LAB 9: DISSECTION: ANTERIOR ABDOMINAL WALL (AAW) AND INGUINAL REGION

10/5/2021

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GOALS

1 Reflect the skin from the anterior and lateral abdominal wall.
2 Identify the two layers of the superficial fascia and reflect them.
3 Clean and identify the external oblique, internal oblique, and transversus abdominis muscles. Cut and reflect the internal and external oblique on one side.
4 Identify and open the rectus sheath on one side and identify the rectus abdominis muscle; cut and reflect the muscle.
5 Identify nerves and blood vessels supplying the anterior abdominal wall.
6 Identify the inguinal ligament, inguinal canal, and deep and superficial inguinal rings.
7 Open the scrotum in male cadavers and identify the spermatic cord and its contents.
8 Identify structures in the subinguinal space.
9 Discuss the clinical anatomy of inguinal hernias.

SURFACE ANATOMY—INSPECT AND PALPATE

- Anterior superior iliac spine and iliac crest
- Pubic tubercle
- Inguinal fold (skin fold in the "groin" over the inguinal ligament)
- Umbilicus
- Linea alba and linea semilunaris (in lean cadavers)

Consult Figures 9.1 and 9.2.

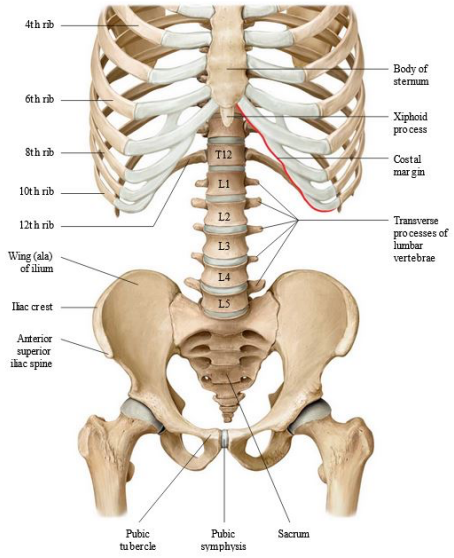

Figure 9.1. Bony Framework of Abdomen: Thieme Atlas of Anatomy, 4th ed., Figure 13.1.

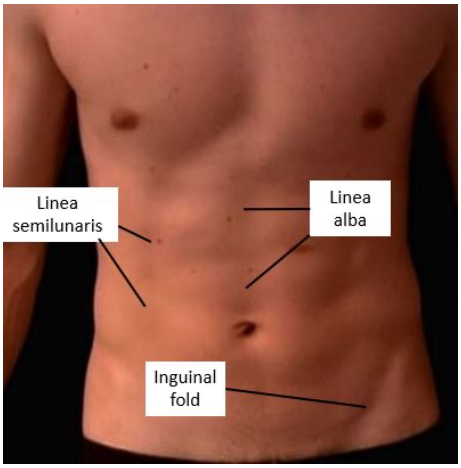

Figure 9.2. Surface anatomy of abdomen: Wikiradiography.net.

REFLECT THE SKIN FROM THE ABDOMINAL WALL

Make incisions as shown in Figure 9.3. Make the incisions deep enough to carry through the skin AND **superficial fascia**. Reflect them together.

- The **upper incisions** along the costal margin were made in a previous lab.
- The **lower incisions** stretch from the **anterior superior iliac spines** laterally to the **pubic tubercles** medially. Make the incisions just below the **inguinal folds** (the skin crease between thigh and abdomen).
- Make the final incision vertically in the midline. Circumscribe the **umbilicus**.

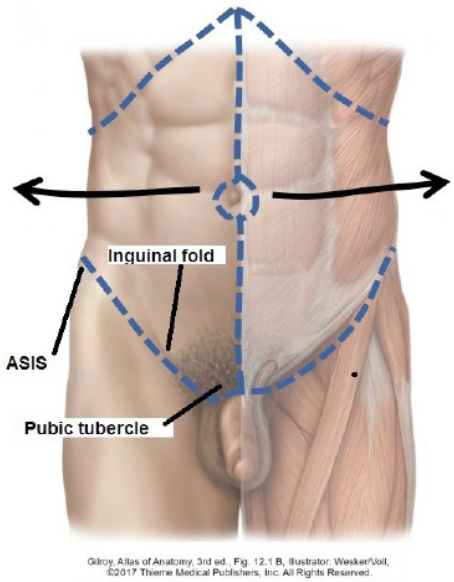

Figure 9.3. Skin incisions.

Reflect the skin and superficial fascia with a scalpel and blunt dissection as far lateral as possible. Leave the skin flaps attached to the body! The superficial fascia may have a very thick layer of adipose tissue.

Identify the two layers of the superficial fascia:

- **Fatty layer of superficial fascia (Camper's fascia)**
- **Membranous layer of superficial fascia (Scarpa's fascia)**—may be difficult to discern, but you should see a pale layer with parallel fiber bundles internal to Camper's fascia, adjacent to the deep fascia on the muscles. Scarpa's fascia is the equivalent of the retromammary fascia of the female breast. You should be able to pass your fingers into the plane between Scarpa's fascia and the muscles of the abdominal wall and separate them.

Now, identify the white **rectus sheath** covering the **rectus abdominis muscle** in the midline of the AAW. The rectus sheath is an **aponeurosis**. We will learn more about the rectus sheath, shortly.

It may be possible to identify a few nerves at this point:

- **Anterior cutaneous branches** of **thoraco-abdominal nerves** penetrate the rectus sheath about an inch to either side of the **linea alba**. **What are thoraco-abdominal nerves?**
- Lateral cutaneous branches of **thoraco-abdominal nerves** pass into the superficial fascia along the mid-axillary line.
- **The T-10 dermatome crosses the umbilicus**. Appendicitis pain often refers here.

