Surgical Anatomy of the Transversus Abdominis and Transversalis Fascia

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THE abdominal wall is composed, in the groin as elsewhere, of three layers of muscle and aponeurosis. The deepest lamina is formed by transversus abdominis muscle and aponeurosis together with its investing transversalis fascia. Each of the three common groin hernias—oblique or indirect inguinal, direct inguinal and femoral—is associated with a primary defect in structure, strength or attachment within the deepest musculo-aponeurotic layer of the groin. Simply stated, a groin hernia is a defect in the transversus abdominis. Although more superficial muscular layers may secondarily become involved late in the growth of a large groin hernia, there is no primary rupture within these superficial structures.

Repair of a groin hernia requires restoration of structure and is an exercise in applied anatomy. A thorough understanding of the relevant normal anatomy, of the range of normal variation in groin struc-

Submitted for publication April 28, 1970.

ture, and of the distortions engendered by a hernia are fundamental to construction of a sound hernia repair. Since groin hernias are due to defects in the transversus abdominis lamina, the surgical anatomy of this layer is of first importance and is the subject of this description.

Method of Dissection

Dissections of fresh male bodies free of pathologic changes in the groin have been performed in the autopsy room in 175 cases. The method of dissection, which is described in detail elsewhere,[1] does not produce any skin defect and does not injure vessels which subsequently may be used to embalm the body. In brief, the skin and subcutaneous fat are reflected together laterally; the external oblique aponeurosis is opened through the superficial inguinal ring and the upper musculoaponeurotic flap of external oblique widely mobilized and excised. The lower flap of the external oblique aponeurosis is rotated inferiorly, the inguinal and lacunar ligaments are

identified and the spermatic cord is mobilized by blunt dissection from the inguinal canal. The inguinal and lacunar ligaments are completely transected or excised and the origin of the cremaster muscle is mobilized and transected. At this point in the dissection, then, all the structures in the groin superficial (external) to the transversus abdominis lamina have been removed.

Next, internally, the pelvic peritoneum, preperitoneal fat and lymphatic tissues are excised. The external iliac-femoral blood vessels and spermatic cord structures are carefully preserved. This portion of the dissection removes all structures deep (internal) to the transversus abdominis lamina. The results of this series of dissections are recorded in detail elsewhere.[1, 2] Summary descriptions of the anatomy will be given here and are illustrated by a photograph (Fig. 1) utilizing transillumination to demonstrate the structures of the tranversus abdominis layer of the groin.

Description of Normal Anatomy

Transversus Abdominis Muscle and Aponeurosis

The lateral half of the transversus abdominis layer is muscle; the medial half is aponeurosis, i.e., a flat tendon. Across the midportion of the groin there is a clearly visible line, the *transversus abdominis arch*, above which muscle and aponeurosis are continuous, i.e., there are no gaps between fibers and no normal apertures of consequence. Below the arch, the transversus abdominis is discontinuous; laterally, there is the aperture of the deep inguinal ring; medially, the posterior wall of the inguinal canal contains discrete reinforcing aponeurotic fibers between which continuity is maintained only by transversalis fascia.

