

Digestive System

University of Jordan
Faculty of Medicine
Batch of 2013-2019



Slide Sheet Handout Other

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Lecture # : 4

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Date: 31/3

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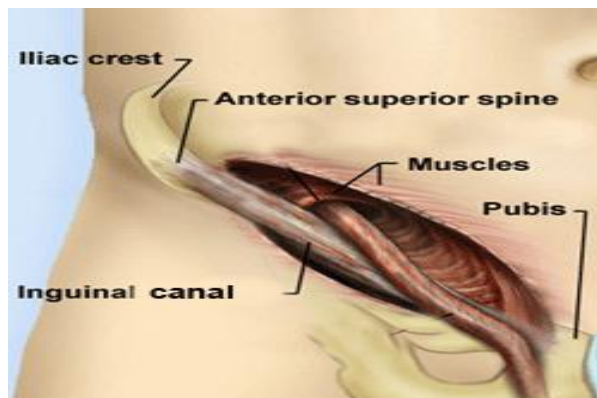
Inguinal canal and hernia

Today we are going to talk about inguinal canal and hernia; this is one of the most important subjects, especially for those who want to be surgeons since they will face inguinal hernia every day.

***you'll find many repeated information and at certain points the sheet will be nothing but scattered information since the doctor explained most topics at the beginning then pass by the slides, so it's not my fault**

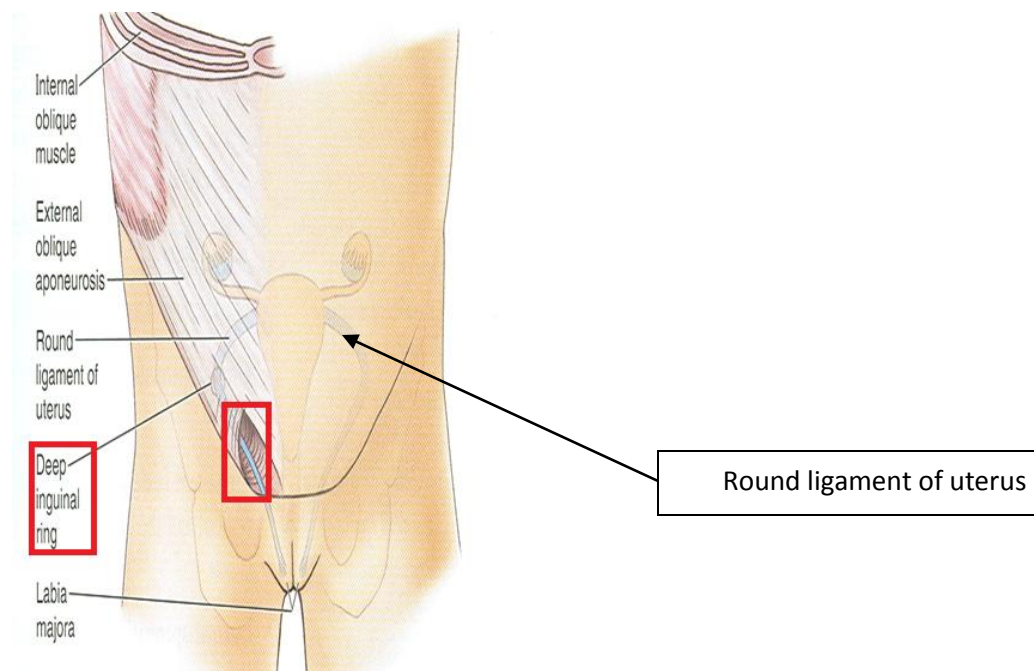


You can see at this picture the inguinal ligament and above it we have the inguinal canal and the spermatic cord that projects from the canal, so one of the contents of the inguinal canal is the spermatic cord in males, while in females we call it round ligament of uterus.



The inguinal canal of male

Now look at this :



We have the uterus, the ovaries and the fallopian tube, and this is the round ligament of uterus which enters the deep inguinal ring and projects from the superficial inguinal ring then goes to labia majora .

So the round ligament of uterus starts from uterus , it passes through the inguinal canal (deep \rightleftarrows superficial ring) then to the labia majora.

In the same picture , these are the superficial and deep inguinal rings (the red squares) and between them we have the inguinal canal.

By that, we can tell that the inguinal canal is :

“Oblique passage above the inguinal ligament, it lies at the anterior abdominal wall between deep and superficial inguinal rings “.

