Inguinal Canal

The inguinal canal is an oblique passage through the lower part of the anterior abdominal wall. In the males, it allows structures to pass to and from the testis to the abdomen. In females, it allows the round ligament of the uterus to pass from the uterus to the labium majus.

The canal is about 1.5 in. (4 cm) long in the adult and extends from the deep inguinal ring, a hole in the fascia transversalis (see page 137), downward and medially to the superficial inguinal ring, a hole in the aponeurosis of the external oblique muscle (see Figs. 4.3 and 4.8). It lies parallel to and immediately above the inguinal ligament. In the newborn child, the deep ring lies almost directly posterior to the superficial ring so that the canal is considerably shorter at this age. Later, as the result of growth, the deep ring moves laterally.

The **deep inguinal ring,*** an oval opening in the fascia transversalis, lies about 0.5 in. (1.3 cm) above the inguinal ligament midway between the anterior superior iliac spine and the symphysis pubis (see Figs. 4.4 and 4.8). Related to it medially are the inferior epigastric vessels, which pass upward from the external iliac vessels. The margins of the ring give attachment to the **internal spermatic fascia** (or the internal covering of the round ligament of the uterus).

The **superficial inguinal ring*** is a triangular-shaped defect in the aponeurosis of the external oblique muscle and lies immediately above and medial to the pubic tubercle (see Figs. 4.3, 4.5, and 4.8). The margins of the ring, sometimes called the **crura,** give attachment to the **external spermatic fascia.**

Walls of the Inguinal Canal

Anterior wall. External oblique aponeurosis, reinforced laterally by the origin of the internal oblique from the inguinal ligament (see Figs. 4.3 and 4.8). This wall is therefore strongest where it lies opposite the weakest part of the posterior wall, namely, the deep inguinal ring.

*A common frustration for medical students is the inability to observe these rings as openings. One must remember that the internal spermatic fascia is attached to the margins of the deep inguinal ring and the external spermatic fascia is attached to the margins of the superficial inguinal ring so that the edges of the rings cannot be observed externally. Compare this arrangement with the openings for the fingers seen inside a glove with the absence of openings for the fingers when the glove is viewed from the outside.

Posterior wall. Conjoint tendon medially, fascia transversalis laterally (see Figs. 4.4 and 4.8). This wall is therefore strongest where it lies opposite the weakest part of the anterior wall, namely, the superficial inguinal ring.

Roof or superior wall. Arching lowest fibers of the internal oblique and transversus abdominis muscles (see Fig. 4.7).

Floor or inferior wall. Upturned lower edge of the inguinal ligament and, at its medial end, the lacunar ligament (see Fig. 4.7).

Function of the Inguinal Canal

The inguinal canal allows structures of the spermatic cord to pass to and from the testis to the abdomen in the male. (Normal spermatogenesis takes place only if the testis leaves the abdominal cavity to enter a cooler environment in the scrotum.) In the female, the smaller canal permits the passage of the round ligament of the uterus from the uterus to the labium majus.

Mechanics of the Inguinal Canal

The inguinal canal in the lower part of the anterior abdominal wall is a site of potential weakness in both sexes. It is interesting to consider how the design of this canal attempts to lessen this weakness.

1. Except in the newborn infant, the canal is an oblique passage with the weakest areas, namely, the superficial and deep rings, lying some distance apart.
2. The anterior wall of the canal is reinforced by the fibers of the internal oblique muscle immediately in front of the deep ring.
3. The posterior wall of the canal is reinforced by the strong conjoint tendon immediately behind the superficial ring.
4. On coughing and straining, as in micturition, defecation, and parturition, the arching lowest fibers of the internal oblique and transversus abdominis muscles contract, flattening out the arched roof so that it is lowered toward the floor. The roof may actually compress the contents of the canal against the floor so that the canal is virtually closed (Fig. 4.20).
5. When great straining efforts may be necessary, as in defecation and parturition, the person naturally tends to assume the squatting position; the hip joints are flexed, and the anterior surfaces of the thighs are brought up against the anterior abdominal wall. By this means, the lower part of the anterior abdominal wall is protected by the thighs (see Fig. 4.20).

