
It lies **lateral** to the supravesical fossa.

- Is the fossa where most direct **inguinal hernias*** occur.



3. Lateral Inguinal Fossa

- Is a depression on the **anterior** abdominal wall, **lateral** to the lateral umbilical fold of the peritoneum.

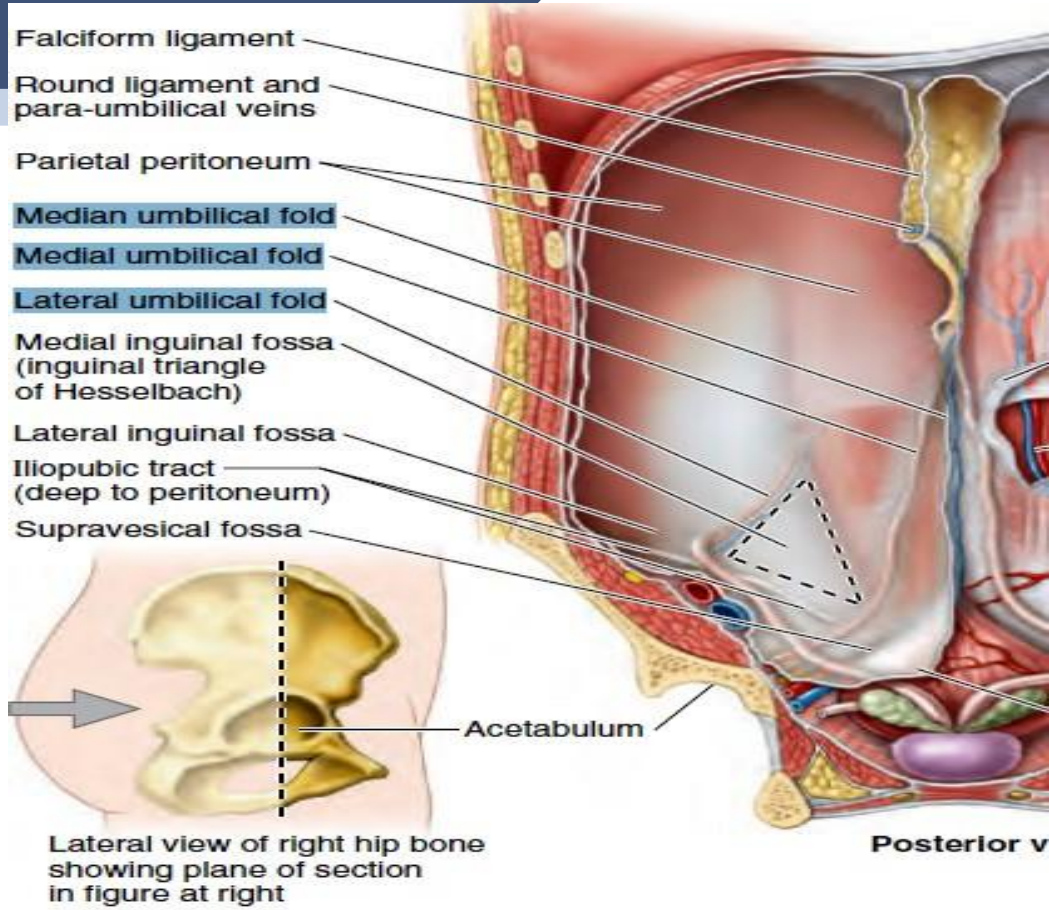


Umbilical Folds or Ligaments

1.Median Umbilical Ligament or Fold

2.Medial Umbilical Ligament or Fold

3.Lateral Umbilical Fold