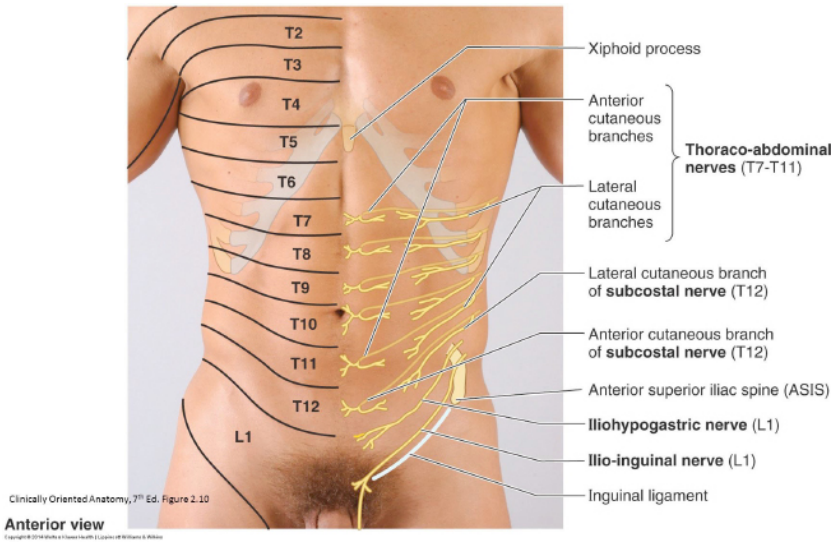

Figure 9.4. Cutaneous nerves and dermatomes of abdominal wall.

MUSCLES OF ANTEROLATERAL ABDOMINAL WALL

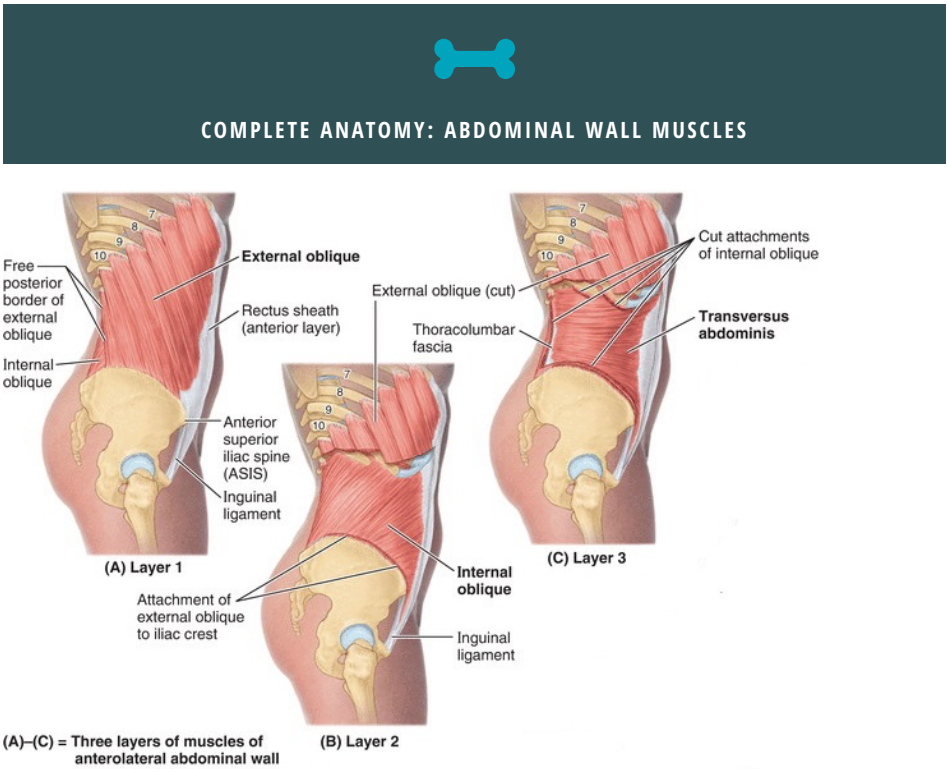

Figure 9.5. Overview of AAW muscles: Clinically Oriented Anatomy. 8th ed., Figure 5.5.

On both sides, clean the external oblique muscle, its aponeurosis, and the rectus sheath.

Use a sharp scalpel blade and scissors to remove fascia from the surface of the external oblique muscle and its aponeurosis. Don't worry if it's not super clean.

What are **aponeuroses**? Why do muscles of the AAW have them?

Where is the origin of the external oblique? See Figure 9.5.

How would you describe the direction of its muscle fascicles?

The external oblique inserts into the **linea alba, iliac crest, and public tubercle** via its aponeurosis (Figure 9.5). What is the linea alba?

Find the superficial inguinal rings = triangular openings in the external oblique aponeuroses near the pubic tubercles.

The **spermatic cord** traverses the superficial inguinal ring in males. The **round ligament of the uterus** passes through the superficial ring in females. See Figure 9.6.

