



Persistence
& Creativity

Anatomy Comics, Objectives 13.1, 13.3 & 13.4

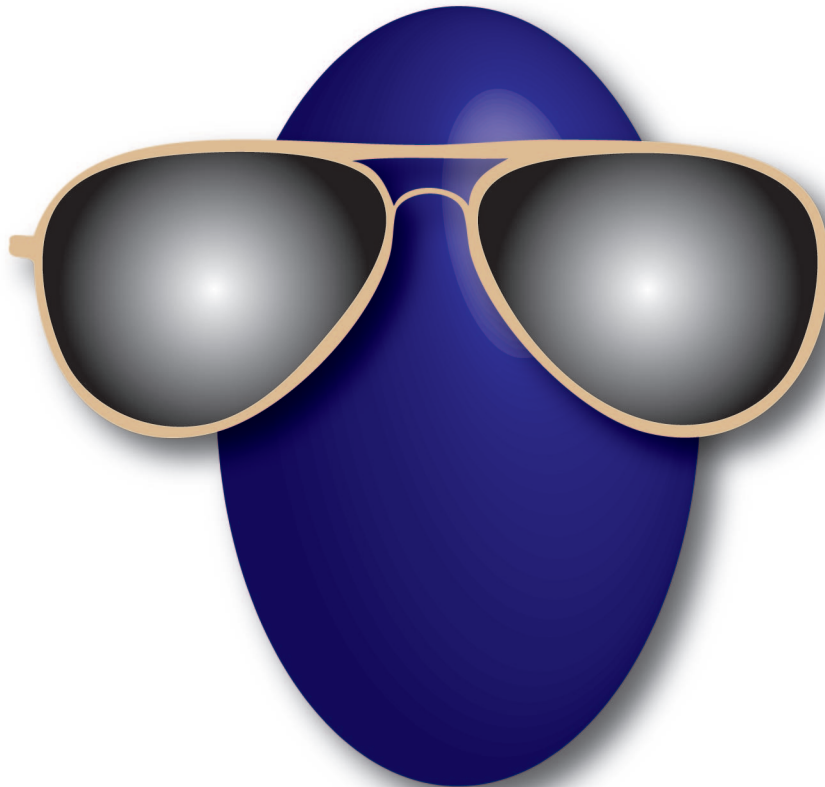


Simple
Comix

13.1 Identify the fascial and muscular components of the anterior abdominal wall, including the sheath of the rectus abdominus muscle above and below the arcuate line.

13.3 Identify the muscular and ligamentous structures that form the borders of the inguinal canal. Demonstrate the structures that pass through the inguinal canal in the male or female. Demonstrate the inguinal triangle and the location of direct versus indirect hernias.

13.4 Note: All students are responsible for the male and female cadaver components of this objective but for DEMO purposes just show the portion that pertains to the sex of the cadaver you dissect.
Male cadavers: Follow the course of the testes as they descend through the inguinal canal to the scrotum. Identify the homologies between abdominal wall fascia (or muscle) and coverings of the spermatic cord.
Female cadavers: Follow the course of the round ligament as it passes through the inguinal canal to the labia majus.



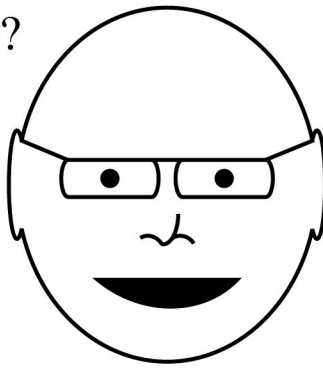
1. What type of hernia is this?

A. Direct

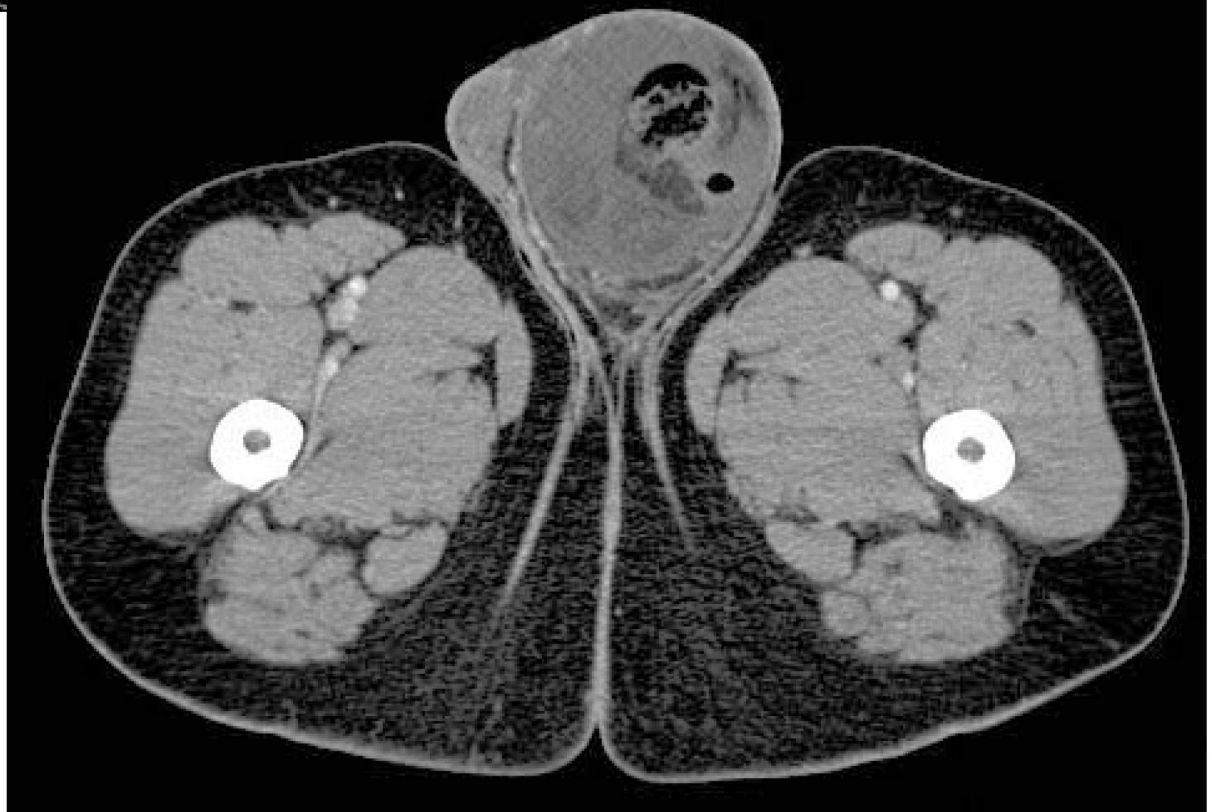
B. Indirect

C. Femoral

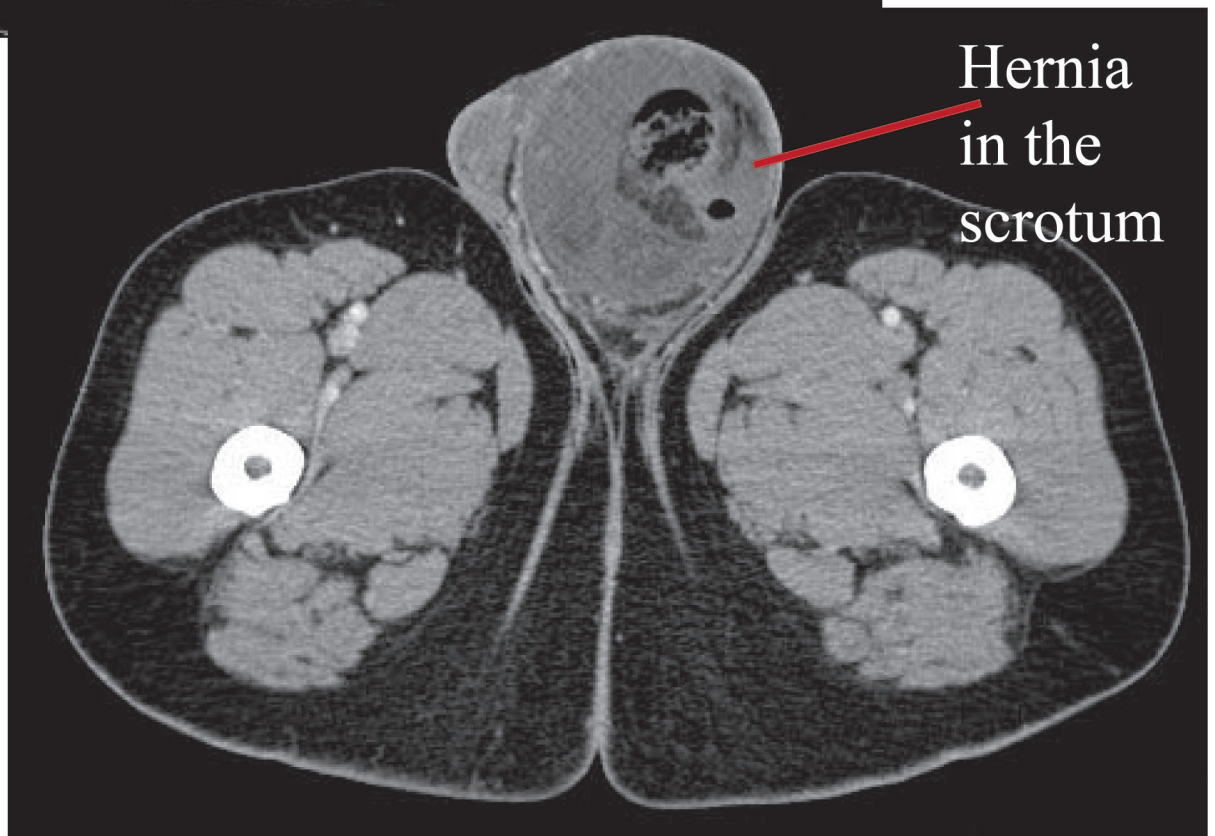
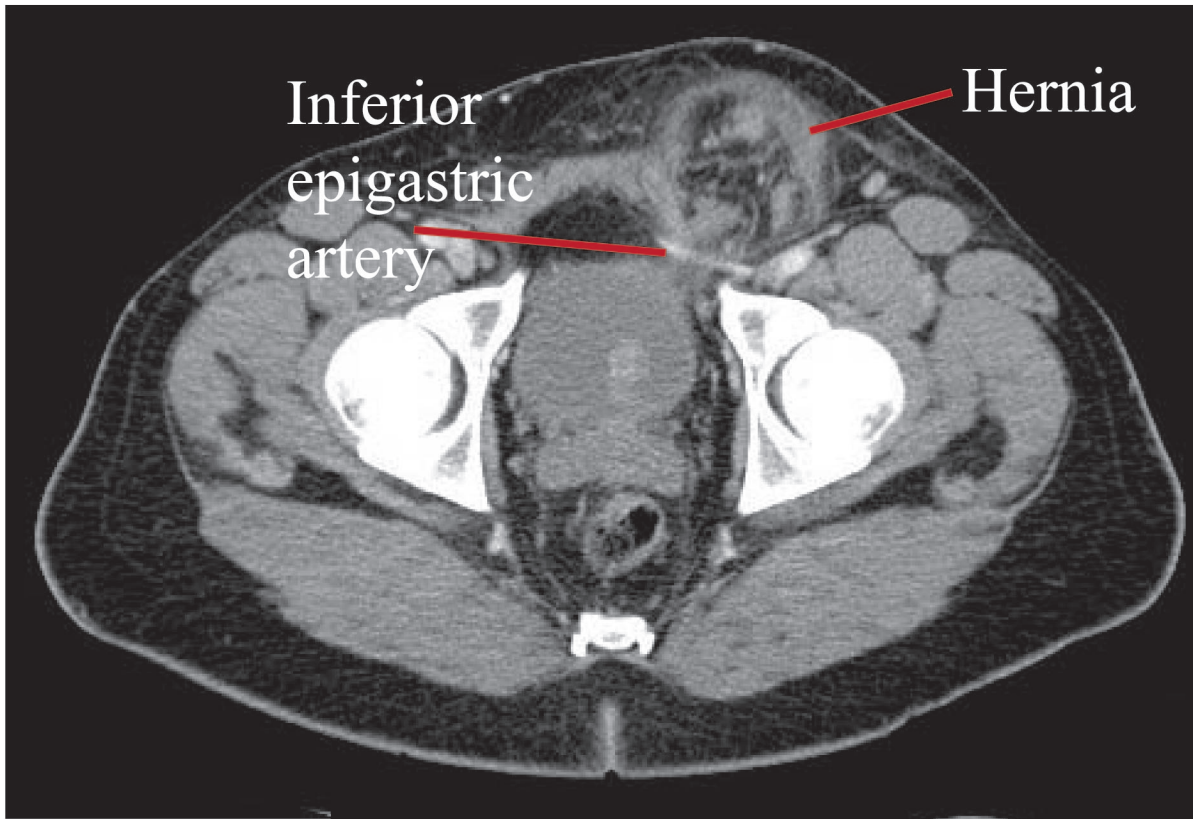
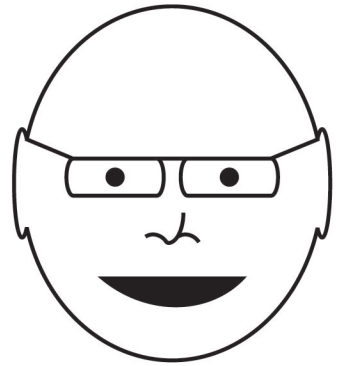
D. Umbilical