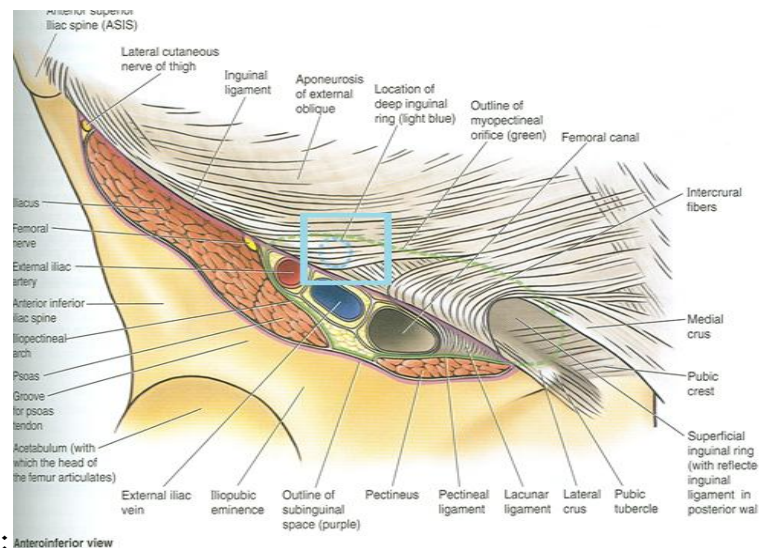
Again, in males the inguinal canal is for passage of spermatic cord and in females it's for passage of the round ligament of uterus.

In addition, we have at the inguinal canal *the genital branch of genitofemoral nerve* (comes from L1 and L2) and the ilioinguinal nerve (L1).

The route of each nerve:

- *Genital branch passes from the deep to the superficial inguinal ring .
- *Ilioinguinal pierces the posterior surface of the canal and passes through the superficial ring to the scrotum.(doesn't pass through the deep ring)

The length of the inguinal canal is about **4cm**, it comes from deep inguinal ring to the superficial inguinal ring and lies parallel to the inguinal ligament, while *in new born*, the deep ring is opposite to the superficial ring (the deep ring is posterior to the superficial) , meaning that this oblique passage is absent .This happens in the new born because the inguinal canal is very short.



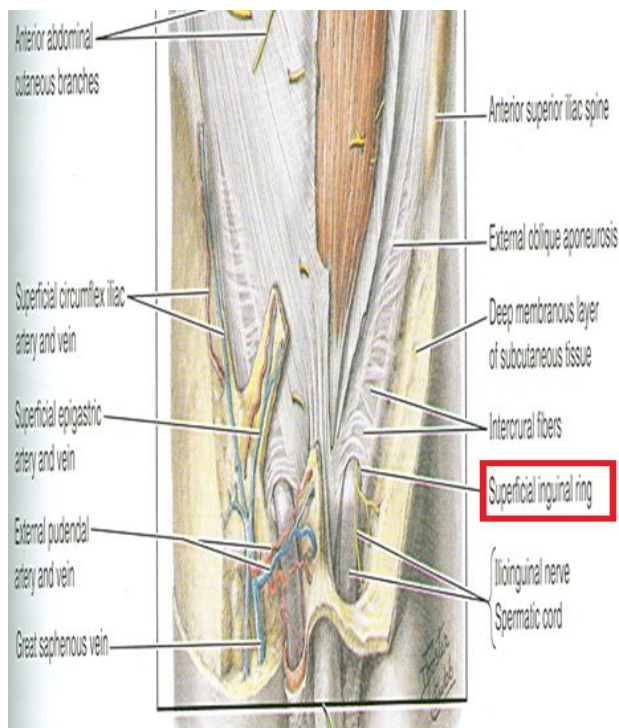
Look at this picture now :

The deep inguinal ring is that with blue dashed lines (I put a blue square around it) about 0.5 inch = 1.3 cm above the inguinal ligament at the mid way between anterior superior iliac spine and the symphysis pubis(mid of the inguinal ligament).

Anatomically, we say that it's above the pulsation of femoral artery.

The **margin of deep inguinal ring** gives **internal spermatic fascia** (fascia surrounding the spermatic cord)

Now let's move to the **superficial inguinal ring** :



Here it is .

It's where you can find the spermatic cord.

We said that the superficial inguinal ring is a defect in the *aponeurosis of external oblique muscle*, and that defect consists of two cruses; medial and lateral (crus means elongated part of an anatomical structure). Together we call them **crura** which are a fold of aponeurosis (*from wiki*: The superficial inguinal ring is bounded below by the crest of the pubis; *on either side by the margins of the opening in the aponeurosis, which are called the crura of the ring*; and above, by a series of curved intercrural fibers.)

The margin of superficial inguinal ring gives external spermatic fascia (fascia surrounding the spermatic cord).