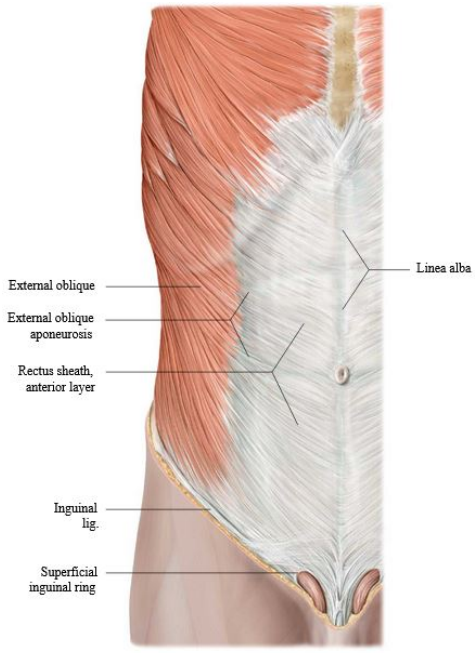

Figure 9.6. External oblique muscle & superficial inguinal ring. Thieme Atlas of Anatomy, 4th ed., Figure 13.4A.

Cut and reflect a portion of the external oblique as shown in Figure 9.7.

! Do this procedure on one side of the cadaver.

- Palpate the **anterior superior iliac spine (ASIS)**. Use scissors to make a shallow horizontal cut in the **external oblique** at the level of the ASIS from lateral to medial, ***stopping at the linea semilunaris***. Lift the external oblique as you cut it to avoid damaging the underlying **internal oblique muscle**.
- Separate the two muscles with your fingers. Once you have a plane established between the muscles, use scissors to continue cutting: (1) **make a vertical cut parallel to the linea semilunaris**, (2) **then a horizontal cut in a lateral direction to the costal margin**. See the dashed lines in the Figure 9.7.
- Reflect the external oblique laterally as shown.

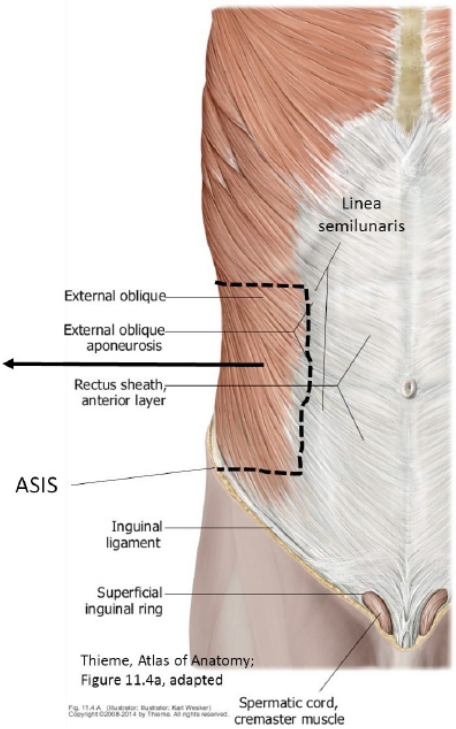

Figure 9.7. Cuts and reflection of the external oblique.

Now you can inspect the internal oblique muscle.

Where is the origin of the internal oblique? See Figure 9.5.

Describe the orientation of its fascicles (fan shaped, eh?). Compare to the external oblique.

The internal oblique inserts on the lower ribs, linea alba, and the pubic bone of the pelvic skeleton. See Figure 9.5.

Cut and reflect the internal oblique as shown in Figure 9.8.

Do this procedure on one side of the cadaver.

- Use the same scissor technique as before: make a horizontal cut in the internal oblique from lateral to medial, ending at the linea semilunaris. Separate it from the underlying **transversus abdominis**.
- Complete the incisions as shown in Figure 9.8 to form a flap in the internal oblique, then reflect the flap laterally.
- Use blunt dissection to separate the internal oblique and transversus abdominis. Fusion of these muscle layers sometimes makes this difficult—do the best you can to reveal as much of the transversus abdominis as possible.
- You are in the **neurovascular plane** of the abdominal wall. The **thoraco-abdominal nerves and vessels** traverse this plane.

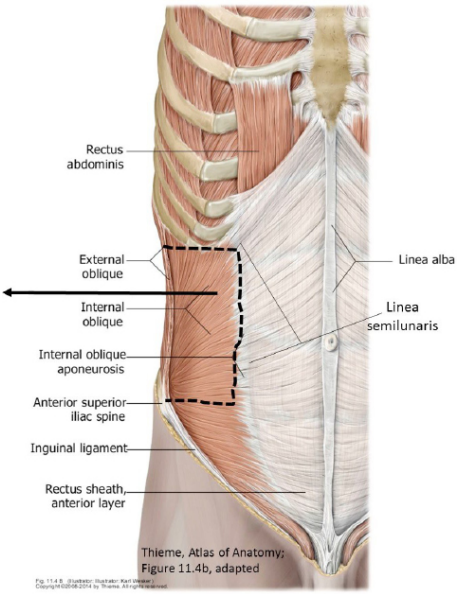

Figure 9.8. Cuts and reflection of internal oblique.

This is the same plane in the body wall that you demonstrated in the thorax dissection—between the 2nd and 3rd muscle layers.

COMPLETE ANATOMY: NERVES OF ANTERIOR ABDOMINAL WALL

Now you can inspect the Transversus Abdominis.

Where does the transversus abdominis originate? See Figure 9.5.

What direction are its fascicles oriented? (Not a trick question!)

The transversus abdominis inserts into the **linea alba** and **pubic bone**.

The aponeuroses of the internal oblique and transversus abdominis fuse as they attach to the pubic bone—this fused portion is called the **conjoint tendon** (see Figure 9.9).

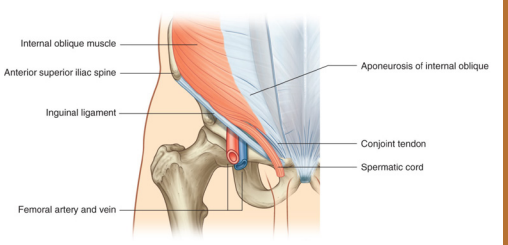

Figure 9.9. Conjoint tendon. Gray's Anatomy for Students, 4th ed., Figure 4.45.