Spermatic Cord

The spermatic cord is a collection of structures that pass through the inguinal canal to and from the testis (Fig. 4.21). It begins at the deep inguinal ring lateral to the inferior epigastric artery and ends at the testis.

Structures of the Spermatic Cord

The structures are as follows:

- Vas deferens
- Testicular artery
- Testicular veins (pampiniform plexus)
- Testicular lymph vessels

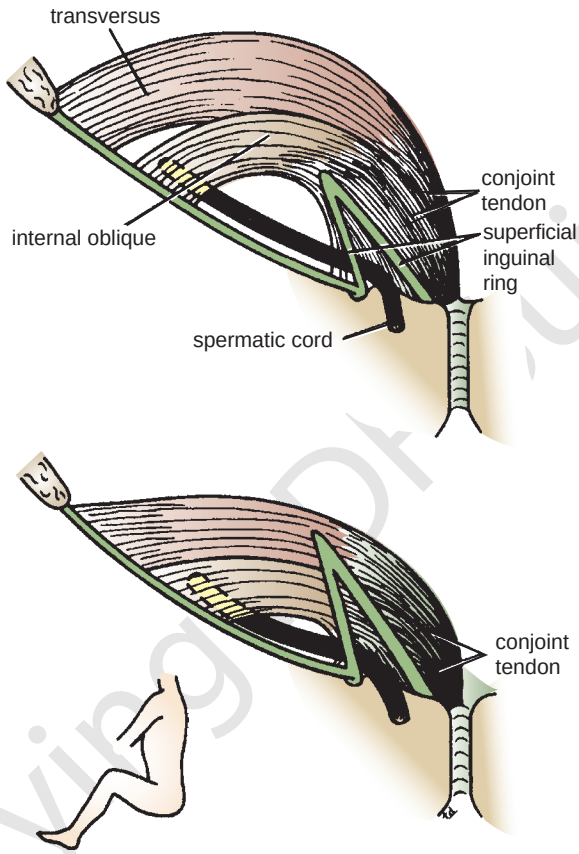

FIGURE 4.20 Action of the muscles on the inguinal canal. Note that the canal is "obliterated" when the muscles contract. Note also that the anterior surface of the thigh protects the inguinal region when one assumes the squatting position.

- Autonomic nerves
- Remains of the processus vaginalis
- Genital branch of the genitofemoral nerve, which supplies the cremaster muscle

Vas Deferens (Ductus Deferens)

The vas deferens is a cordlike structure (see Figs. 4.5 and 4.21) that can be palpated between finger and thumb in the upper part of the scrotum. It is a thick-walled muscular duct that transports spermatozoa from the epididymis to the urethra.

Testicular Artery

A branch of the abdominal aorta (at the level of the 2nd lumbar vertebra), the testicular artery is long and slender and descends on the posterior abdominal wall. It traverses the inguinal canal and supplies the testis and the epididymis (see Fig. 4.21).

Testicular Veins

An extensive venous plexus, the **pampiniform plexus,** leaves the posterior border of the testis (see Fig. 4.21). As the plexus ascends, it becomes reduced in size so that at about the level of the deep inguinal ring, a single testicular vein is formed. This runs up on the posterior abdominal wall and drains into the left renal vein on the left side and into the inferior vena cava on the right side.