Deep inguinal ring	⇒	internal spermatic fascia
Superficial inguinal ring	⇒	external spermatic fascia

Now if you look at the anterior abdominal wall, you'll notice that it's similar to what we have taken before:

-skin

-superficial fascia

- Fatty layer(campar's fascia)
- Membranous layer(scarpa's fascia)

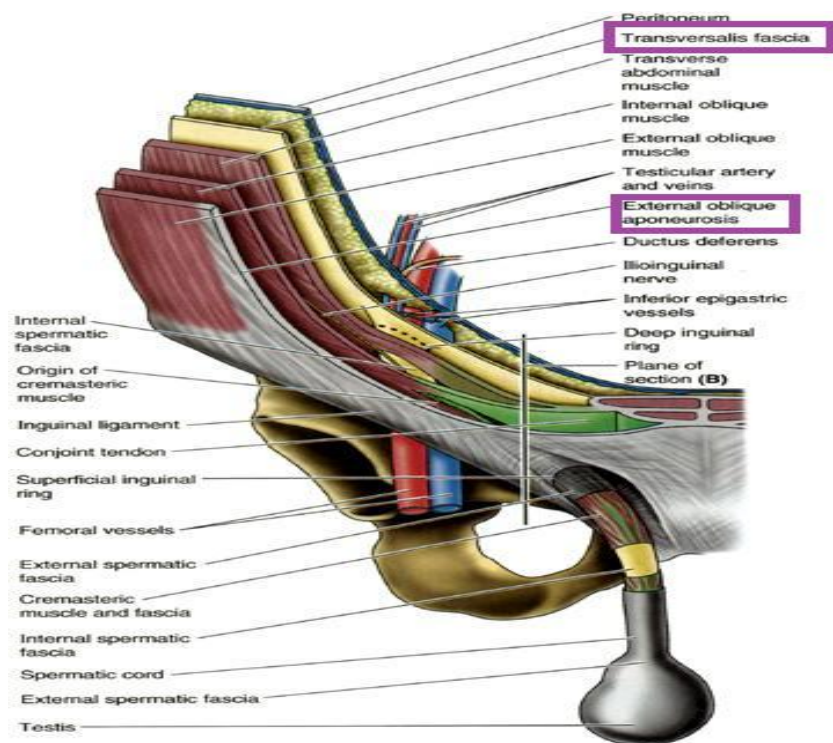
-muscles

- External
- internal
- Transverse

-extra peritoneal fat

-parietal peritoneum (the white material)

Look at this:



The deep inguinal ring found in transversalis fascia and the superficial is in external oblique aponeurosis .(look at the squares)

Now let's get a closer look at the inguinal canal :

It has anterior wall, posterior wall , roof and floor .

*Floor

It's the easiest, consist of inguinal ligament and most medially we find the lacunar ligament.

*Roof

It's arching fibers of internal oblique muscle and transverse abdominis muscle .

*Anterior surface /wall

Formed by *external oblique aponeurosis* (all of it found anteriorly) and supported by *flashy fibers* of internal oblique muscle.

Remember that the internal oblique muscle has origin from the inguinal ligament (lateral 2/3) so it gives support to the anterior wall of the inguinal canal .

The deep ring is a weak point in the posterior wall , so anterior to it, you'll find external oblique aponeurosis and flashy fibers of internal oblique muscle .

If you apply a pressure on the abdominal wall, what you are doing is increasing the intra-abdominal pressure, so the deep ring will move *forward* (to the anterior wall) ,now that ring will find external oblique aponeurosis and flashy fibers of internal oblique muscle in front of it.

This is called : "reinforce to the deep ring"

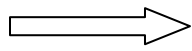
*Posterior wall

All of it is made by transversalis fascia, and medially there's conjoint tendon (made by internal oblique muscle and transverse abdominis muscle), this tendon *supports the superficial inguinal ring* which contains the spermatic cord).

external oblique aponeurosis and flashy fibers of internal oblique muscle \rightsquigarrow reinforce the deep ring
conjoint tendon \rightsquigarrow reinforce the superficial ring

Functions of Inguinal Canal

1. Passage of spermatic cord in males



some contents found in the spermatic cord go to the testes at the scrotum and part of it, like vas deferens (which starts from the epididymis), goes to the abdomen, so there are structures that get out of the testes and structures that get into the testes.

2. Passage of round ligament in female
3. Passage of genital branch of genitofemoral nerve and the ilioinguinal nerve.

Inguinal triangle / Hesselbach's triangle

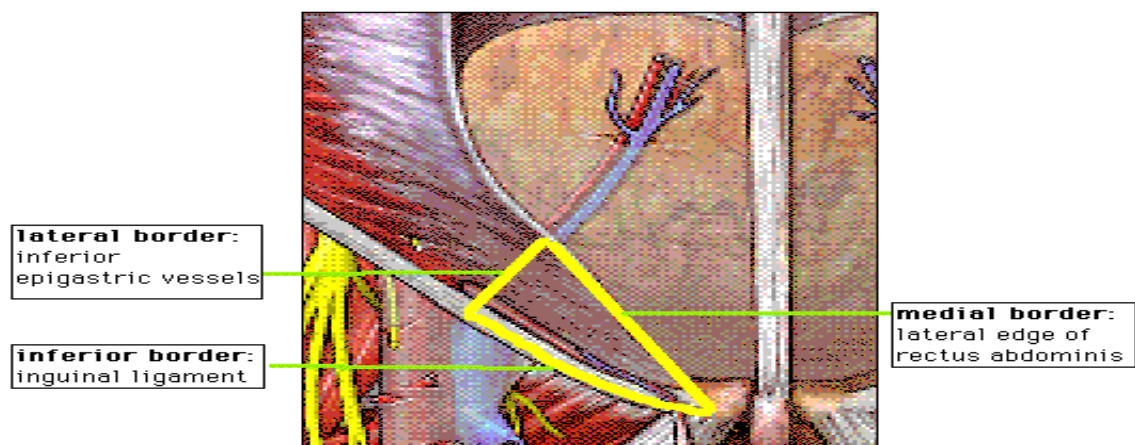
What is the difference between inguinal canal and inguinal triangle ?