Open the rectus sheath; cut and reflect the rectus abdominis.

! One side only—leave the rectus sheath intact on the other side.

Point to Ponder
The **rectus sheath** is formed by the fused aponeuroses of the external oblique, internal oblique, and transversus abdominis. ***It has two layers = anterior and posterior—these form an envelope around the rectus abdominis that prevents bowstringing when the trunk is flexed.***

- Study Figure 9.10. Use a scalpel to make a shallow incision in the **rectus sheath** just off the midline; from the xiphoid above to a point parallel to the ASIS below (**points 1 to 2** in Figure 9.10).
- Use scalpel, forceps, and scissors to reflect the **anterior layer of the rectus sheath** laterally toward the linea semilunaris. This will expose the **rectus abdominis** inside the two layers of the rectus sheath.

Where does the rectus abdominis arise and insert? What are its actions?

- Once the rectus sheath is opened, horizontally transect the rectus abdominis above the umbilicus and reflect the inferior portion down (see figure 9.10). This exposes the **posterior layer of the rectus sheath** behind the muscle.

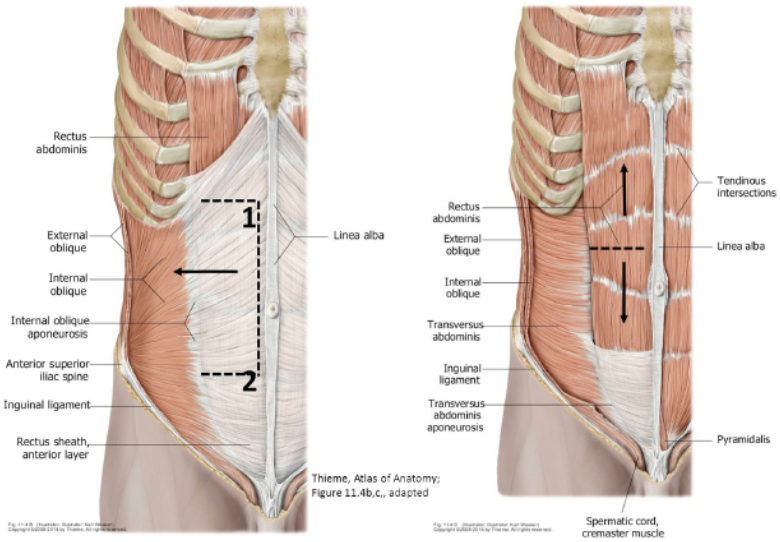

Figure 9.10. Open anterior rectus sheath; reflect rectus abdominis muscle.

Identify:

- **Tendinous intersections** of the rectus abdominis (these segment the muscle into a "six-pack")
- **Anterior** and **posterior layers of the rectus sheath**
- **Linea alba** and **linea semilunaris**
- **Arcuate line** (about halfway between umbilicus and pubic tubercles—Figure 9.11): a curved line formed by the sudden forward transition of aponeuroses—below the arcuate line all 3 layers of aponeuroses pass anterior to the rectus abdominis (discuss this in the "Chalk Talk" below).

- **Transversalis fascia**—there is no rectus sheath behind the rectus abdominis below the arcuate line—instead the transversalis fascia is adjacent to the posterior surface of the muscle.
- **Inferior epigastric vessels**—these pass under the arcuate line and enter the rectus sheath. They ascend behind the rectus abdominis.

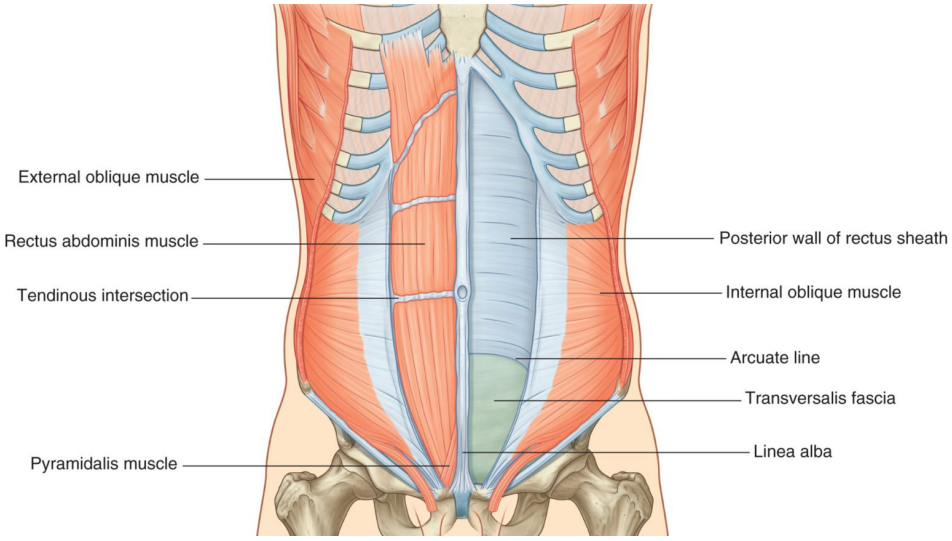

Figure 9.11. Arcuate line. Gray's Anatomy for Students, 4th ed., Figure 4.32.

Where do the inferior epigastric arteries arise?

The inferior epigastric arteries anastomose with arteries that descend behind the rectus abdominis from above. Which arteries? Where do they arise?