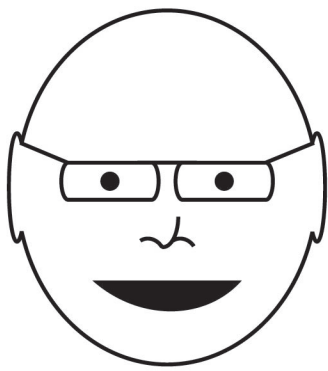


Right to
the point,
huh?



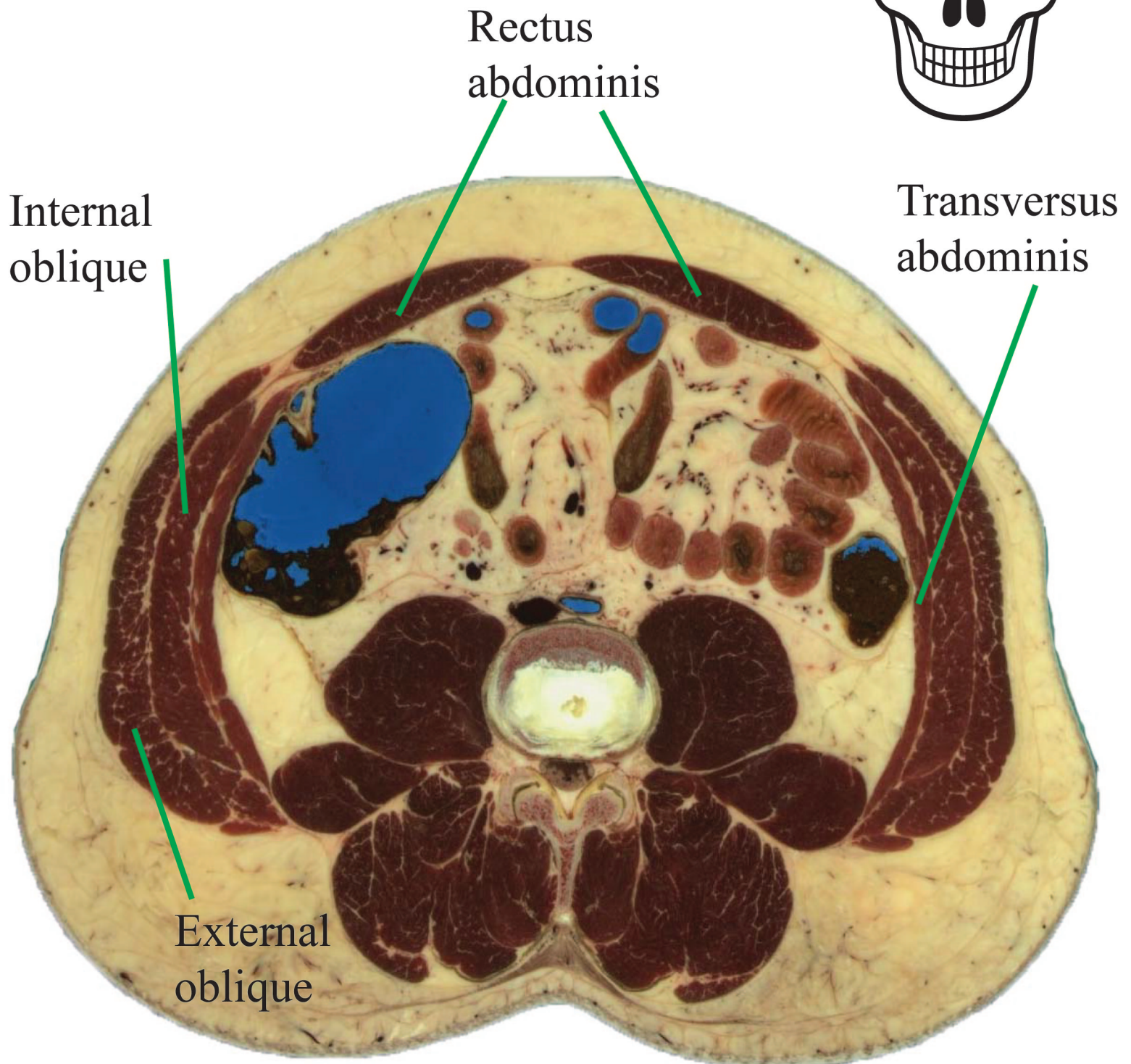
This is an indirect hernia. Femoral and umbilical are incorrect because the hernia does not involve the thigh or umbilicus, it involves the scrotum. You can tell that this is an indirect and not a direct hernia because the inferior epigastric artery is displaced medially. Don't worry, we'll go over the anatomy of the inguinal canal and all of this will become clear, at least that's the plan!



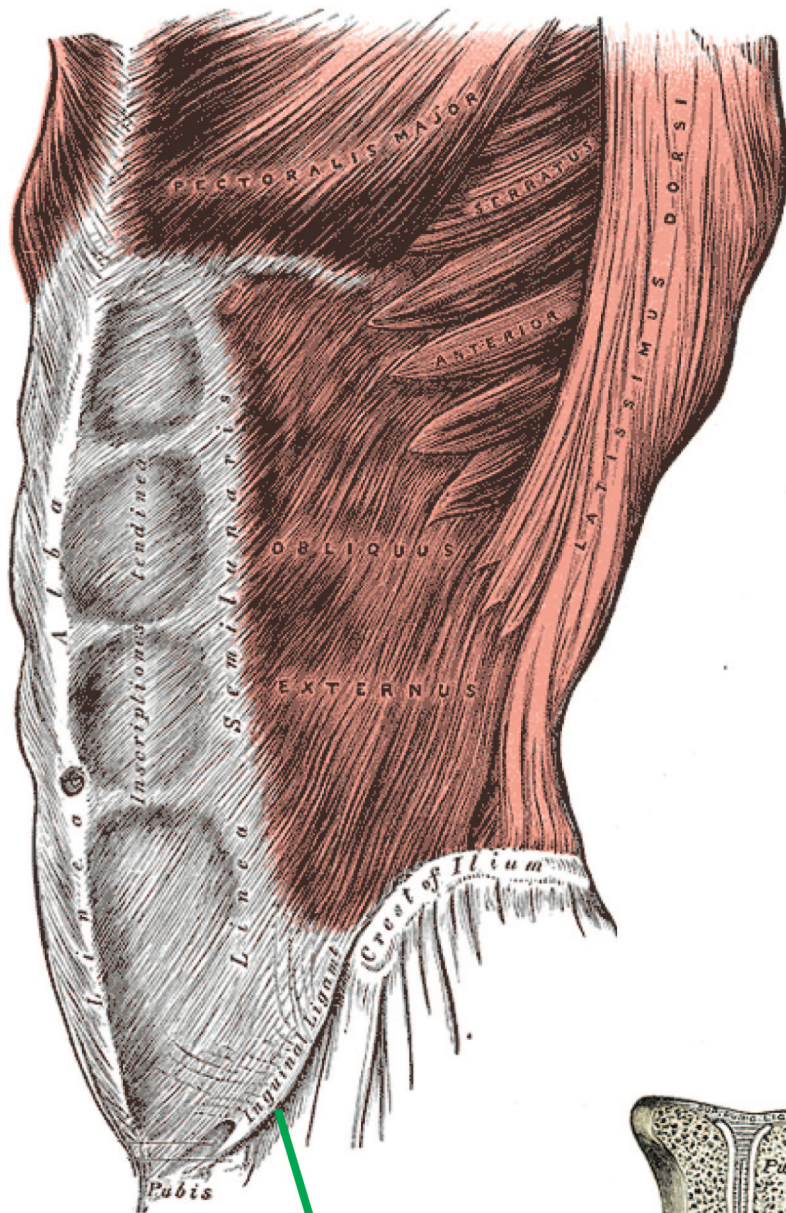
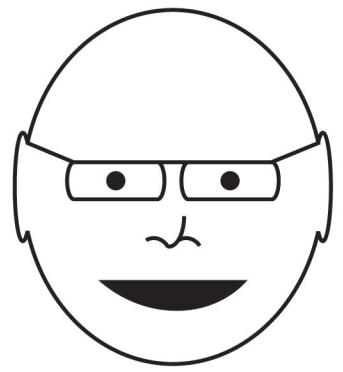


We'll start by identifying the muscles of the anterior abdominal wall. Luckily you already know them, they are pretty much the same as the muscles of the chest wall.

Well, close enough, check them out below.



Now, there is an extra thing or two we need to know about these muscles, starting with the external oblique. The most inferior part of the external oblique aponeurosis (which is just a fancy term for a sheet-like tendon) forms the inguinal ligament. The ligament runs from the anterior superior iliac spine to the pubic tubercle.

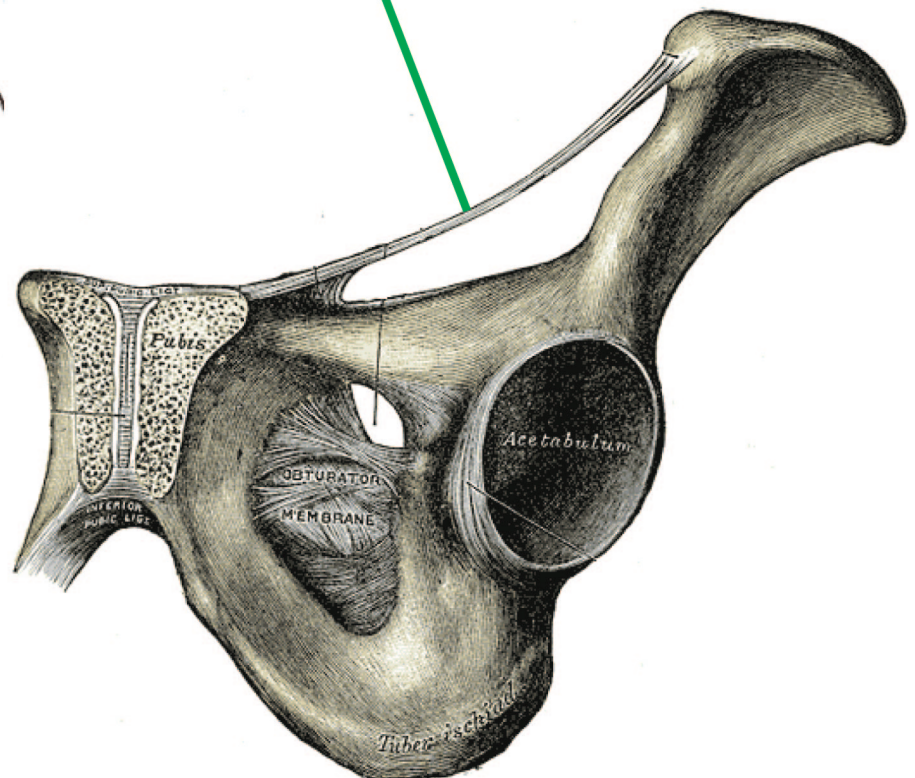


Stealing from Gray's Anatomy again, eh?!