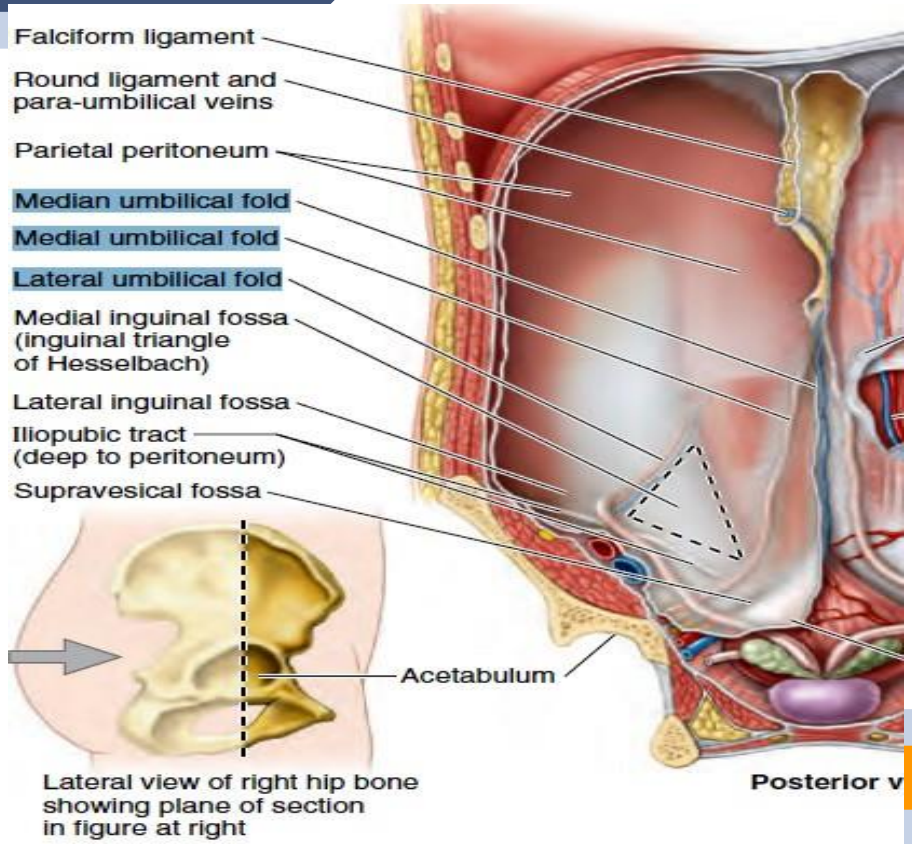
1. Median Umbilical Ligament or Fold

■Is a fibrous cord, the remnant of the obliterated urachus *, which forms a median umbilical fold of the peritoneum.

■Lies between the transversalis fascia and the peritoneum and extends from the apex of the bladder to the umbilicus.

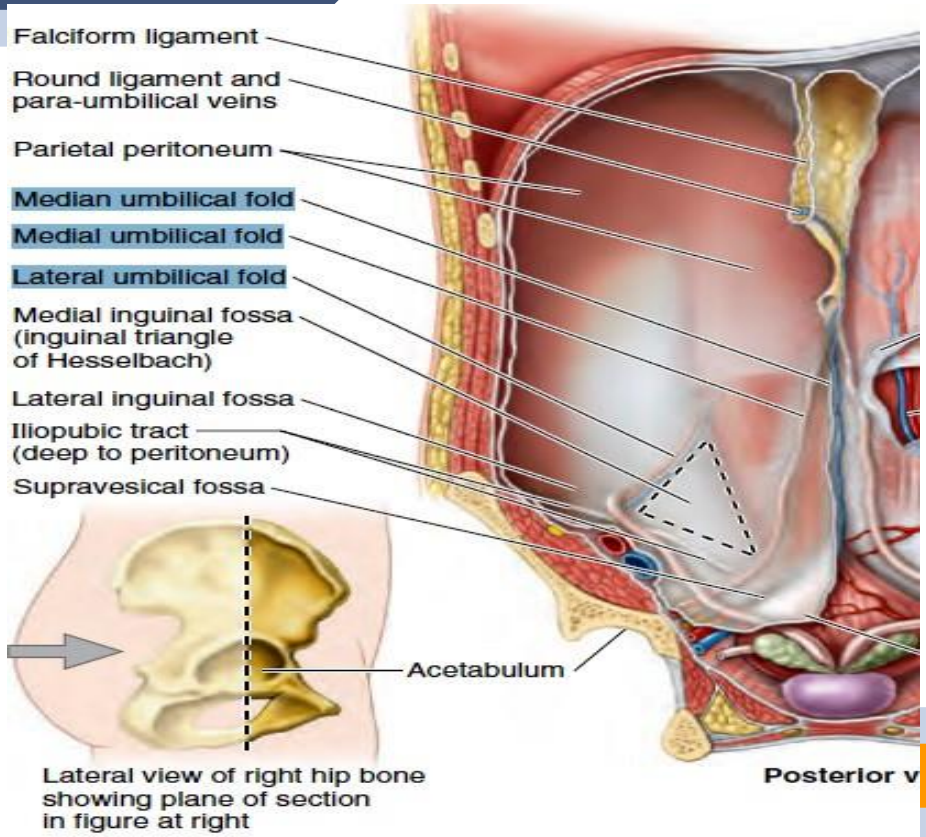
NB: Urachus: *A canal that connects the urinary bladder to the umbilicus (bellybutton) during fetal development.*