COMPLETE ANATOMY: POSTERIOR VIEW OF ABDOMINAL WALL

CHALK TALK

Draw and discuss the layers of the abdominal wall and the composition of the rectus sheath. Understand the concept of the **arcuate line**. Draw transverse sections of the AAW **above and below the arcuate line** to show how the rectus sheath is formed by the aponeuroses (see Figure 9.12).

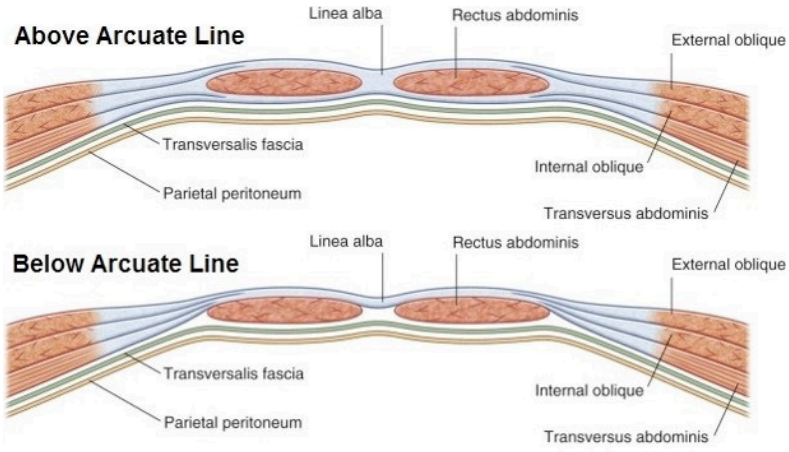

Figure 9.12. Composition of the rectus sheath layers. Gray's Anatomy for Students, 4th ed., Figure 4.33.

INGUINAL REGION

COMPLETE ANATOMY: INGUINAL CANAL

Locate

- **Anterior superior iliac spine**
- **Pubic tubercle**
- **Inguinal ligament**

Where are the bony attachments of the inguinal ligament? Recognize that the ligament is the free inferior edge of the external oblique, rolled inward like the letter "J".

Locate the **midpoint of the inguinal ligament** and place a finger there. This is the surface projection of the **deep inguinal ring**. Note the location of the **superficial ring** (near the pubic tubercle). These are the internal and external openings of the **inguinal canal**. Appreciate that the inguinal canal has an oblique orientation and is only a few inches long. See Figure 9.13.

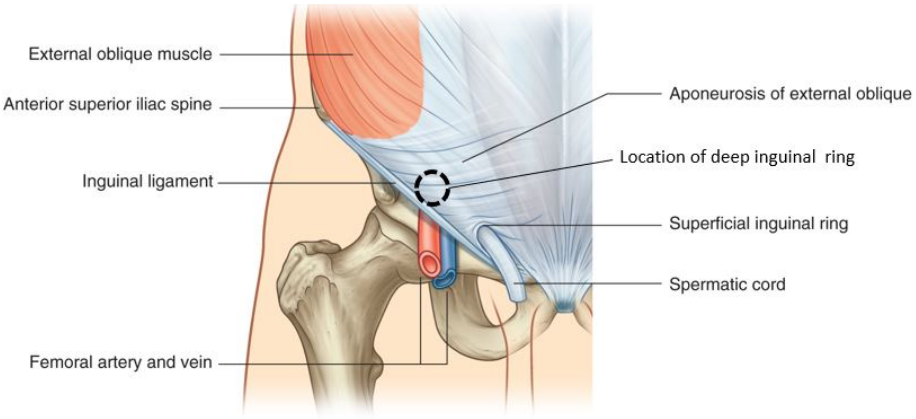

Figure 9.13. Inguinal canal and inguinal rings. Gray's Anatomy for Students, 4th ed., Figure 4.44.

Expose the inguinal canal.

> ***Open the inguinal canal on ONE side of the cadaver only.*** If possible, do it on the same side where you cut and reflected the muscles earlier. See Figures 9.14 and 9.15.

- Make a shallow horizontal incision in the external oblique and its aponeurosis commencing at the ASIS and carry it medially, almost to the midline (this cut may have been made earlier on the deep side of your dissection).
- Make a vertical incision in the aponeurosis just off the midline as shown in the figure and carry the incision downward just medial to the **pubic tubercle**.

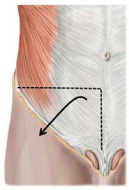

Figure 9.14. Exposing the inguinal canal. Thieme Atlas of Anatomy, 4th ed., Figure 13.4A.

- Use scissors and forceps to **carefully** peel down the aponeurosis toward the thigh, using the inguinal ligament as a hinge. ***Reflect only the external oblique aponeurosis***. Since this layer forms the anterior wall of the inguinal canal, the **inguinal canal** and **deep inguinal ring** should now be exposed. Do this in both sexes.

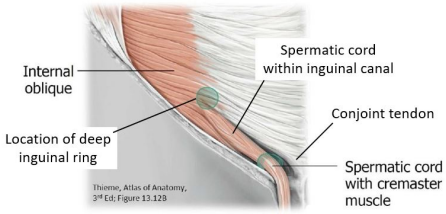

Figure 9.15. Inguinal canal exposed.

Identify the following:

- **Deep** and **superficial inguinal rings**
- The fibers of the internal oblique and transversus abdominis muscles arching over the inguinal canal. These are in the roof of the canal.
- The **conjoint tendon** (fused internal oblique and transversus abdominis aponeuroses) attaching to the **pubic bone**. The conjoint tendon is the medial-most part of the posterior wall of the canal.
- See if you can spot the **inferior epigastric vessels ascending on the abdominal wall,** medial to the deep inguinal ring (Figure 9.16). They are important landmarks for hernias (discussed later).