The lateral half of the transversus abdominis arch, in cases of indirect inguinal hernia, forms the superior margin of the hernia defect. The medial half of the transversus abdominis arch defines the superior limit of the posterior wall of the inguinal canal and, in typical cases of direct inguinal hernia, forms the superior margin of the direct hernia defect.
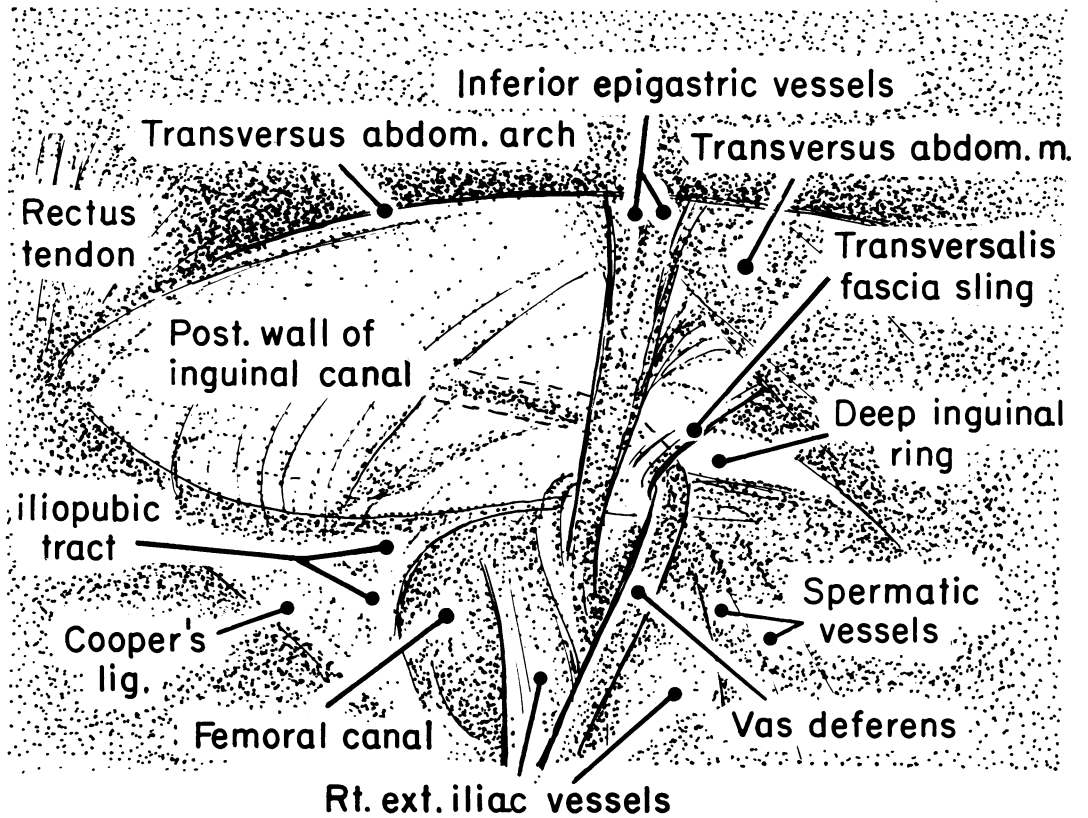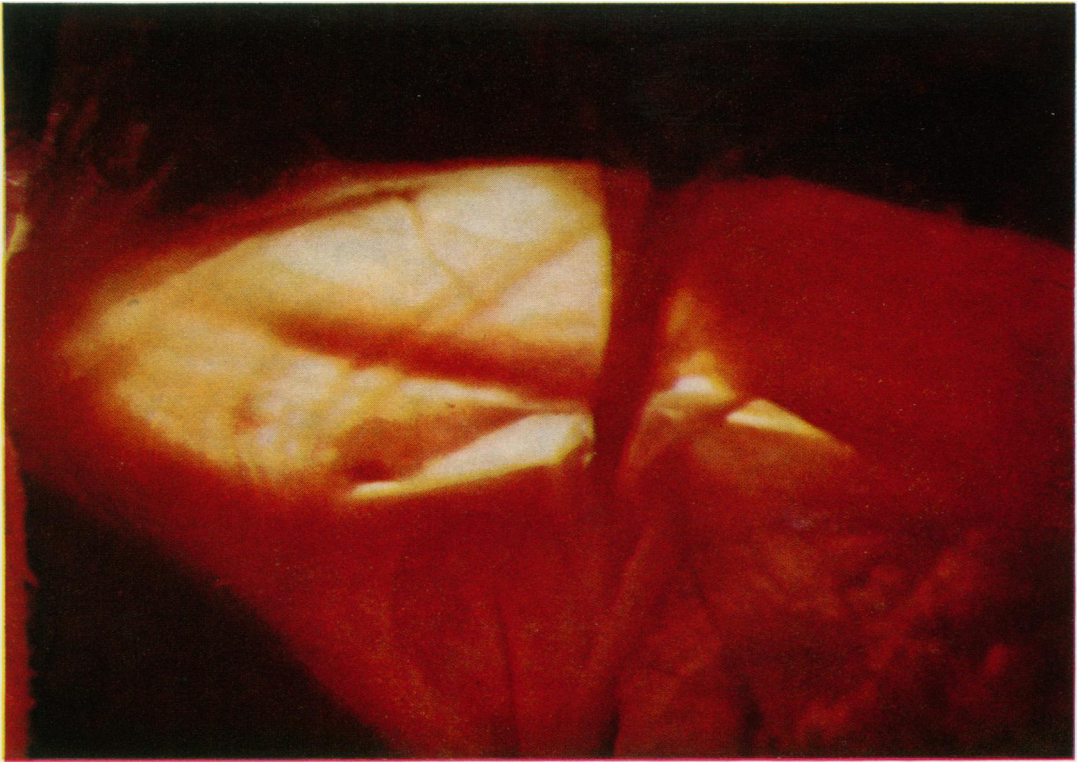
Iliopubic Tract