Inguinal ligament

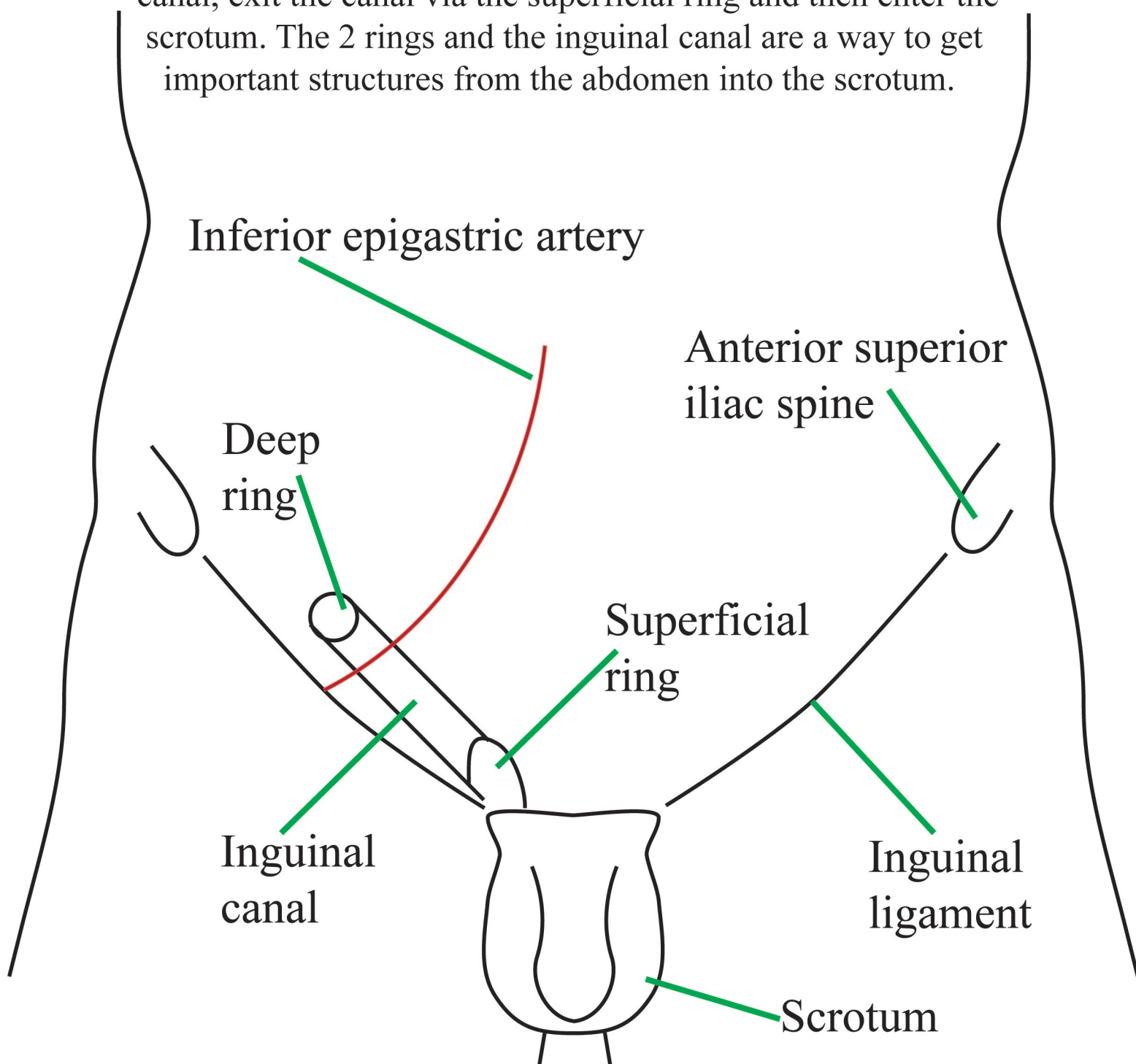
Inguinal ligament

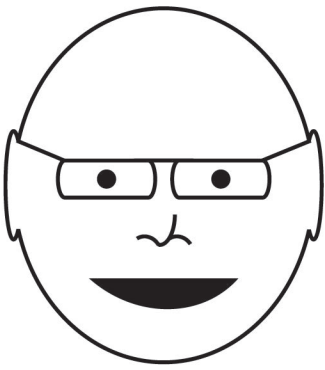


The inguinal ligament forms part of the inguinal canal, where most of that funny hernia stuff occurs in the weaker sex (men, natch!). Let's take a look at where the inguinal canal lives before resuming our discussion of the abdominal wall muscles. I'm hopeful that you can recognize the drawing below as the lower abdomen/upper thighs of a man. I have labelled our important landmarks. The entrance to the inguinal canal is the so called deep ring and the exit is the superficial ring.

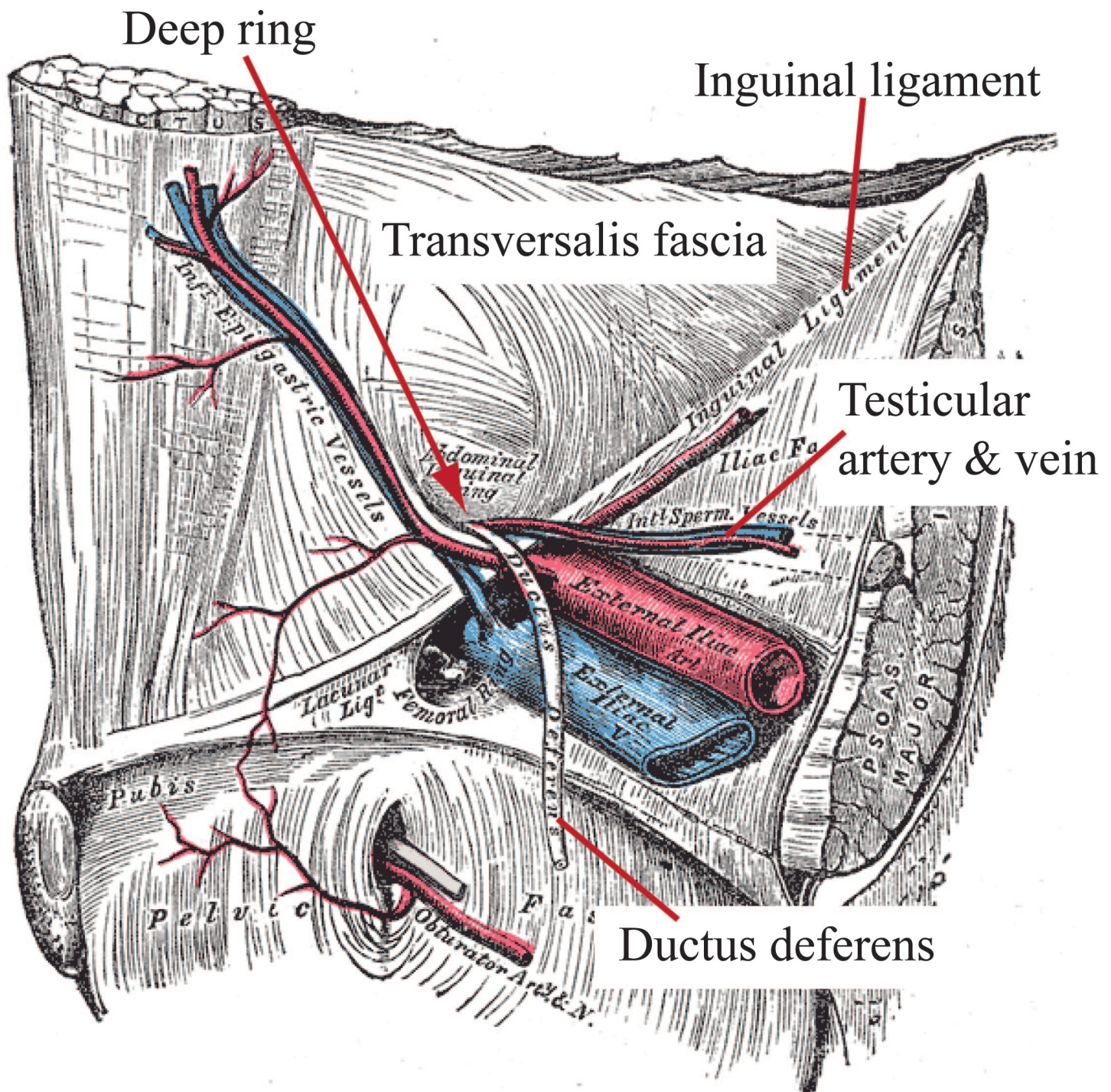


Structures pass from the abdomen through the deep ring, down the inguinal canal, exit the canal via the superficial ring and then enter the scrotum. The 2 rings and the inguinal canal are a way to get important structures from the abdomen into the scrotum.





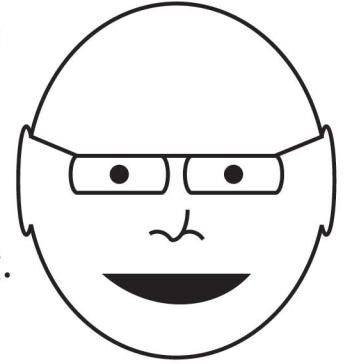
The illustration from Gray's below is drawn as if you were standing inside the lower abdomen, looking at the back of the deepest lateral abdominal muscle, the transversalis. The deep inguinal ring is actually a hole in the transversalis fascia. Intraabdominal structures (testicular artery/vein and the ductus deferens) go through the deep ring and enter the inguinal canal.