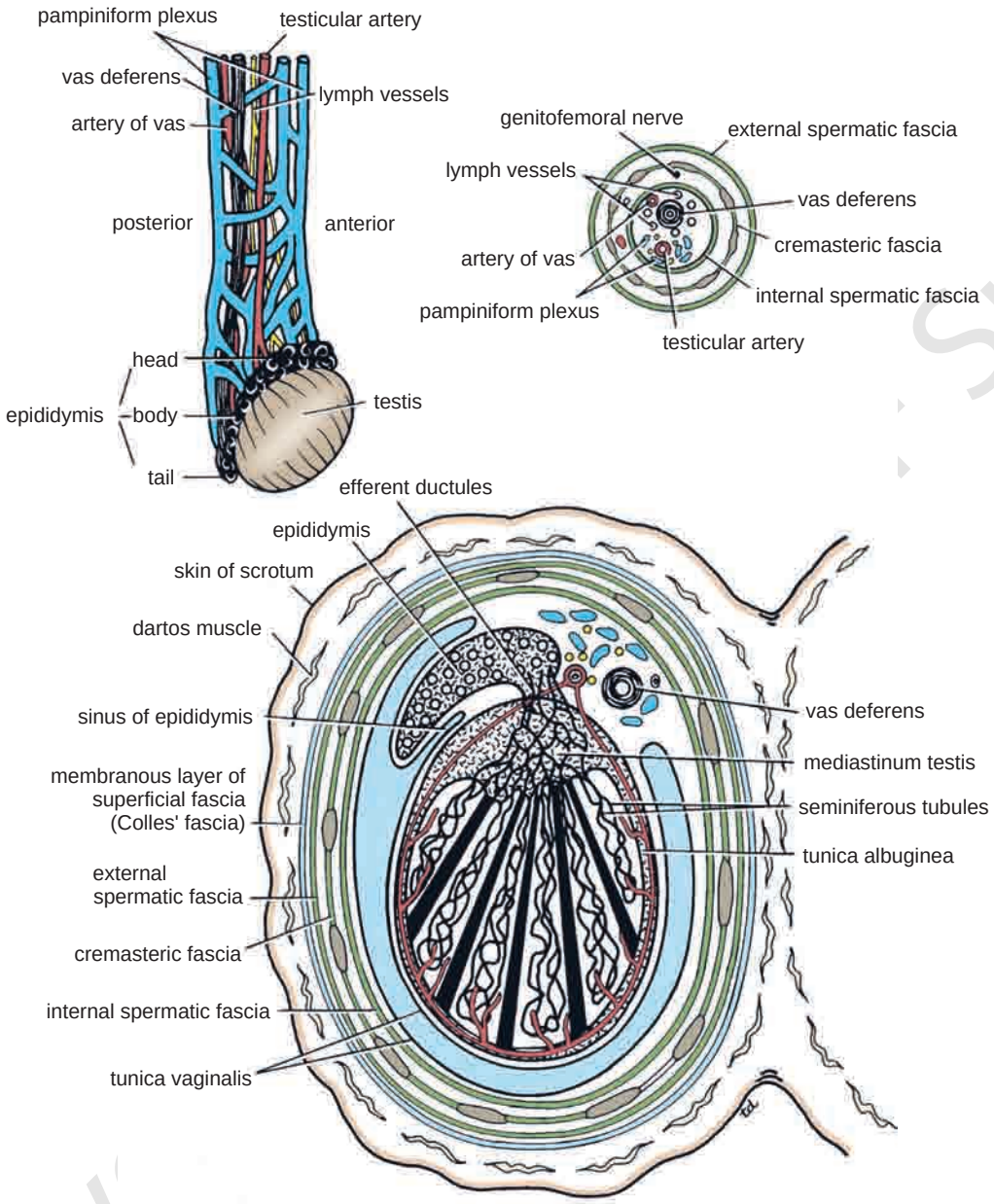

FIGURE 4.21 Testis and epididymis, spermatic cord, and scrotum. Also shown are the testis and epididymis cut across in horizontal section.

Lymph Vessels

The testicular lymph vessels ascend through the inguinal canal and pass up over the posterior abdominal wall to reach the lumbar (para-aortic) lymph nodes on the side of the aorta at the level of the 1st lumbar vertebra (Fig. 4.22).