- *The urachus is normally obliterated, so it is usually a solid cord. Failure for the urachus to fill in leaves it open.*
- *The telltale sign of an open urachus is leakage of urine thro' the umbilicus.*
- *An open urachus is a malformation and needs to be surgically corrected.*



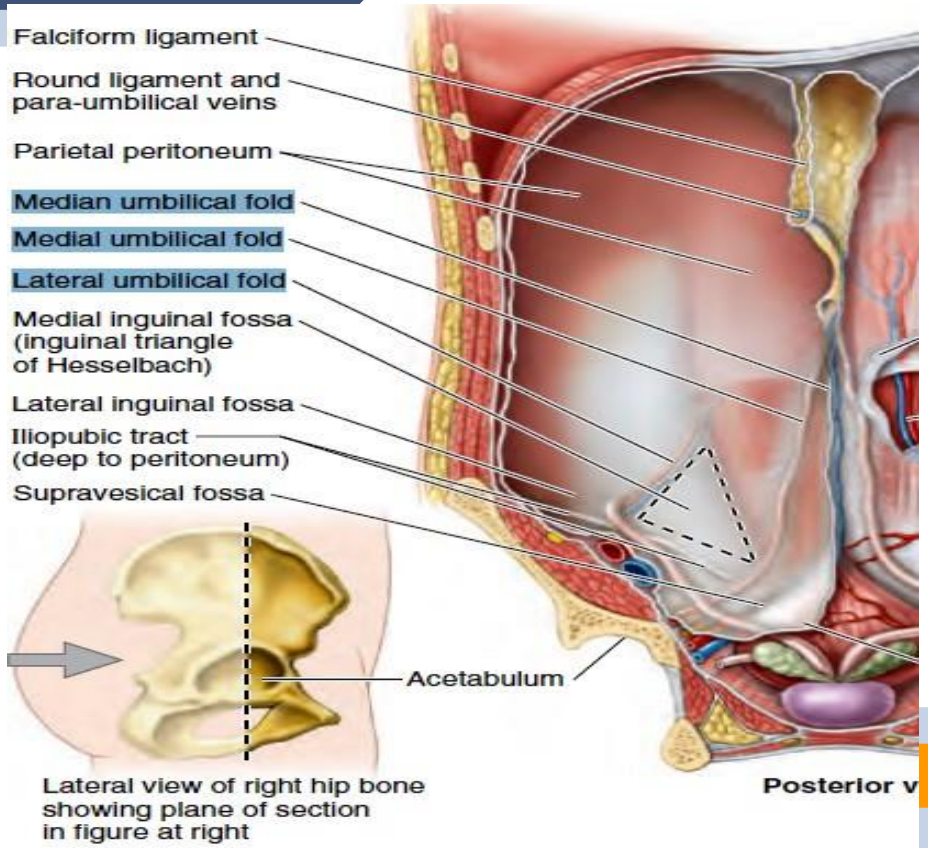
2. Medial Umbilical Ligament or Fold

■Is a fibrous cord, the remnant of the **obliterated umbilical artery**, which forms a medial umbilical fold and extends from the side of the bladder to the umbilicus.