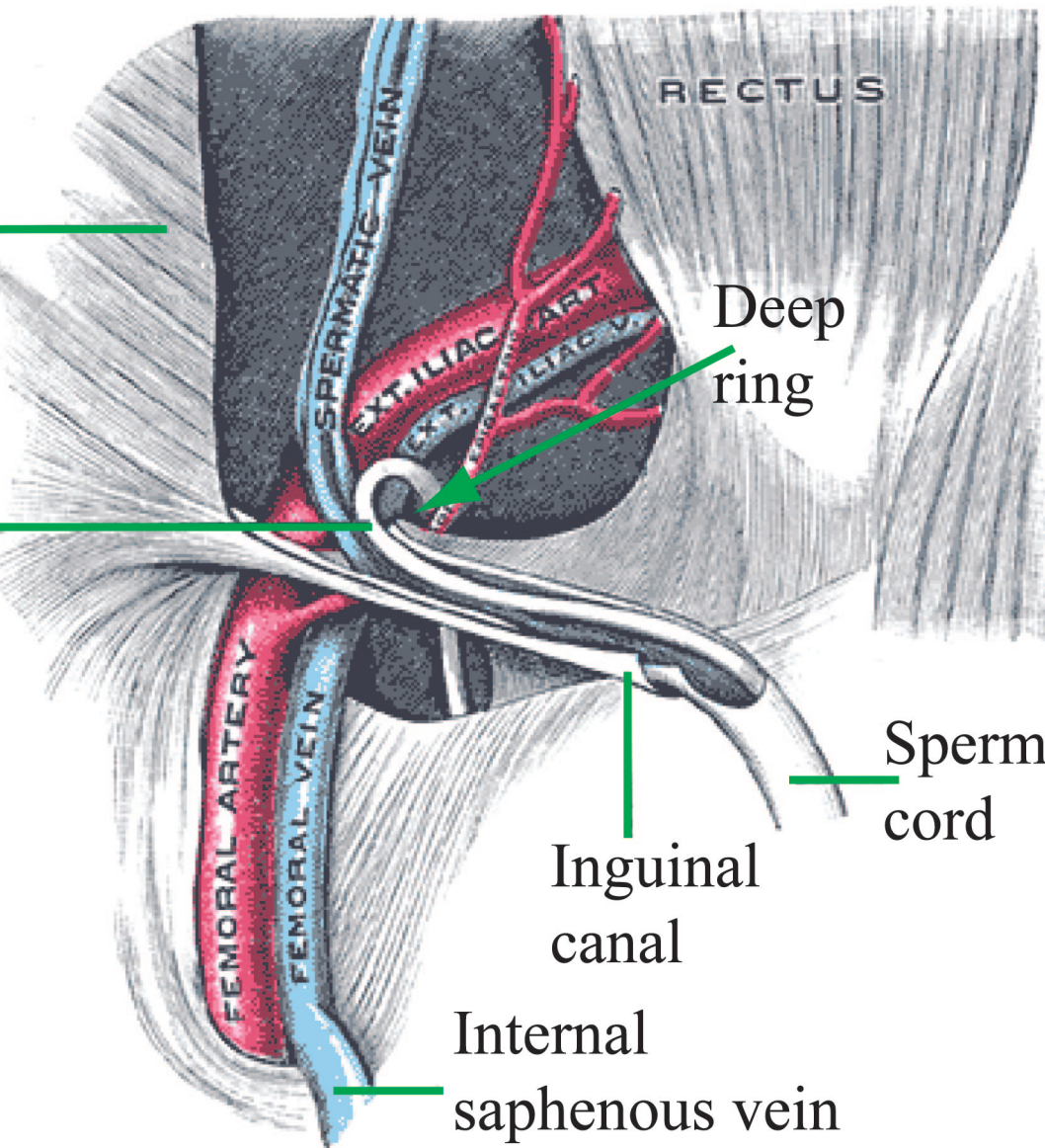
Let's look at the anatomy of the inguinal canal from the front. This is a deep dissection, with exposure of the deep ring, showing the oblique, inferior and medial course of the canal and its contents: the spermatic cord.

We'll go over the components of the spermatic cord which contains the structures that traverse the inguinal canal in detail later, but for now, we'll move on to the superficial ring.



External
oblique
muscle

Ductus
deferens

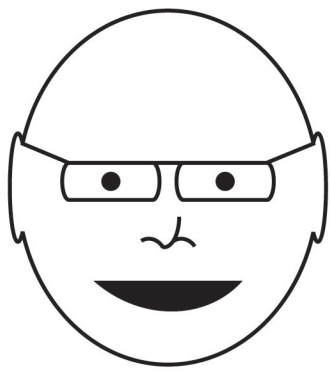


Deep
ring

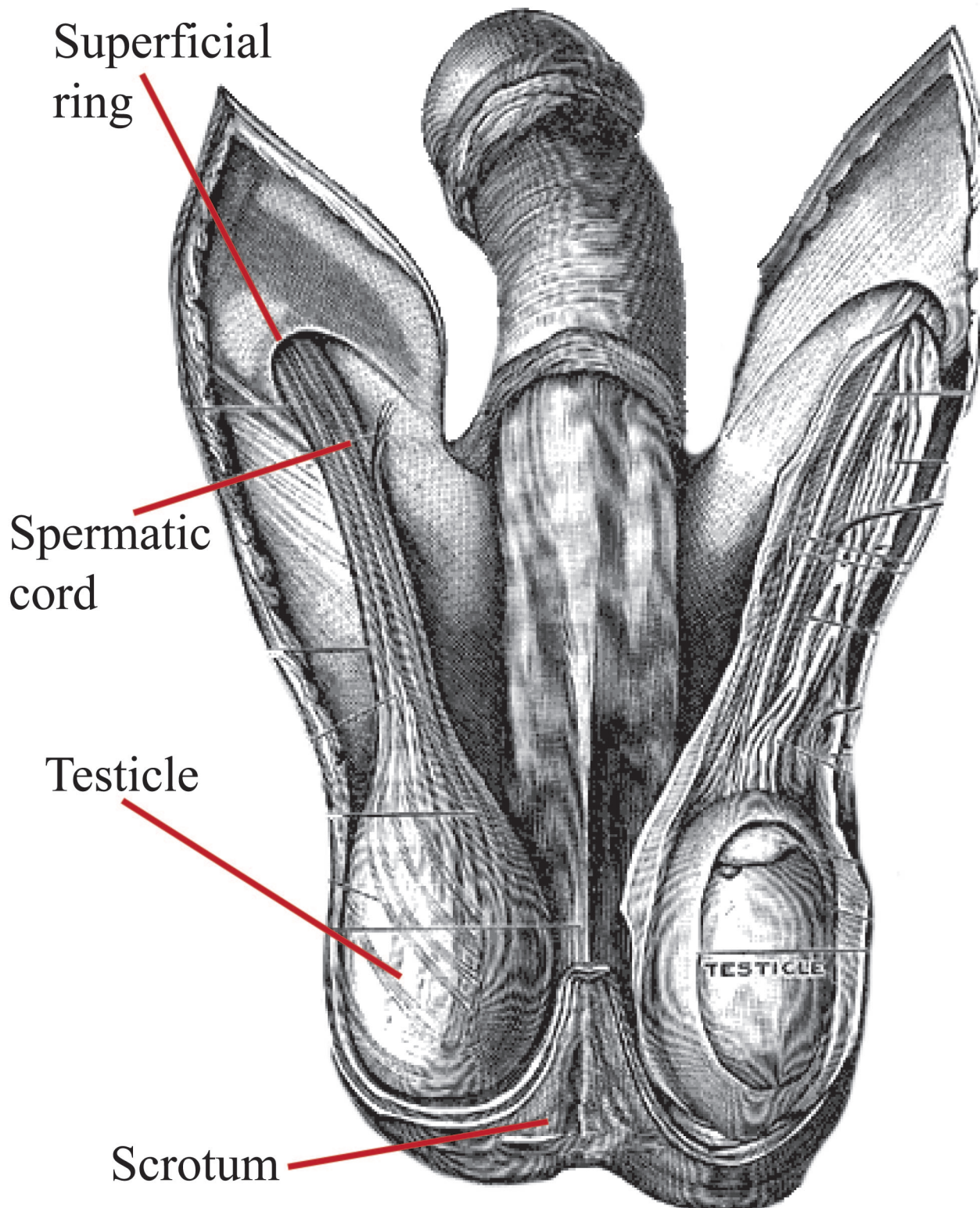
Spermatic
cord

Inguinal
canal

Internal
saphenous vein



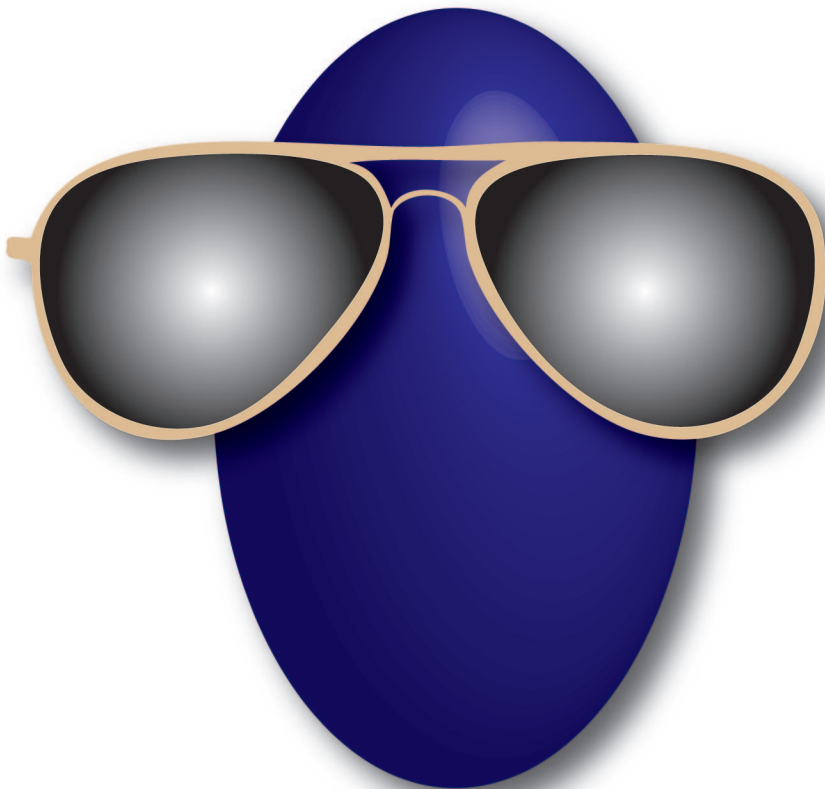
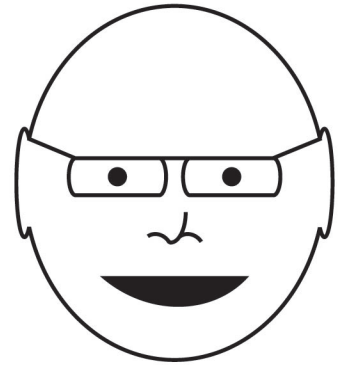
We have finally reached the superficial ring! The contents of the inguinal canal (the spermatic cord) exit the canal through the superficial ring and enter the scrotum. Why is all of this complex anatomy necessary? Well, it's because there is one organ that is literally too cool to hang out in the abdomen with real hard working organs!





Indeed, there is one organ that has the cojones to demand its own climate controlled house (the scrotum) with a private driveway (the inguinal canal), and that organ is the well, uh...

Are you blushing, even your teeth are red?! The testicles “live” in the scrotum because the scrotum keeps the testes 2 degrees cooler than the rest of the body, which is essential for spermatogenesis. But you are correct, the testicle is a bit of a prima donna (not literally of course) and even has his own entourage (the spermatic cord contents). We are now ready to review the descent of the testes from the abdomen into the scrotum.



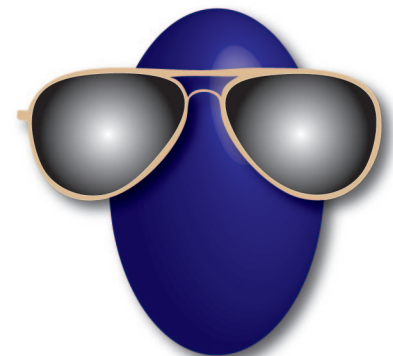
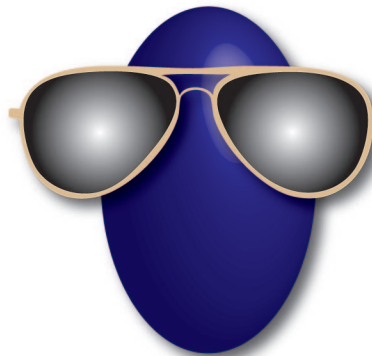
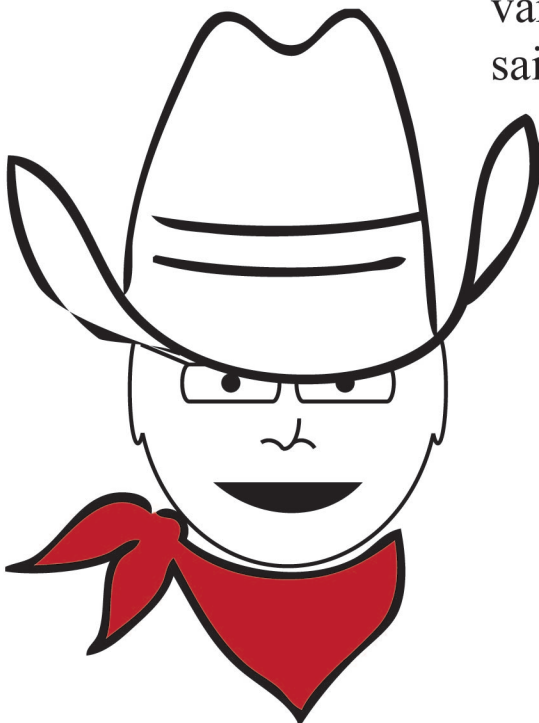
Yes, “Descent of the Testicle: Journey through the Darkness”, the dramatic role that launched me on the path to superstardom!