It's the type of hernia;

Hernia in the inguinal triangle \rightsquigarrow direct inguinal hernia

Hernia in the inguinal canal \rightsquigarrow indirect inguinal hernia

The yellow triangle at this picture :



The boundaries of the triangle :

***Base/inferior border : inguinal ligament

***lateral border : inferior epigastric vessels (branches of external iliac artery and vein).

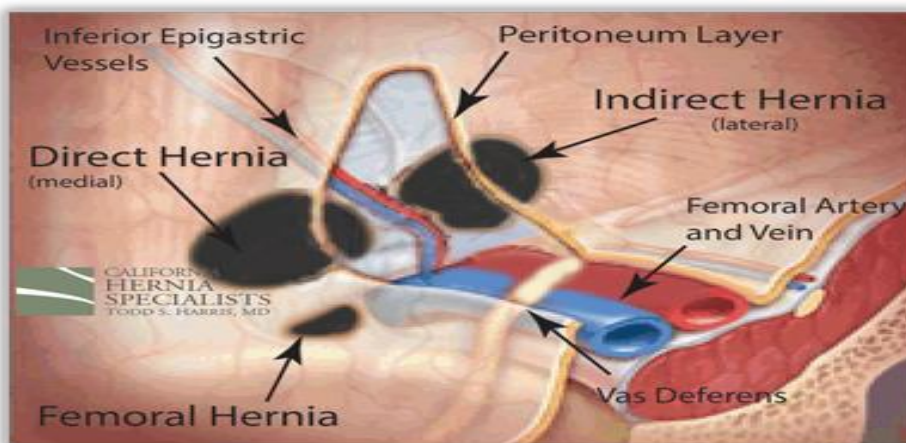
***medial border :linea semilunaris (lateral edge of rectus abdominis muscle / rectus sheath , the same)

The inferior epigastric artery is important in the cases of hernia :

Direct hernia >>>> **medial** to the inferior epigastric artery .

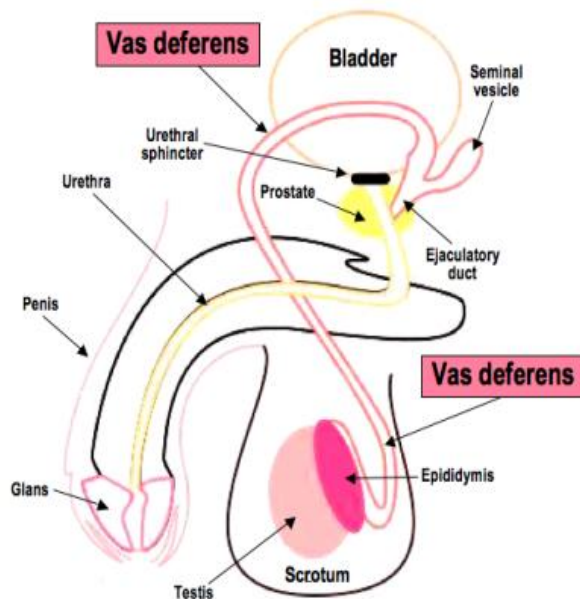
Indirect hernia >>>> **lateral** to The inferior epigastric artery

Look at this picture for illustration :



-Spermatic cord

it's group of structures , the most important one is **vas deferens** (ductus deferens) الوعاء الناقل , it's length about 45cm , starts from the tail of **epididymis** in the scrotum and enter the inguinal canal and from the **deep ring** it goes to the **posterior** surface of the **urinary bladder** and terminates in the **seminal vesicle** .



Function of vas deferens : conveys the sperms from epididymis to seminal vesicles .

Sometimes in the operations of hernia , doctors make mistakes by ligating vas deferens with spermatic cord ,which results in infertility in males.

Good doctors separate the vas deferens while operating , asking one of their helpers to hold it away to avoid hurting it.

-testicular artery and artery to vas

-sympathetic fibers for sympathetic innervation

-pampiniform plexus of veins :

Group of veins that make plexus , if those veins were large and tortuous we call this condition varicocele (دوالي الخصية) common in people who stand a lot for a long time like the police men) and this leads to killing of sperms because of the temperature increment .

You know that the formation of sperms in testes happens at 2-3 degrees below the body temperature and that's why the testes are located outside the body.