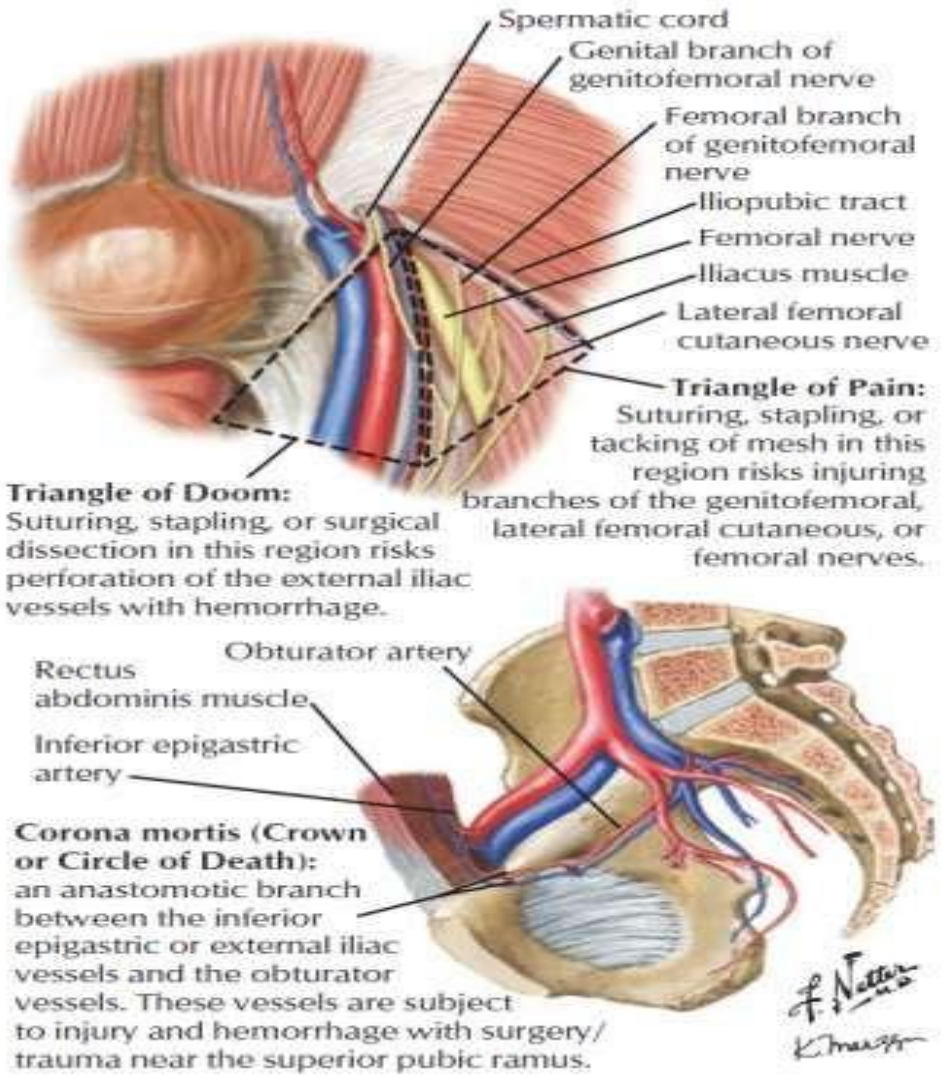


3. Lateral Umbilical Fold

- Is a fold of the peritoneum that covers **inferior epigastric vessels** and extends from the medial side of the deep inguinal ring to the arcuate line.