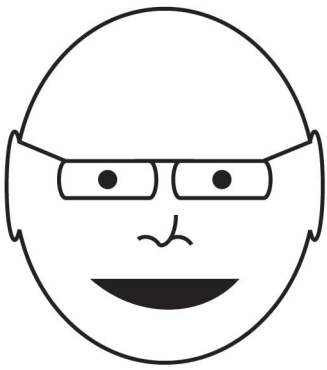
In the fetus, the testicles start off at the back of the abdominal wall, just below the kidneys. Somehow, they have to migrate to the scrotum, through the anterior abdominal wall layers that we have seen. The sequence of events goes something like this:



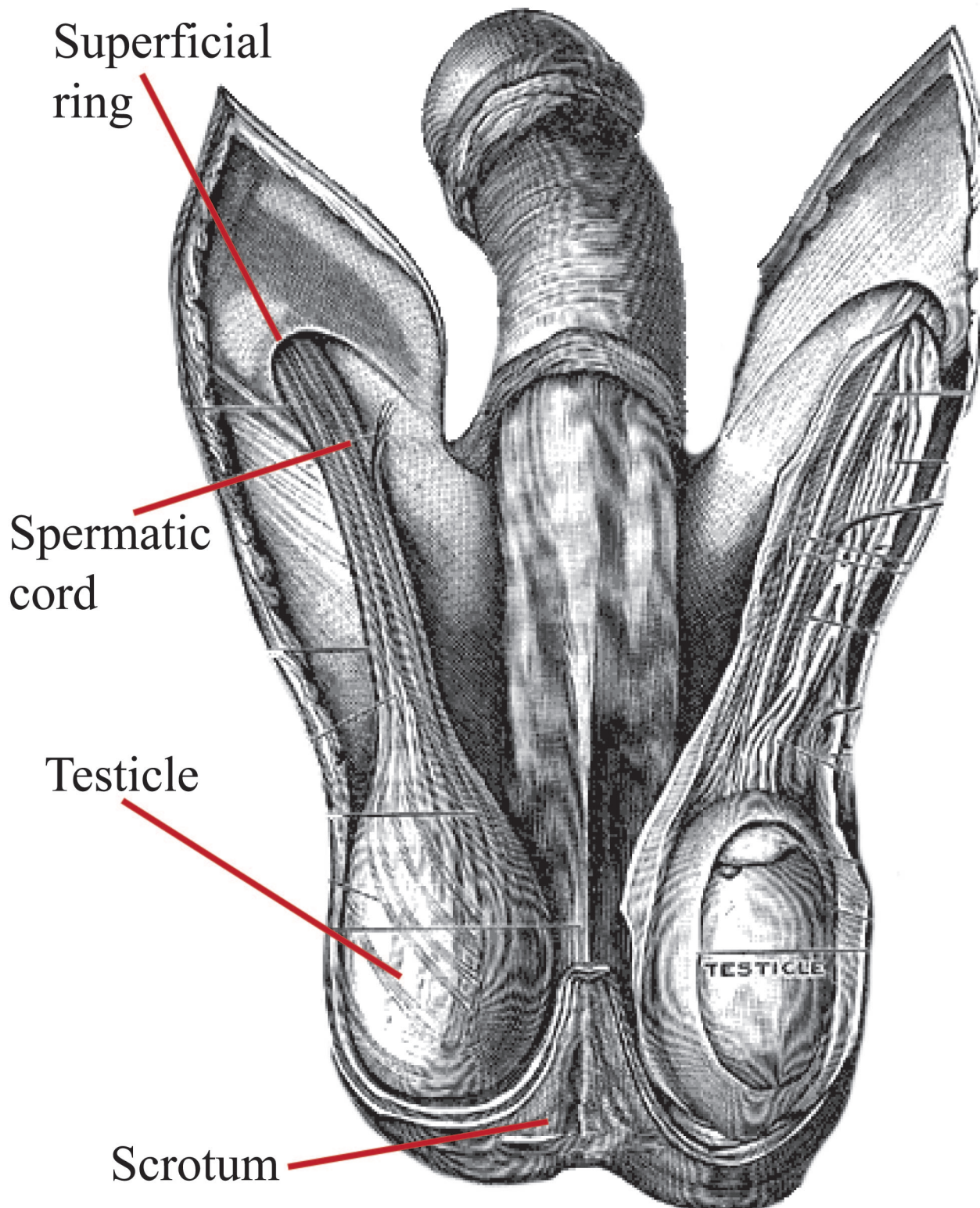
- 1) A “ligament” called the gubernaculum grows down from the bottom of the testicle, obliquely through the anterior abdominal wall to the future home of the scrotum.
- 2) The processus vaginalis, an outpouching of peritoneum, follows the path established by the gubernaculum into the scrotum. On the way to the scrotum, the processus vaginalis opens up the deep ring, creates the inguinal canal and opens the superficial ring.
- 3) The testicle descends from the abdomen behind the processus vaginalis, through the deep ring, the inguinal canal and the superficial ring to enter the scrotum.
- 4) On their way through the abdominal wall, the processus vaginalis and the testicle drag along some of the abdominal wall layers, specifically the transversalis fascia, the internal oblique muscle and fascia and the external oblique aponeurosis. These form the layers of the spermatic cord, which we’ll look at next.

Git along you
varmint!! I
said git!!

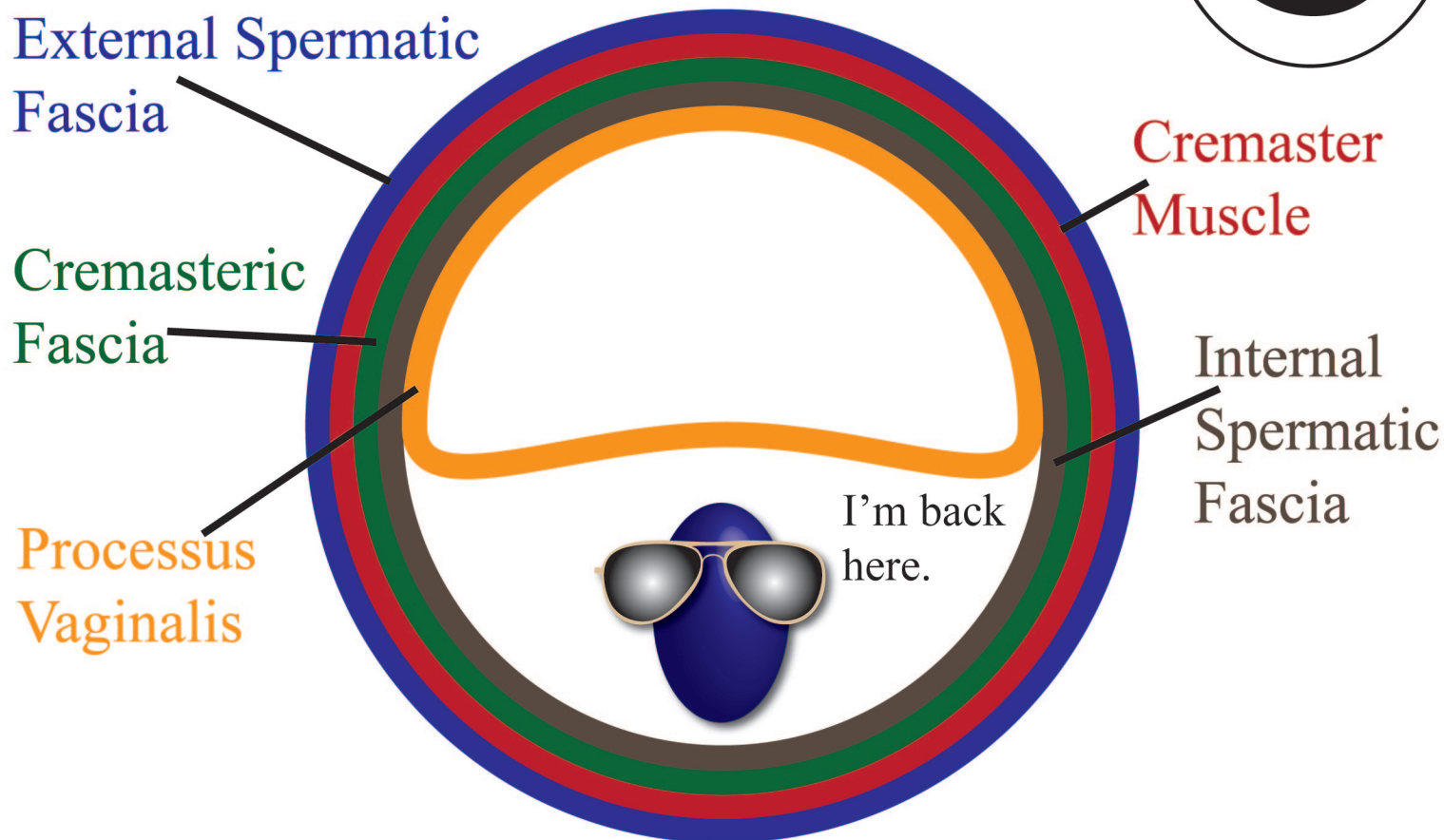
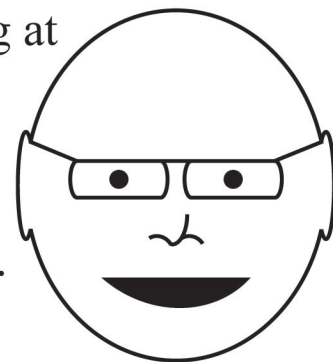




We have already seen this image, but now we want you to have a look at the spermatic cord. Remember, the layers of the spermatic cord are derived from those abdominal wall layers and are continuous with the layers around the testicle. The remnants (if any) of the processus vaginalis are also inside the cord as well the “entourage” of the testicle, which we will also look at.



We'll consider the layers of the spermatic cord first, by looking at the cord in cross section. These layers are derived from the anterior abdominal wall, as summarized in the chart at bottom. Remember, the testicle descends posterior to the processus vaginalis.