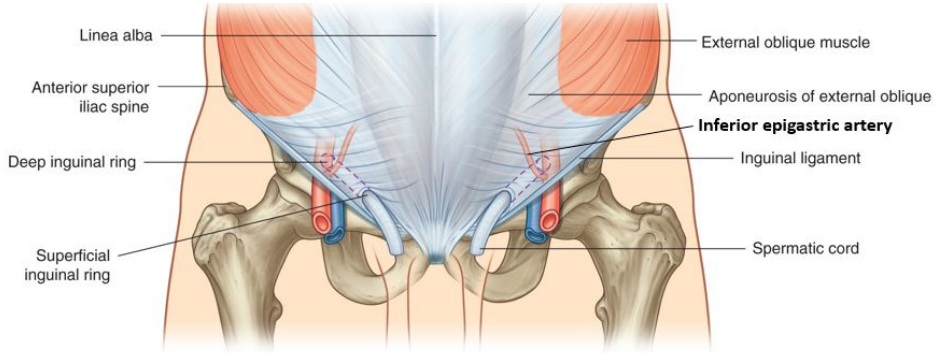

Figure 9.16. Deep ring and inferior epigastric artery. Gray's Anatomy for Students, 4th ed., Figure 4.42.

CHALK TALK

Draw and discuss the inguinal canal noting the structures that form its walls, floor, and roof, and the locations of the inguinal rings.

BOUNDARIES of the **inguinal canal**:

- **Lateral:**
- **Medial:**
- **Superior:**
- **Inferior:**
- **Anterior:**
- **Posterior:**

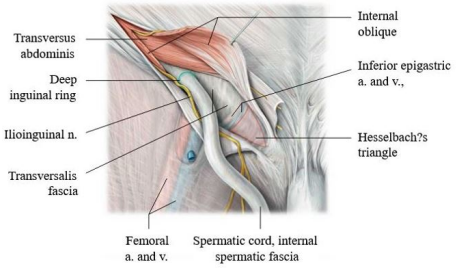

Figure 9.17. Structures bordering the inguinal canal. Gray's Anatomy for Students, 4th ed., Figure 13.14B.

An important region of the anterior body wall just medial to the deep inguinal ring is called the **inguinal triangle** (**Hesselbach's triangle)**. See Figures 9.17 and 9.18.

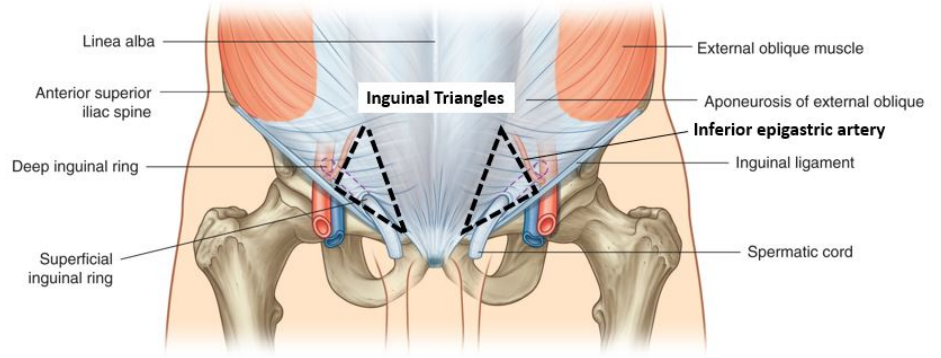

Figure 9.18. Inguinal (Hesselbach's) triangles. Gray's Anatomy for Students, 4th ed., Figure 4.42.

This area is said to be "un-reinforced" since the internal oblique and transversus abdominis aponeuroses (conjoint tendon) don't fully cover it = there is a deficit inferiorly that is only covered by **transversalis fascia** (Figure 9.19).

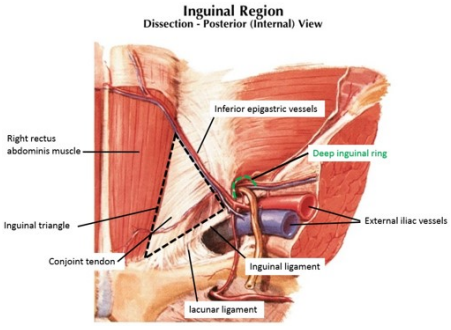

Figure 9.19. Inguinal triangle—internal view

This area is said to be “un-reinforced” since the internal oblique and transversus abdominis aponeuroses (conjoint tendon) don’t fully cover it = there is a deficit inferiorly that is only covered by **transversalis fascia** (Figure 9.19).

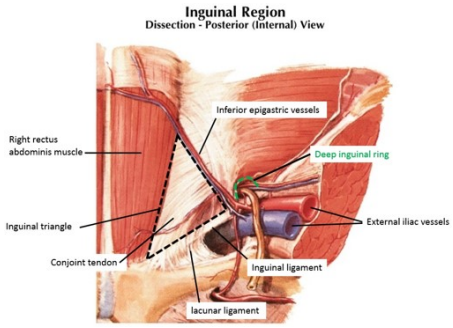

Figure 9.19. Inguinal triangle—internal view looking at posterior side of the anterior abdominal wall. Netter, Atlas of Human Anatomy, Plate 262.

CHALK TALK

Sketch and discuss the boundaries of the inguinal triangle.

- **Medial**: Lateral border of rectus abdominis
- **Lateral**: Inferior epigastric vessels
- **Inferior**: Inguinal ligament

CLINICAL CORRELATION

What is the definition of a **hernia** in general? What are **inguinal hernias**? Spend some time in lab discussing the applied anatomy of inguinal hernias = DIRECT vs. INDIRECT.