Landmarks

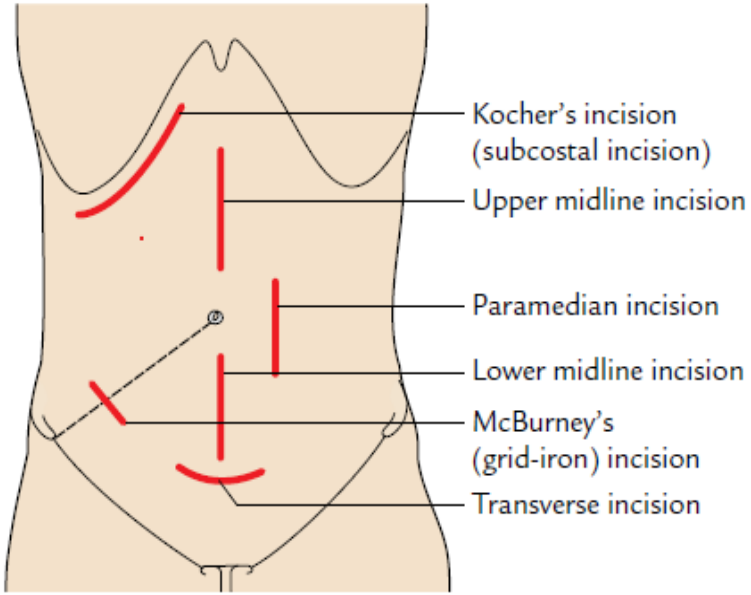


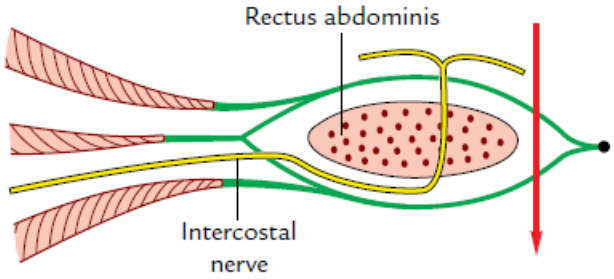
- Inguinal Landmarks in Hernia Repair:
- Warning Triangles and Corona Mortis

Incisions on Abdominal Wall

- “ Pray before surgery, but remember: God will not alter a faulty incision”
  - • Keeney’s Dictum
- **Maingot’s 3 requirements**
  - • Accesibility
  - • Extensibility
  - • Security