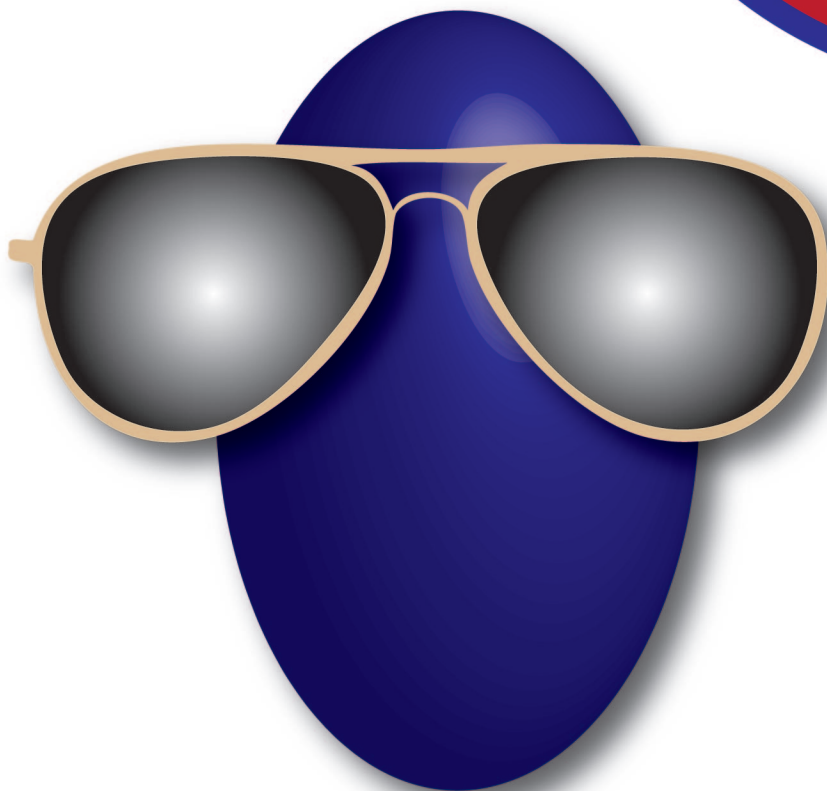
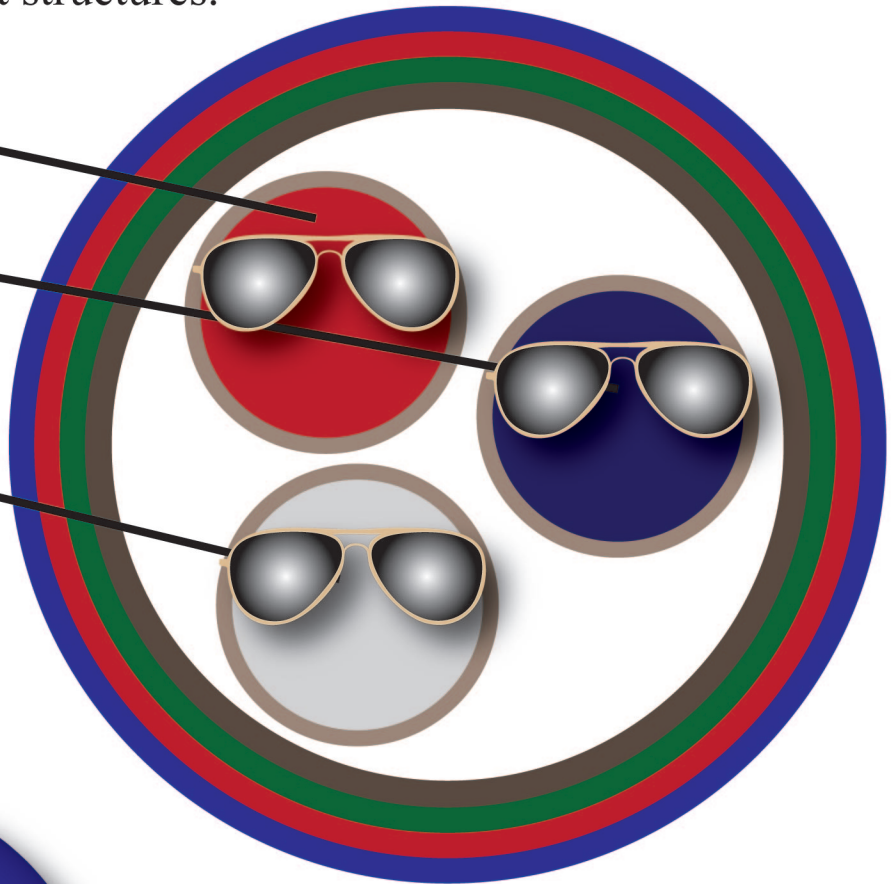
Abdominal Wall Layer	Spermatic Cord Layer
External Oblique Aponeurosis	External Spermatic Fascia
Internal Oblique Muscle	Cremaster Muscle
Internal Oblique Fascia	Cremasteric Fascia
Transversalis Fascia	Internal Spermatic Fascia
Peritoneum	Processus Vaginalis



Around birth, the processus vaginalis degenerates, so we have eliminated it from this illustration. We'll talk about what happens when the processus vaginalis fails to involute (hint: its bad!) in just a minute, but first we have to learn what lives inside the spermatic cord. We haven't shown everything in the cord, but we have shown the most important structures.

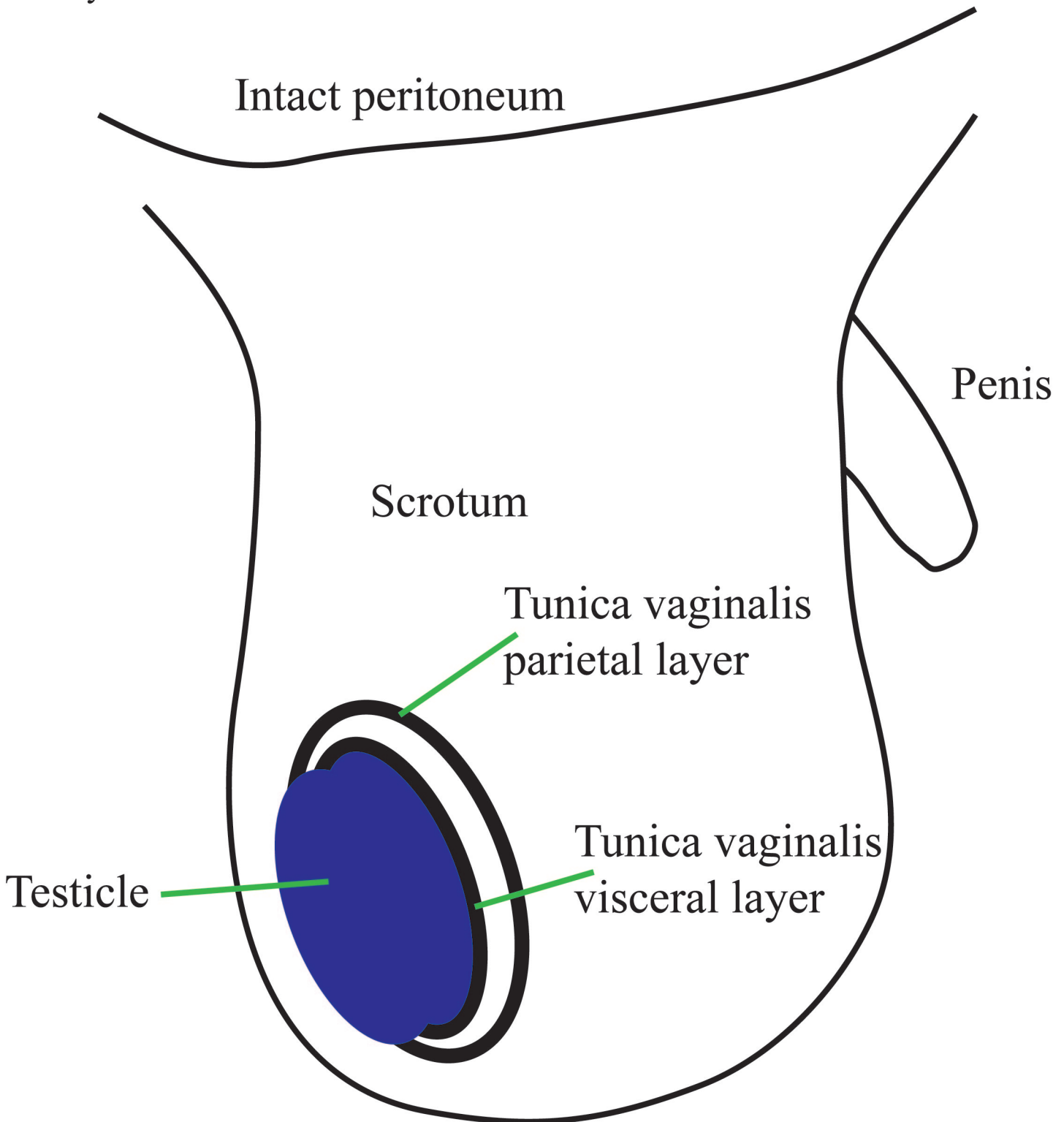
Testicular artery
and vein

Ductus
deferens

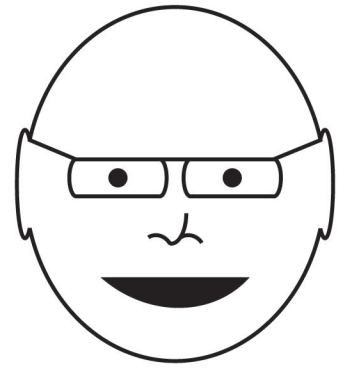


Hey, I need my posse!
The artery nourishes
me, the vein takes away
my waste products and
the ductus deferens
transports the fruits
of my labor!

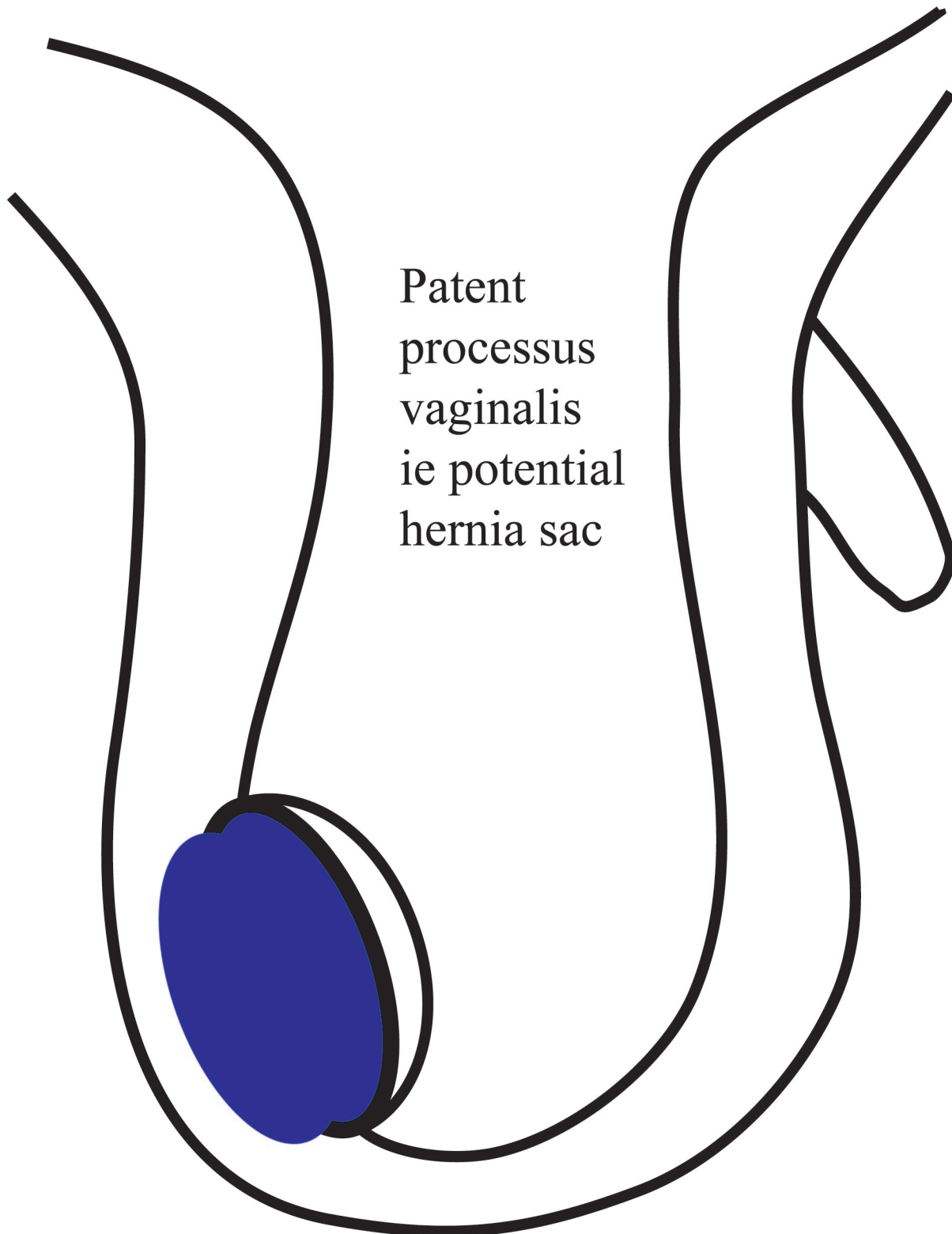
We have to learn just a little more embryology. In most males, the processus vaginalis involutes almost completely, leaving only the tunica vaginalis, a sac-like remnant of peritoneum surrounding the testicle similar to the way the pericardium envelops the heart, with an outer parietal and an inner visceral layer. As a result, there is no longer communication between the abdominal cavity and the scrotum.