Solution : surgery , cutting of the excess veins so the temperature becomes normal and he can have babies now.

We have 3 layers covering the spermatic cord:

- 1.External spermatic fascia : from the external oblique aponeurosis and attached to the superficial inguinal ring.
2. cremasteric muscle and fascia : from the internal oblique aponeurosis in the inguinal canal.
3. Internal spermatic fascia : from transversalis fascia and attached to the deep inguinal ring.

So again, the doctor read the **content of spermatic cord :**

- Vas deferens/ductus deferens
- Testicular artery and vein
- Testicular lymph vessels
- Autonomic nerves : especially sympathetic fibers
- **Processus vaginalis**

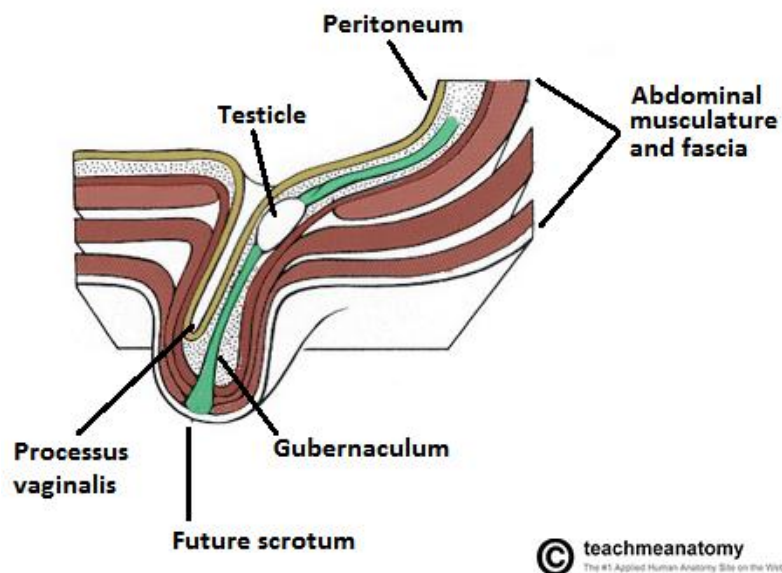
Before talking about it we have to know **where the testes formed in the embryo.**

They are formed in the ***posterior wall of the abdomen*** at the level of L1 **vertebra** , now before the 8th month of pregnancy ,the testes must reach the

scrotum in males and ovaries must reach the ovarian fossa in the pelvis in females .

The question is who carry them down?

Something called gubernaculum in the embryo (actually it is a ligament) and processus vaginalis , which is a portion of the peritoneum .



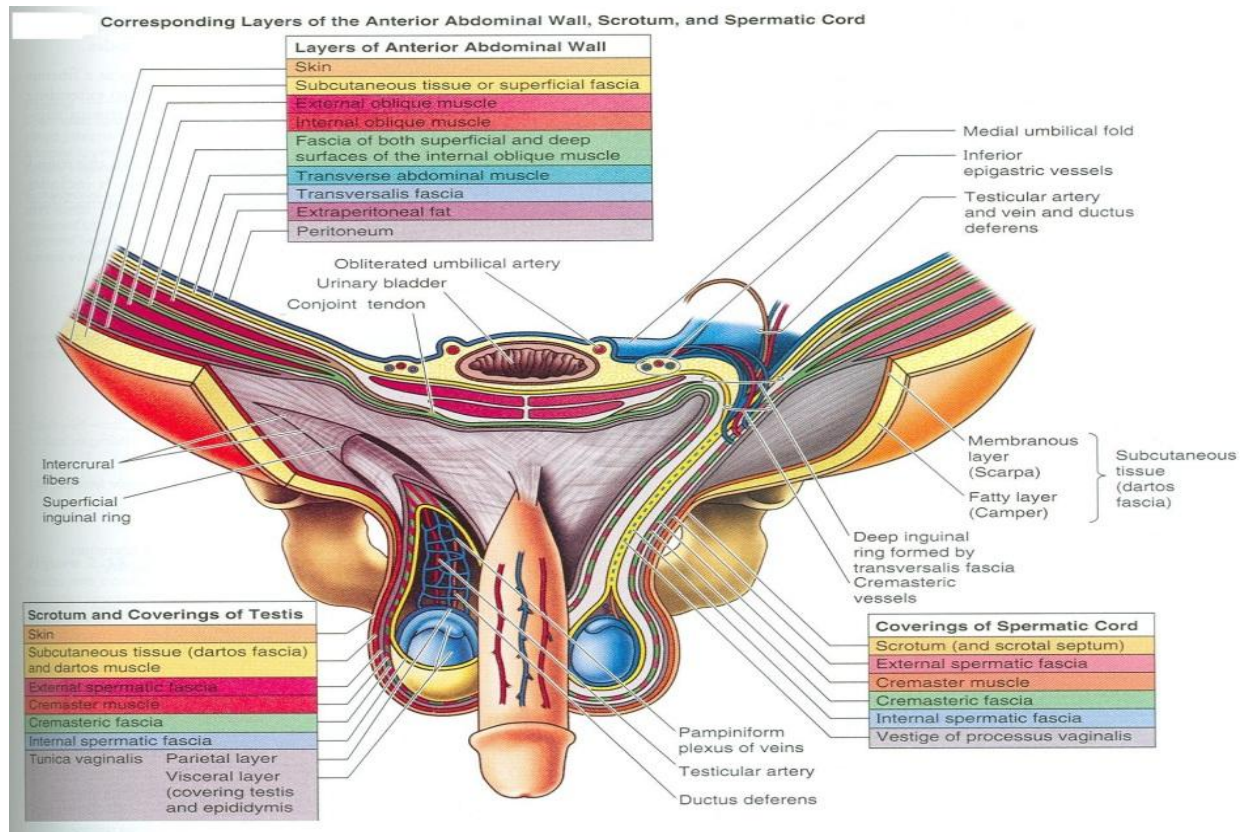
So processus vaginalis is part of the peritoneum , together with the gubernaculum go to the testis and pull it through the inguinal canal to the scrotum (the one that forms the inguinal canal is processus vaginalis) *before the 8th month.*