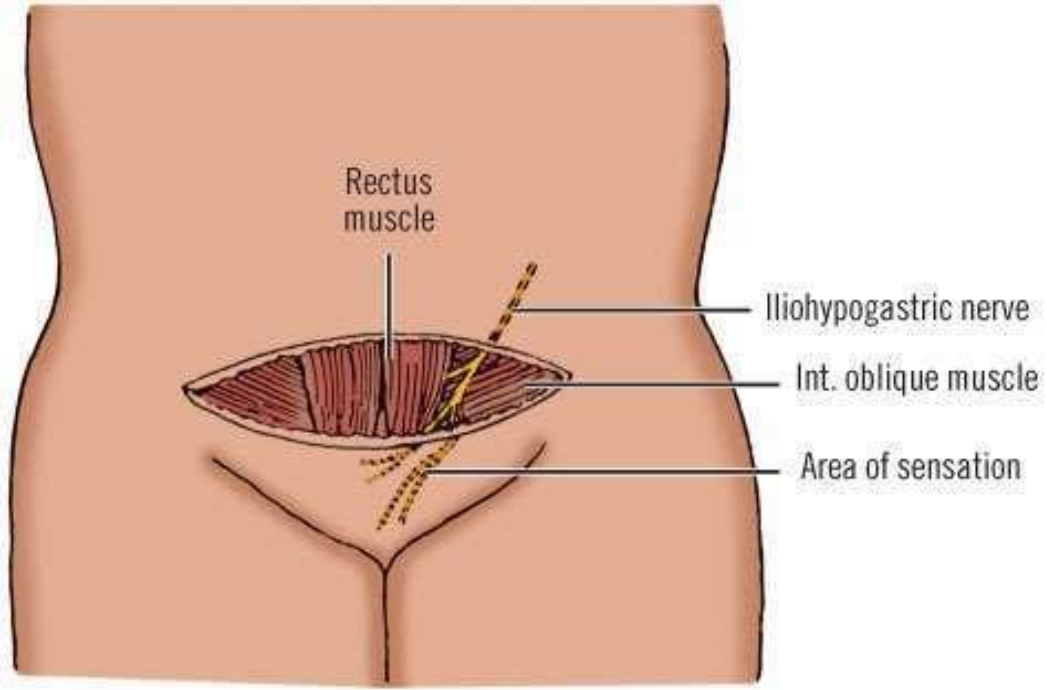
Abdominal incisions

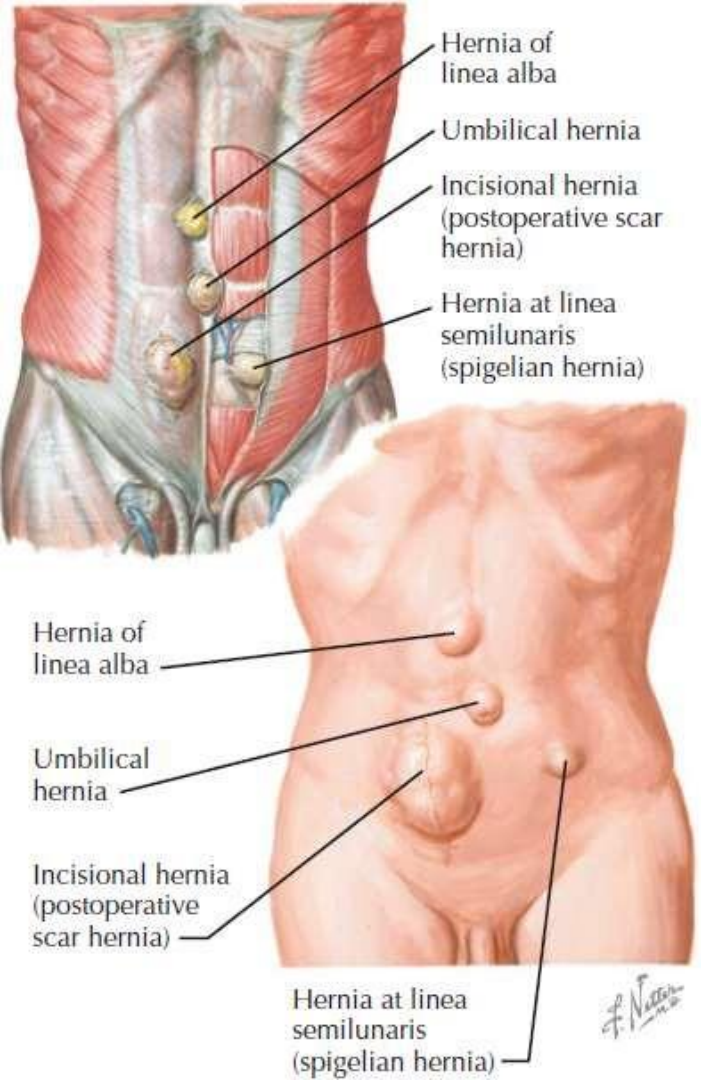




- **Paramedian abdominal incision (arrow) & course of intercostal nerve.**

Pfannelstiel Incision





Ventral hernias

- Umbilical–paraumbilical
- Epigastric
- Incisional
- Parastomal
- Spigelian
- **Lumbar**
- Traumatic

Lumbar hernias

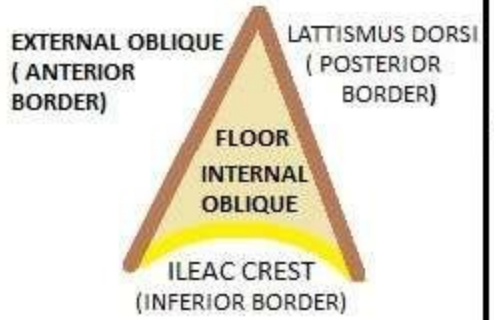


FIG : INFERIOR LUMBER TRIANGLE (PETIT`S TRIANGLE)