But if the processus vaginalis remains patent, abdominal contents can slither through the deep ring, travel down the inguinal canal within the spermatic cord, exit the canal through the superficial ring and enter the scrotum. This is called an indirect hernia.

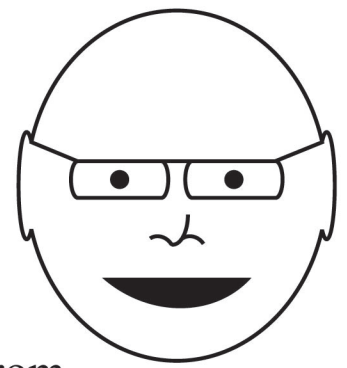


Abdomen

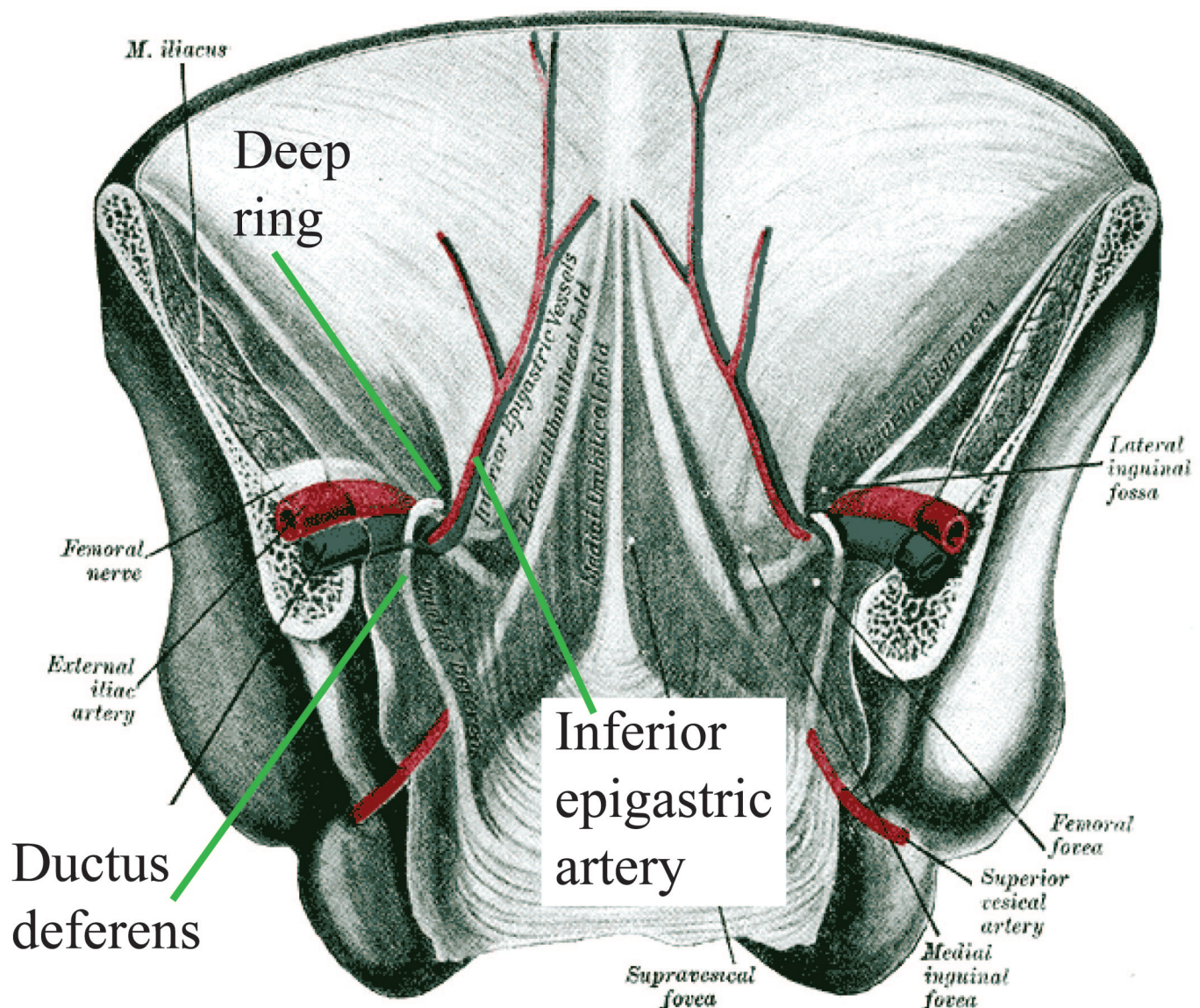


Patent
processus
vaginalis
ie potential
hernia sac

We have spent hardly any time looking at cross sectional anatomy! Let's look one more drawing from Gray's to learn the final pieces of anatomy we need to understand inguinal hernias. Then we'll look at cross sectional images of the inguinal canal, the spermatic cord, some of the cord's components and the inferior epigastric artery.



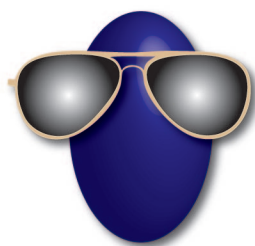
The illustration below shows the anterior abdominal wall from behind and shows the ductus deferens entering the deep ring, just lateral to the proximal inferior epigastric artery. The inferior epigastric artery arises from the external iliac artery just above the inguinal ligament and travels cephalad posterior to the rectus abdominis muscle to anastomose with the superior epigastric artery.



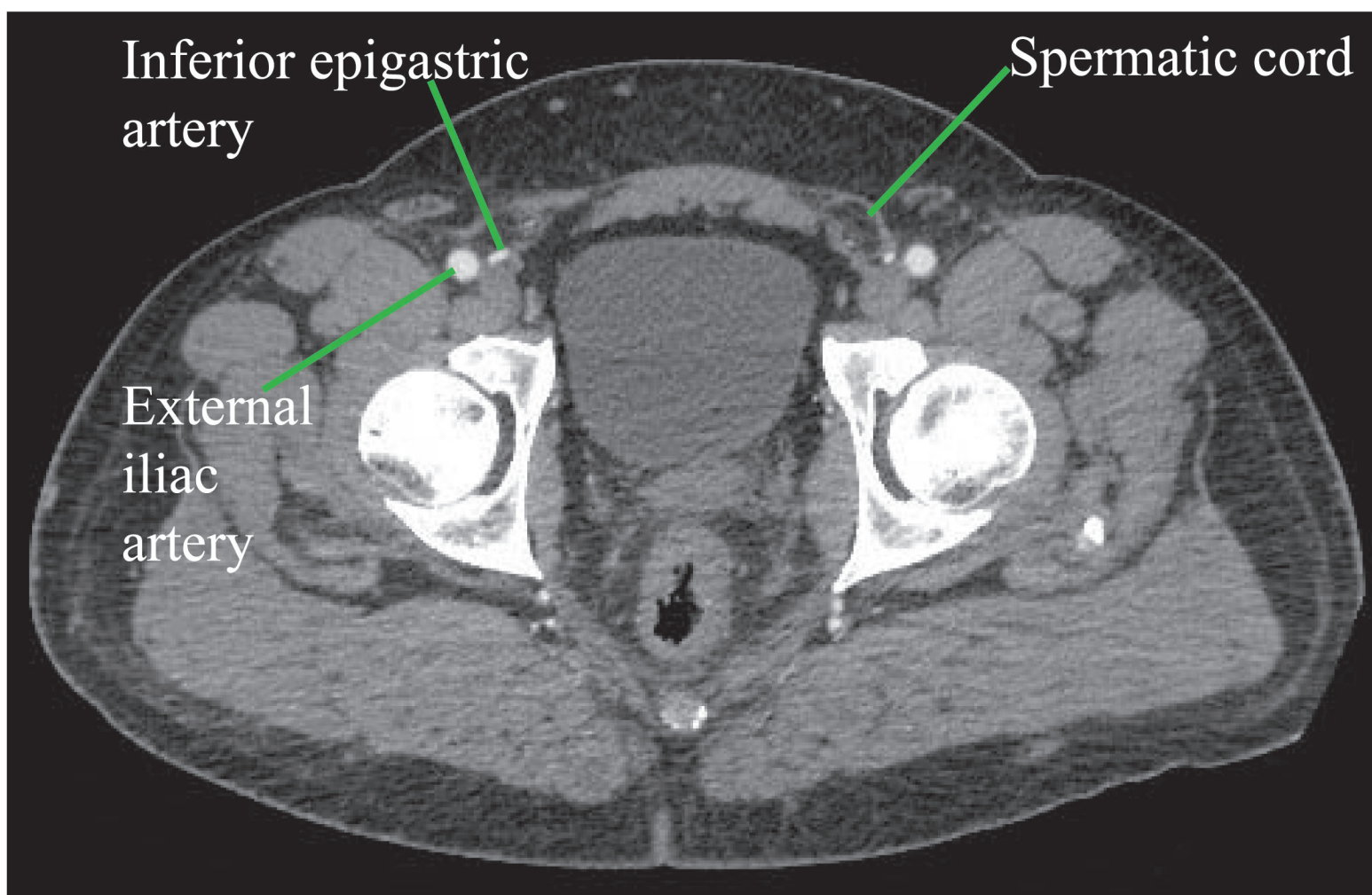
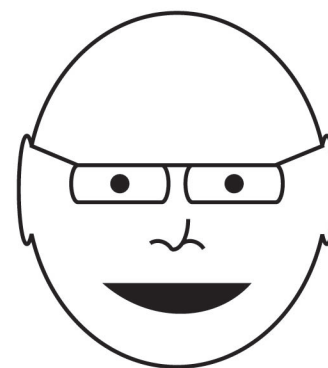
At last, cross sectional images! I have labelled the right inferior epigastric artery, shown just above its origin from the external iliac artery. I have also labelled the left spermatic cord. There is a tiny white dot in each spermatic cord: the testicular artery. From lateral to medial, the big white dot is the external iliac, the little dot is the epigastric and the tiny dot is the testicular artery in the cord.

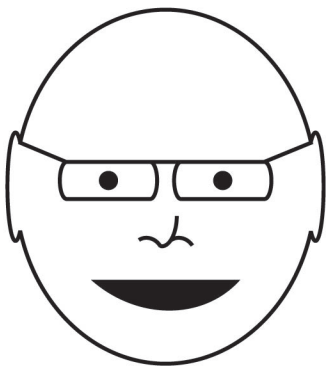


What about me?!