Direct inguinal hernias bulge into the inguinal triangle, medial to the inferior epigastric vessels. Indirect inguinal hernias enter the deep ring lateral to the inferior epigastric vessels.

SPERMATIC CORD

COMPLETE ANATOMY: SPERMATIC CORD & TESTIS

In male cadavers, open the scrotum.

If you have a female cadaver, skip down a section, but be sure you visit a male dissection and study the anatomy.

- Using a scalpel or scissors, make a vertical skin incision starting at the **superficial inguinal ring** and extending to the **inferior pole of the scrotum**.
- Use blunt dissection to separate the skin and **superficial fascia of the scrotum** (called the **dartos**) from the **spermatic cord** and swing the entire cord with testes superiorly out of the scrotum. The testes hang from the body wall via the spermatic cord like a pendulum. **Why are the testes outside of the body cavity?**
- Use scissors to open the fascial layers of the spermatic cord and to tease out the contents of the cord = you should find the **pampiniform plexus of veins** and the **ductus deferens** with ease.

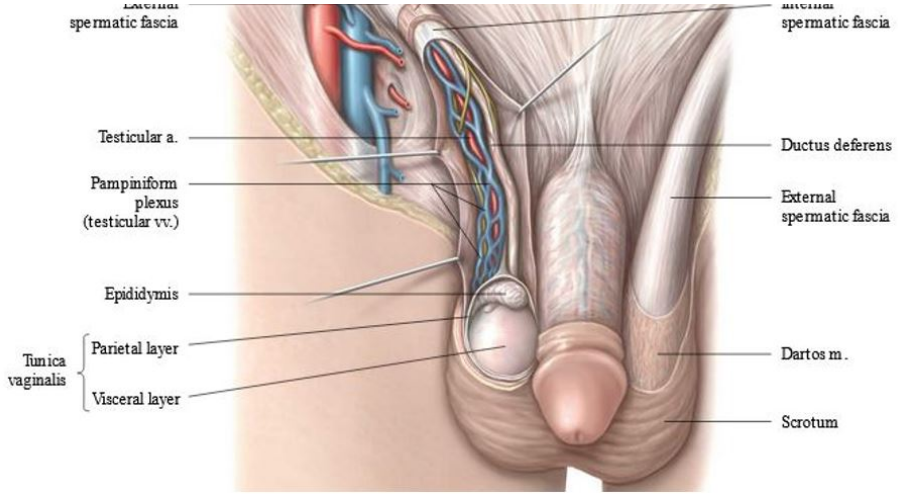

Figure 9.20. Fascia and contents of spermatic cord. Thieme Atlas of Anatomy, 4th ed., Figure 13.17B.

Identify the following in males:

- **Cremasteric fascia with cremaster muscle**: hold the fascia up so light can illuminate it and note the loops of skeletal muscle in the fascia = **cremaster muscle**. **What is the function of the cremaster? From which layer of the abdominal wall is the cremaster derived developmentally?**
- **Pampiniform plexus of veins** (translation = "tendril" or "vine-like"). **What is the function of the pampiniform plexus?**
- **Ductus deferens** = palpate its wire-like texture! **What is the function of the ductus (vas) deferens?**
- The **testicular artery** is challenging to find—it is surrounded by the twisted veins of the pampiniform plexus—it is less tortuous and paler in color than the veins. **Where does the testicular artery arise?**

Coverings of the Testes and Epididymis

- A serous sac is related to the anterior surface of the testis = the **tunica vaginalis**. If you haven't opened the tunica vaginalis yet, use scissors and make a cut vertically to lay open the serous sac.
- The layer of serous membrane facing the testis (on the deep surface of the spermatic cord fascia) is the **parietal layer of the tunica vaginalis**. The shiny layer of serous membrane directly adhered to the testis itself is the **visceral layer of tunica vaginalis**.
- The thick capsule of the testis is the **tunica albuginea** ("white coat"). The visceral tunica vaginalis is firmly attached to the tunica albuginea. Use scissors to cut open the testis—inside are the many tiny **seminiferous tubules**.
- Identify the **epididymis**. The **ductus deferens** attaches to the **tail of the epididymis** (Figure 9.21). The epididymis is a storage unit where sperm mature.

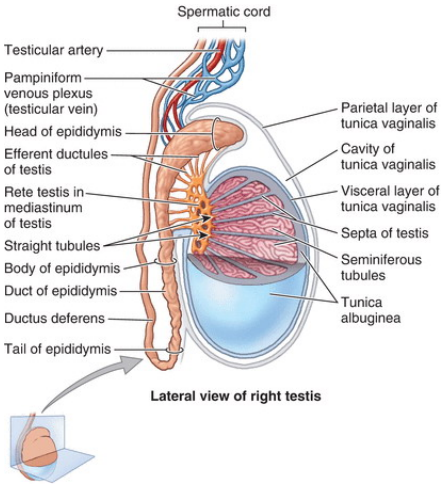

Figure 9.21. Testis and epididymis. Clinically Oriented Anatomy, 8th ed., Figure 5.21.

The **tunica vaginalis** is a small serous sac developmentally derived from a *diverticulum of peritoneum from the abdomen* = the **processus vaginalis**. Like all good serous sacs, it has two continuous serous layers (**parietal** and **visceral**) with a potential space (**serous cavity**) between them.

Review these clinical terms: **Hydrocele** and **Varicocele**

In female cadavers, incise the skin of a labium majus.

- Although we have focused much of our discussion in the inguinal region on males, the counterpart of the spermatic cord in the inguinal canal of females is the **round ligament of the uterus**.
- Make a vertical incision, starting at the superficial inguinal ring and extending downward into the **labium majus**. Probe around in the fascia and try to find the **round ligament of the uterus** as it emerges from the superficial inguinal ring into the **labium majus**. It may be difficult to locate.