Autonomic Nerves

Sympathetic fibers run with the testicular artery from the renal or aortic sympathetic plexuses. Afferent sensory nerves accompany the efferent sympathetic fibers.

Processus Vaginalis

The remains of the processus vaginalis are present within the cord (see below).

Genital Branch of the Genitofemoral Nerve

This nerve supplies the cremaster muscle (see Fig. 4.21) (see page 222).

Coverings of the Spermatic Cord (the Spermatic Fasciae)

The coverings of the spermatic cord are three concentric layers of fascia derived from the layers of the anterior abdominal wall. Each covering is acquired as the processus vaginalis descends into the scrotum through the layers of the abdominal wall (Fig. 4.23).

- **External spermatic fascia** derived from the external oblique aponeurosis and attached to the margins of the superficial inguinal ring

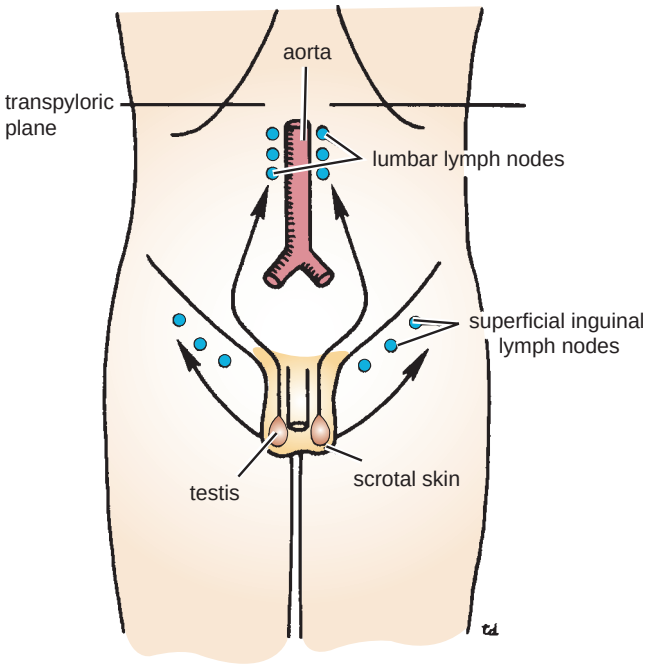

FIGURE 4.22 Lymph drainage of the testis and the skin of the scrotum.

- **Cremasteric fascia** derived from the internal oblique muscle
- **Internal spermatic fascia** derived from the fascia transversalis and attached to the margins of the deep inguinal ring

To understand the coverings of the spermatic cord, one must first consider the development of the inguinal canal.

Development of the Inguinal Canal

Before the descent of the testis and the ovary from their site of origin high on the posterior abdominal wall (L1), a peritoneal diverticulum called the **processus vaginalis** is formed (see Fig. 4.23). The processus vaginalis passes through the layers of the lower part of the anterior abdominal wall and, as it does so, acquires a tubular covering from each layer. It traverses the fascia transversalis at the deep inguinal ring and acquires a tubular covering, the **internal spermatic fascia** (see Fig. 4.4). As it passes through the lower part of the internal oblique muscle, it takes with it some of its lowest fibers, which form the **cremaster muscle.** The muscle fibers are embedded in fascia, and thus the second tubular sheath is known as the **cremasteric fascia** (see Fig. 4.4). The processus vaginalis passes under the arching fibers of the transversus abdominis muscle and therefore does not acquire a covering from this abdominal layer. On reaching the aponeurosis of the external oblique, it evaginates this to form the superficial inguinal ring and acquires a third tubular fascial coat, the **external spermatic fascia** (see Figs. 4.4 and 4.5). It is in this manner that the inguinal canal is formed in both sexes. (In the female, the term spermatic fascia should be replaced by the covering of the round ligament of the uterus.)