So, when the baby is out, you have to check whether the testes are in the scrotum or not , if not the baby may has mal-descent and he needs surgery .

- Cremasric artery : to the cremasteric muscle .
- Artery of the vas deference
- Genital branch of genitofemoral nerve

- Ilioinguinal nerve from L1 , goes through the inguinal canal and become *sensory* to the scrotum .

If you look at this picture you'll find the layers of the anterior abdominal wall.



Now let's talk about their continuation on the scrotum,

- The fatty layer gives dartos muscle
- The membranous layer (Scarpa's fascia) gives colle's fascia
- Then we have the 3 spermatic fascias;
 - external spermatic fascia
 - cremasteric muscle and fascia
 - internal spermatic fascia

And finally tunica vaginalis around the scrotum which is a remnant of the processus vaginalis .

When the processus vaginalis delivers the testes, it will be obliterated/closed in the deep ring, and the remaining portion around testes become *tunica vaginalis* which surround it except posteriorly .

There's a shiny material called tunica albuginea.

(extra information : tunica albuginea is a layer of connective tissue that surrounds penis, testicles and ovaries)

Vas deferens

Length : 45 cm

Function : conveys the sperms from epididymis to seminal vesicles

Pay attention

at the last line in slide 19 it's written that : "to the prostatic urethra " which is wrong , the doctor corrected it and said : "it reaches the seminal vesicles ,and from the seminal vesicle we have ejaculatory duct which opens in the prostatic urethra "

*** It's the ejaculatory duct not the vas deferens that opens in the prostatic urethra***

Testicular artery

-Branch of abdominal aorta at the level of L2

-It descends with spermatic cord in the inguinal canal

-Supplies testes and epididymis

Testicular veins

Plexus of veins called **pampiniform** plexus of veins, those veins *start from the testes* in the form of plexus, but when they reach the deep ring they become one vein >>> **testicular vein** .

***Drainage of the vein:

On the **right** side it drains into **inferior vena cava**.

On the **left** side it drains into **left renal vein**.

***varicocele is more common at the left side than the right one; because the vein on the right side is oblique , while on the left is perpendicular and with long standing there will be stagnation in blood and formation of varicocele.

Autonomic nerves

Sympathetic nerves, descend with **testicular artery** , and the afferent fibers are sensory while the genital branch of genitofemoral nerve supplies the cremasteric muscle.

What is the function of cremasteric muscle ?

We have something called **cremasteric reflex**, it causes itching at the upper medial side of the thigh(*mediated by sensation through the femoral branch of genitofemoral (L1,L2) and ilioinguinal sensory nerves L1*), then the reflex is contraction of the cremasteric muscle and the testis goes upward, this reflex happens in winter to pull the testes upward to protect them from the very cold weather in winter, where the cremasteric muscle contract by *the genital branch of genitofemoral nerve (motor , L1,L2)* .

Testicular lymphatic vessels

The lymph vessels from testes and epididymis go to lumbar /Para-aortic lymph nodes (at the sides of aorta) to the extent of L1 , while lymph in the scrotum go to superficial inguinal lymph nodes .

There's a way to differentiate between cancers :

Cancer in the scrotum>>> enlargement of superficial inguinal lymph nodes

Cancer in testes / epididymis >>>> enlargement of para-aortic lymph nodes

Processus vaginalis

(Extends from L1 to scrotum)

We said that it's important in fetus , and it must be closed (obliterated) before delivery at the deep ring , if it remains opened, there will congenital **INDIRECT** inguinal hernia.

Inguinal hernia

Protrusion of one of the contents of abdomen (like small intestine or greater omentum) through weak point in the anterior / posterior abdominal wall.

Why ?