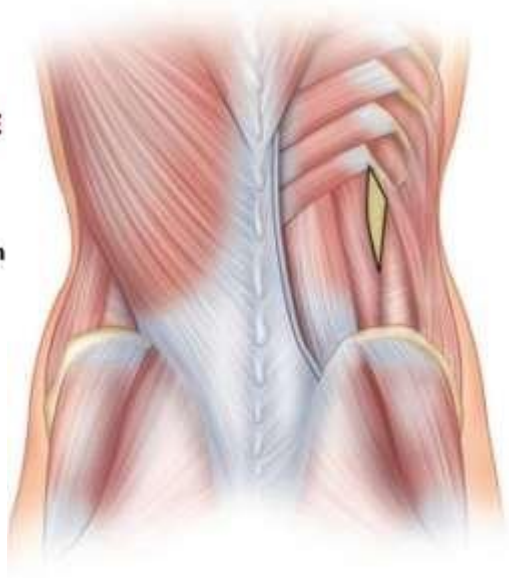
1. More superficial in location

FIG : SUPERIOR LUMBER TRIANGLE (GRVNFELTT- LESSHAFT)

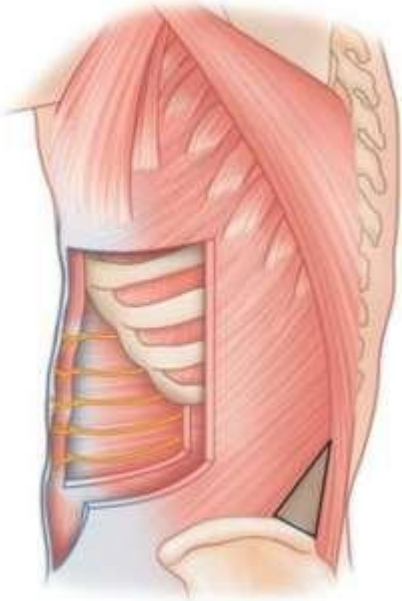
1. More commonly site of herniation than petit triangle

1. Of all lumbar hernias, 20% are congenital.
2. Lumbar hernias are more common on the left than on the right side.
3. Grynfeltt's hernias are more common than Petit's hernias.
4. There is a 2 : 1 male predominance.
5. Patient presents with" lump in flank".
6. It increases in size and should be repaired wen found.
7. Pseudohernia may occur in the lumbar area as the result of paresis of the thoracodorsal nerves. This is caused by loss of muscle control and tone in lumbar region.

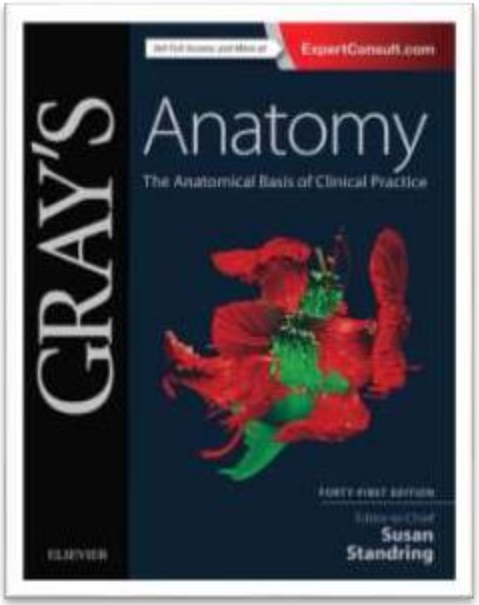
Gryfeitt-Lesshalft`s triangle



Petit's triangle



REFERENCES


GRAY'S
Anatomy
The Anatomical Basis of Clinical Practice
Susan
Standring