Embryology—a processes vaginalis also develops in the inguinal region of females, giving rise to the **inguinal canal**. As the **round ligament** traverses the inguinal canal, it is surrounded by the same fascial layers as those surrounding the spermatic cord structures in males. Proximally, the round ligament attaches to the uterus in the pelvic cavity.

SUBINGUINAL SPACE

This is the passageway beneath the inguinal ligament, ***connecting the abdominopelvic cavity to theproximal thigh***.

- Reflect the skin from the proximal thigh, about an inch or two below the inguinal ligament. ***Do this on one side only.*** Use scissors and blunt dissection to clean the **femoral artery and vein**.

CLINICAL CORRELATION

The **mid-inguinal point** (midpoint of the inguinal ligament) is an important landmark. Earlier we located the **deep inguinal ring** superior to it—the **femoral artery** is inferior to the mid-inguinal point. Its pulsations can be felt here. If you can locate the femoral artery—you know that the **femoral vein** is medial to it!

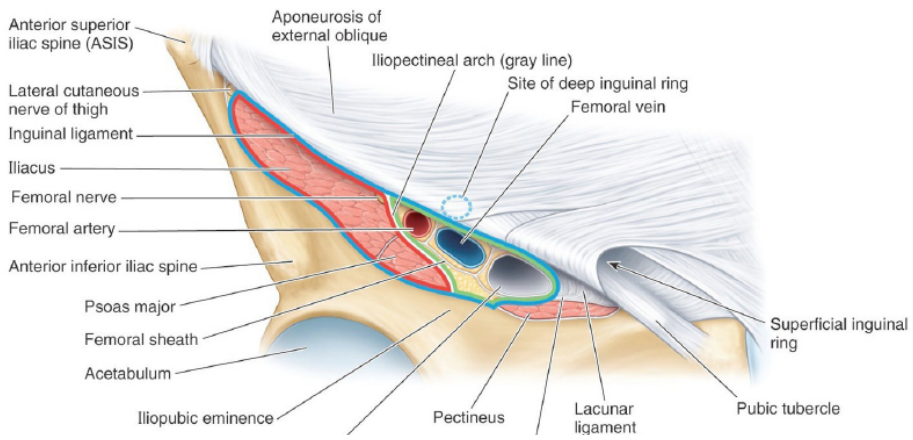

Figure 9.22. Subinguinal space. Clinically Oriented Anatomy, 8th ed., Figure 5.14.

What are the names of the femoral artery and vein proximal to the inguinal ligament (within the abdominopelvic cavity)? Realize that these vessels are one and the same—only the names have changed.

- Lateral to the artery, locate the **femoral nerve**.
- Medial to the femoral vein, use blunt dissection to locate the **femoral canal**. The femoral canal is a potential space, filled with loose connective tissue and a few lymph nodes and vessels. Its function is to provide space for expansion of the femoral vein when venous return from the lower limb increases.
- Place a finger in the femoral canal and rotate it medially to palpate the sharp edge of the **lacunar ligament**. The lacunar ligament is the part of the inguinal ligament that is reflected downward on to the pubic bone.

A handy mnemonic for recalling structures in the subinguinal space, from lateral to medial = **NAVEL**. (E & L = empty space with lymphatics)

CLINICAL CORRELATION
The femoral canal is a potentially weak area where a viscus from the abdominal cavity could protrude into the thigh, below the inguinal ligament = **a femoral hernia**. ***A femoral hernia can strangulate if compressed against the sharp edge of the lacunar ligament.***

CHECKLIST, LAB #9

REVIEW AND MAKE SURE YOU HAVE IDENTIFIED EACH OF THE STRUCTURES BELOW.

ANTERIOR ABDOMINAL WALL AND INGUINAL REGION

- ☐ Fatty layer of superficial fascia (Camper's)
- ☐ Membranous layer of superficial fascia (Scarpa's)
- ☐ External oblique muscle & aponeurosis
- ☐ Internal oblique muscle & aponeurosis
- ☐ Transversus abdominis muscle & aponeurosis
- ☐ Rectus abdominis muscles
- ☐ Tendinous intersections in rectus abdominis
- ☐ Rectus sheath (Anterior and posterior layers)
- ☐ Arcuate line
- ☐ Transversalis fascia (can be seen behind the rectus abdominis, inferior to the arcuate line)
- ☐ Linea alba and linea semilunaris
- ☐ Thoracoabdominal nerves (= lower intercostal nerves in the neurovascular plane of AAW)
- ☐ Inferior epigastric vessels
- ☐ Inguinal ligament

- [ ] Lacunar ligament (can be felt)
- [ ] Superficial and deep inguinal rings
- [ ] Inguinal canal
- [ ] Inguinal (Hesselbach's) triangle
- [ ] Dartos fascia of scrotum (= the superficial fascia of the scrotum)
- [ ] External spermatic fascia of spermatic cord
- [ ] Cremasteric fascia w/ cremaster muscle
- [ ] Ductus deferens
- [ ] Pampiniform plexus
- [ ] Testicular artery (hard to separate from pampiniform plexus, but understand its location in the spermatic cord)
- [ ] Testes
- [ ] Tunica vaginalis (visceral and parietal layers)
- [ ] Epididymis
- [ ] Round ligament of the uterus—EXTRA BONUS POINT (seen leaving the superficial inguinal ring in female cadaver)
- [ ] Femoral artery and vein
- [ ] Femoral nerve
- [ ] Femoral canal