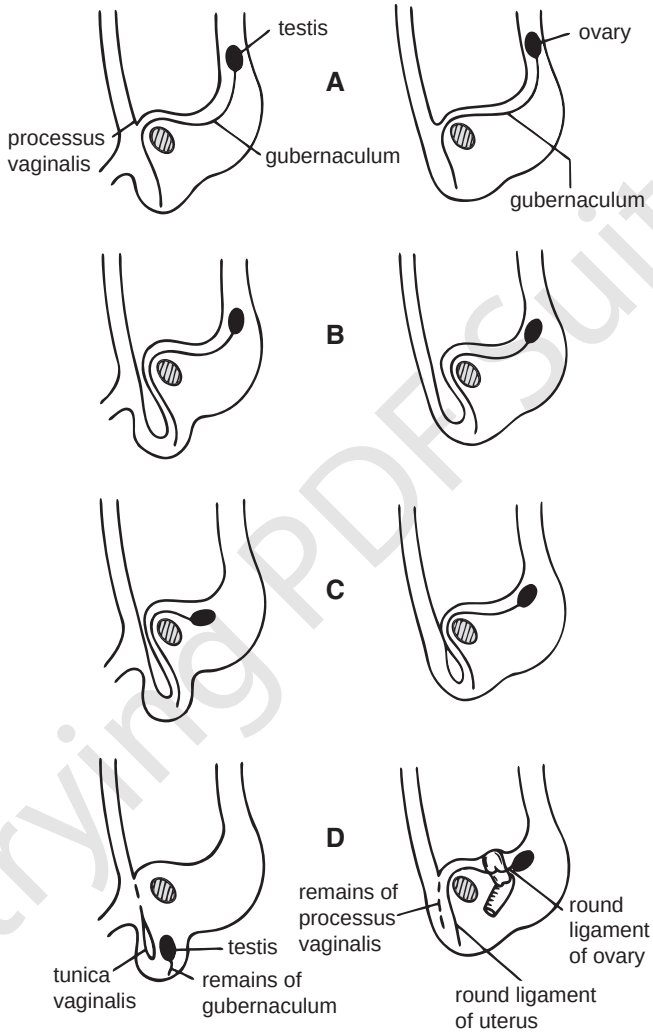

FIGURE 4.23 Origin, development, and fate of the processus vaginalis in the two sexes. Note the descent of the testis into the scrotum and the descent of the ovary into the pelvis.

In the male, the testis descends through the pelvis and inguinal canal during the seventh and eighth months of fetal life. The normal stimulus for the descent of the testis is testosterone, which is secreted by the fetal testes. The testis follows the gubernaculum and descends behind the peritoneum on the posterior abdominal wall. The testis then passes behind the processus vaginalis and pulls down its duct, blood vessels, nerves, and lymph vessels. The testis takes up its final position in the developing scrotum by the end of the eighth month.

Because the testis and its accompanying vessels, ducts, and so on, follow the course previously taken by the processus vaginalis, they acquire the same three coverings as they pass down the inguinal canal. Thus, the spermatic cord is covered by three concentric layers of fascia: the external spermatic fascia, the cremasteric fascia, and the internal spermatic fascia.

In the female, the ovary descends into the pelvis following the gubernaculum (see Fig. 4.23). The gubernaculum becomes attached to the side of the developing uterus, and gonad descends no farther. That part of the gubernaculum extending from the uterus into the developing labium us persists as the **round ligament of the uterus.** Thus, he female, the only structures that pass through the

CLINICAL NOTES

Vasectomy

Bilateral vasectomy is a simple operation performed to produce infertility. Under local anesthesia, a small incision is made in the upper part of the scrotal wall, and the vas deferens is divided between ligatures. Spermatozoa may be present in the first few postoperative ejaculations, but that is simply an emptying process. Now only the secretions of the seminal vesicles and prostate constitute the seminal fluid, which can be ejaculated as before.

inguinal canal from the abdominal cavity are the round ligament of the uterus and a few lymph vessels. The lymph vessels convey a small amount of lymph from the body of the uterus to the superficial inguinal nodes.