Small intestine>>> because it has mesentery , so it move ,like jejunum and ilium .(note :duodenum is retro-peritoneum and immobile)

Greater omentum>>> because it's very long .

There must be a **weak point** ,it's a must , like :

*deep inguinal ring because it was opened and then closed

*inguinal triangle : weak especially in old age because the abdominal muscles become weak.

What exactly happens ?

- 1- Sometimes in adults who have chronic cough (like people who smoke a lot, so they will cough a lot), they use intra-abdominal muscles thus increase the pressure on these weak points, and that pressure causes the peritoneum to enter through the deep ring and form hernia.
- 2- Chronic constipation >> the patient press on his abdomen which leads to press on weak points and finally you'll notice a bulge (hernia) coming from anterior abdominal wall.

The first thing to get in the ring is the peritoneum (this beginning called hernia sac) because it is the lining of the abdominal cavity then followed by greater omentum /small intestine .

Hernia consist of : -hernial sac

-contents and covering of the sac

Hernia starts at deep inguinal ring and goes through the canal to the superficial ring and it could reach scrotum .(this is the indirect inguinal hernia and we said that it lies lateral to the inferior epigastric artery).

Hernial sac in relation to the pubic tubercle lies above and medial to it .

****Reminder :** femoral hernia lies below and lateral to the pubic tubercle.

* **Hernial sac** is mostly peritoneum and part of processus vaginalis , it lies beside the spermatic cord and could reach the scrotum.

***the indirect hernia in females could reach the labia majora.

The neck of the hernia sac is found in the deep ring and it's 20 times more common in young males than females.

So the indirect hernia is the most common hernia and most of it is congenital (when we have no closure of the processus vaginalis)

Direct Inguinal Hernia

In the inguinal triangle , the hernia projects **ONLY** forward on the abdominal wall *due to weakness in the abdominal muscles* and it's common in old age especially if he/she has chronic cough .

*rarely in women.

***MEDIAL** to inferior epigastric artery.

Refer to the table in slide 34 ; you'll find at the table 2 tests :

- 1- Superficial inguinal ring test >>> to restore the hernia to the superficial ring , if you feel the pulsation of inferior epigastric **on the tip of your fingers then it's indirect hernia**, while if you feel the pulsation on the **lateral side then it's direct hernia** , it depends on the direction of reduction .
- 2- Deep ring test >>> to restore the hernia to the abdomen and close the deep ring by your index , then ask the patient to cough , if it was indirect there will be no bulge since you closed the deep ring, but if it was direct, there will be bulge .

(the doctor said that he will illustrate this at the practical sessions)

In the case of indirect hernia ,,,, the scrotum could reach the knee joint because it's skin and fat .



Indirect hernia reaching the
scrotum

Scrotum

We have talked about the scrotum and the layers of it, the skin of the scrotum is wrinkled and brown, and below the skin there's dartos muscle (*which is smooth muscle*) which gives the skin those wrinkles, and of course there's hair on the skin.

The scrotum is found outside the body because the testes must be in the scrotum where the formation of sperms takes place at a temperature which is 2-3 degree lower than the body's temperature.

Superficial fascia : we said that it's 3 layers surrounding the scrotum .

We can see that the spermatic cord reaches the scrotum on right and left side separated by penis, and we said that the membranous layer is called colle's fascia.

The layers again :

- external spermatic fascia
- cremasteric muscle and fascia
- internal spermatic fascia
- tunica vaginalis: comes from processus vaginalis and surrounds the testes from anterior, medial and lateral side EXCEPT posteriorly, why?

>>>Because of the presence of epididymis.

***tunica albuginea is the shiny layer .

Sometimes there is a condition called hydrocele that happens in the testes, what's the hydrocele ?

>>>it's accumulation of fluids in the testes in tunica vaginalis(surrounding the testes).

Treatment >>> aspiration, we put cannula and let it enter all layers of scrotum until we reach tunica vaginalis(fluids are found outside the tunica vaginalis)