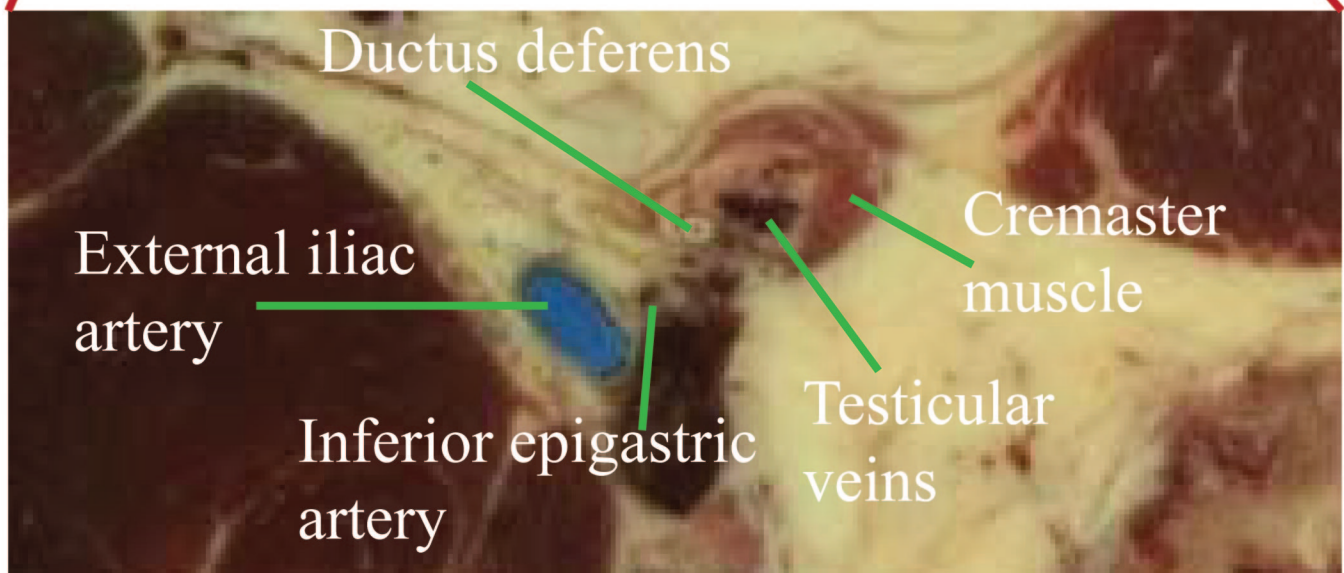
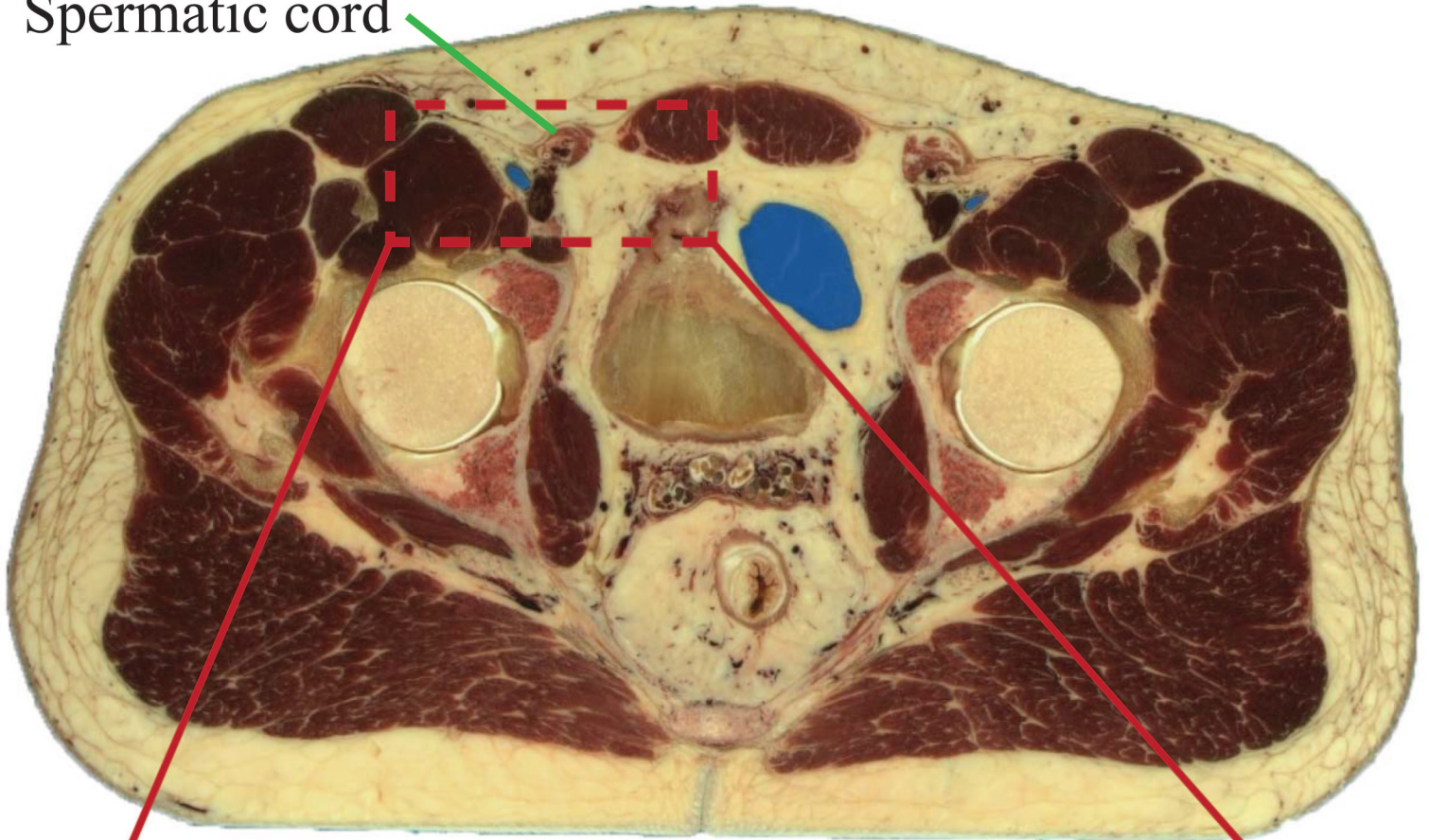
Don't make
a scene!

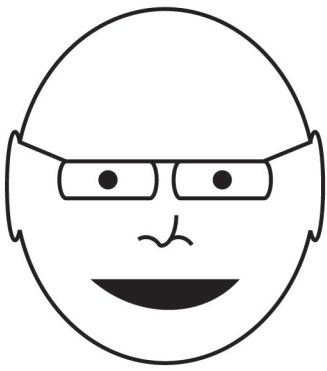




This image from the visible human shows the same anatomy as the CT scan we just looked at. Because the structures that are within and adjacent to the spermatic cord are so small we also included a magnified view of the inguinal canal. We will look at all of this in lab!

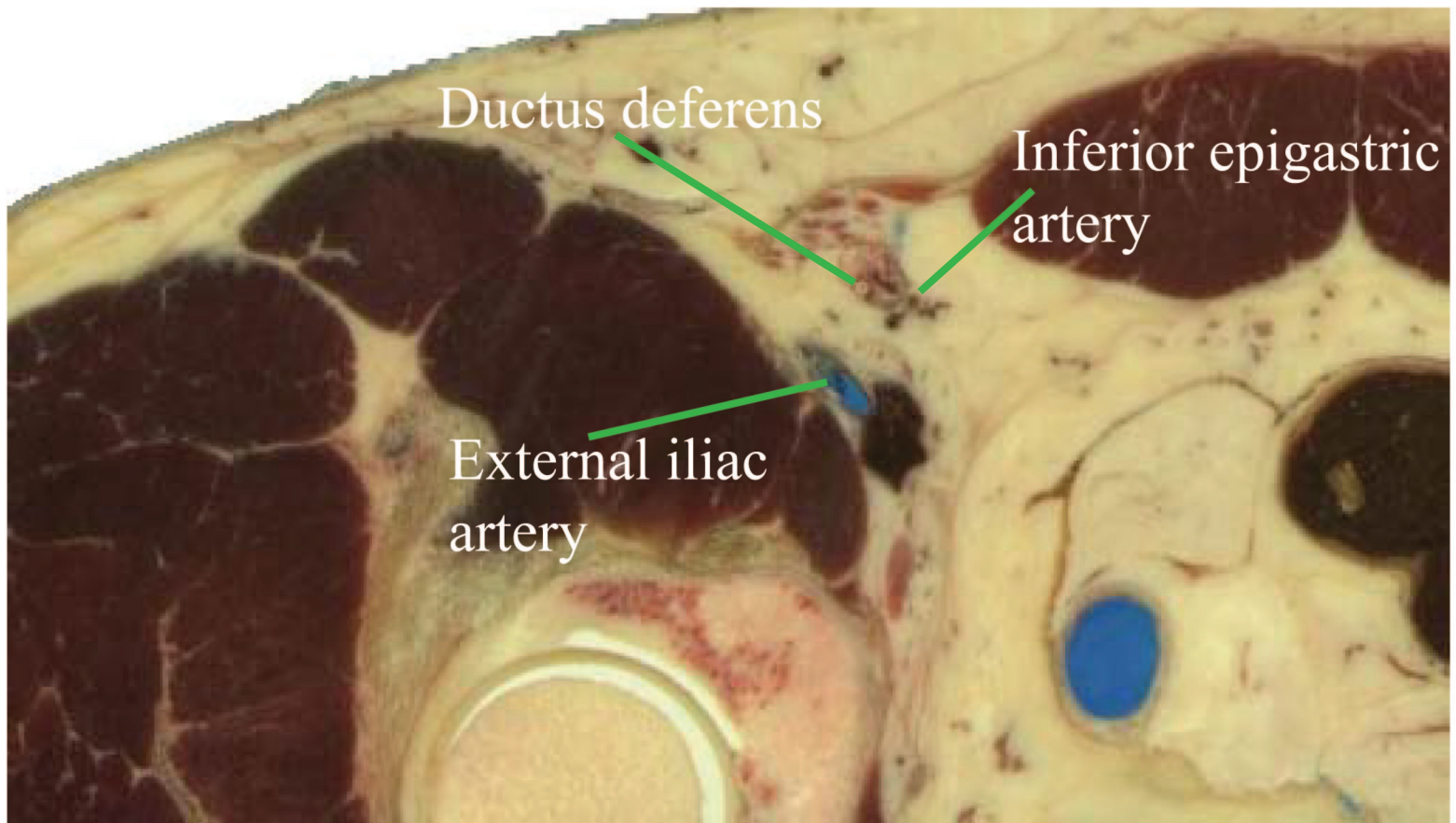
Spermatic cord





This visible human image shows that the inferior epigastric artery (yes, it is that tiny dot) medial to the spermatic cord at about the level of the deep ring. I cannot actually see the deep ring, but this is where it lives. This anatomy explains why an indirect hernia displaces the inferior epigastric artery medially: the herniated bowel enters the deep ring lateral to the inferior epigastric. The mass effect of the laterally located hernia pushes the artery medially.

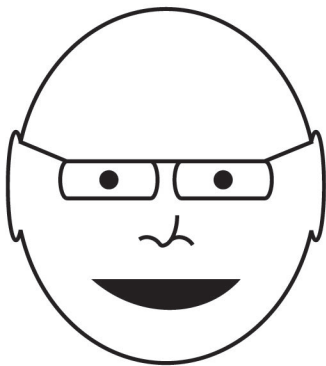
Easy peasy. Go back to the question we started with and look at the hernia pushing the artery medially.



Papa, thanks for not getting fired, I know you left some comedy gold on the table!!



Yes, I am trying to exercise some self-control. Unlike some people.



Join us soon for another thrilling episode of “Anatomy Comics”!! Starring me and what’s his name.