Testes

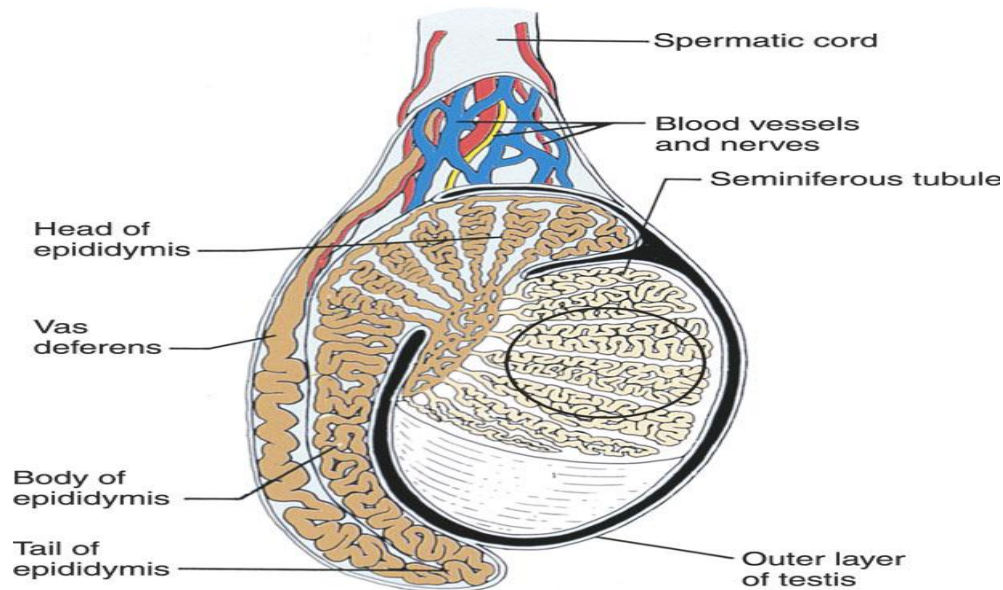
Two testes found within scrotum, consist of coiled seminiferous tubules where the formation of sperms takes place , precisely at its wall .

So formation Of sperms occurs in the wall of seminifrous tubules of the testes.

After the sperms formation , they are deposited in the epididymis .

*Epididymis consist of :*head *body *tail

Function of epididymis : **maturation of sperms** (sperms stay for 10-14 days in the epididymis for maturation before they travel through the vas deferens to seminal vesicle) .



At the tail of epididymis, we find the beginning of vas deferens which travels with spermatic cord and reaches the posterior surface of urinary bladder to end in the seminal vesicles, then the ejaculatory duct emerges from the seminal vesicle and it opens in prostatic urethra.

Note : urethra in males is divided into three parts :

- 1-prostatic urethra
- 2-membranous urethra
- 3-penile urethra.

***the end of vas deferens called >>>ampulla .

Blood supply of testes

Testicular artery from the abdominal aorta at the level of L2.

Vein

At right ~~~~~To inferior vena cava .

At left ~~~~~ to left renal vein .

Lymphatic drainage of testes

from scrotum ~→ superficial inguinal lymph nodes.

From testes ~~~→ para-aortic lymph nodes at level of L1 .

Nerve supply to testes:

1 - Autonomic nerve :

Afferent sensory nerve

sympathetic around the testicular artery.

2 - genital branch of genitofemoral nerve is important for cremasteric reflex .

Information you should know:

1-Varicocele : dilatation and tortuousness of pampiniform plexus of veins , more common on the left side and can cause infertility .

2- vasectomy : cut and ligation of the vas deferens, so no sperms to go to seminal vesicles and by default no sperm to go out (sterility).

In the past , women who didn't want babies used to ligate the fallopian tube , now men ligate the vas deferens since women

became bossy 

3- Processus vaginalis , it must be obliterated , if it still persist, it will cause indirect inguinal hernia and sometimes congenital hydrocele and sometimes it causes encyst above the cord .

Hydrocele

We said that it's accumulation of fluids in tunica vaginalis , the reason maybe inflammation or idiopathic .

Treatment : aspiration(tapping) by cannula .

*****Layers that are penetrated by the cannula are really important**

The last thing is anomalies of the testes

Sometimes the testes are not found after birth in the scrotum after delivery

It could be :

1- Cryptorchidism>> abnormal site like in the

- Abdominal cavity
- In inguinal canal
- At superficial inguinal ring
- In upper part of scrotum

And at these situations there must be surgical treatment(as soon as possible before the age of 6) because it could transform into cancer cells .

2- Maldescent

It could reach :

Superficial fascia

Root of penis

Perineum

In the thigh

****Cryptorchidism is more common ****

Now this box contains the most prominent differences in this sheet

- 1) Inguinal canal :
 - in males → contains the spermatic cord
 - in females → contains the round ligament of uterus
- 2) Superficial and deep inguinal ring :
 - In adults, they are parallel to the inguinal ligament
 - In new born , they are opposite to each other
- 3) Source of spermatic fascia:
 - margin of deep ring gives the internal spermatic fascia
 - margin of superficial ring gives the external spermatic fascia
- 4) Location of the two rings
 - deep ring in the transversalis fascia
 - superficial ring in the external oblique aponeurosis
- 5) Type of hernia :
 - direct hernia in inguinal triangle
 - indirect hernia in inguinal canal or could be congenital due to persistence processus vaginalis
- 6) the relation of hernia to the inferior epigastric artery:
 - direct hernia medial to the artery
 - Indirect hernia lateral to the artery

- 7) relation between the enlarged lymph nodes with type of cancer :
 - enlargement in the superficial inguinal lymph nodes >the cancer in the scrotum
 - enlargement in the para-aortic lymph nodes > cancer in testes or epididymis

Done by :Raghad al-Masri



GI System
Anatomy #4

Dr. "Mohammad Al-Mohtasib"

March 29, 2015



Best wishes