This is a small aponeurotic band, described by Thomson early in the nineteenth century, which bridges the groin from the iliacus fascia laterally to the superior ramus of the pubis medially. The lateral half of the iliopubic tract forms the inferior margin of the deep inguinal ring and, in cases of indirect inguinal hernia, forms the inferior margin of the indirect hernia defect. The iliopubic tract also crosses the external iliac-femoral vessels, where it defines the upper border of the anterior femoral sheath.

Medially, the iliopubic tract bridges the femoral canal and then curves posteriorly and inferiorly, its fibers spreading fan-wise to insert adjacent to Cooper's ligament into a broad area of the superior ramus of the pubis. In typical cases of direct inguinal hernia, the iliopubic tract forms all or a part of the inferior margin of the direct hernia defect. In cases of femoral hernia, i.e., herniation into the femoral canal, the

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FIG. 1. This photograph was taken on completion of a dissection which had removed all tissues in the groin both superficial and deep to the transversus abdominis muscle and aponeurosis and their associated structures. The camera was placed within the pelvis, "looking" from within outward, and the transversus abdominis structures were delineated by transillumination. The area covered by the photograph is approximately 6 × 10 centimeters. See text for description of normal structure.

FIG. 2. A line drawing (scale 1:1) identifying the important structures within the transversus abdominis layer of the groin which are illustrated in Figure 1. Direct inguinal hernias occur in the region of and just below the label, "post. wall of inguinal canal." Indirect inguinal hernias occur through the deep ring at and medial to the dot on the label leader, "deep inguinal ring." Femoral hernias occur through the femoral ring at the point indicated by the dot on the label leader. "femoral canal."

Inferior epigastric vessels

Transversus abdom. arch

Transversus abdom. m.

Rectus tendon

Transversalis fascia sling

Post. wall of inguinal canal

Deep inguinal ring

iliopubic tract

Spermatic vessels

Cooper's lig.

Femoral canal

Vas deferens

Rt. ext. iliac vessels

iliopubic tract forms the superior margin of the femoral hernial orifice.

The iliopubic tract is sometimes confused with the inguinal ligament. In some texts, an internal view of the groin similar to that of Figure 1 is presented in which the iliopubic tract is mislabelled as "inguinal ligament" and the recurving fibers of iliopubic tract on the medial margin of the femoral canal are mislabelled as "lacunar ligament." The inguinal and lacunar ligaments cannot be seen in an internal view of the groin, since the transversus abdominis aponeurosis, transversalis fascia and the spermatic cord within the inguinal canal all intervene between the viewer and these more superficial tissues.

Cooper's Ligament

This fibrous ligament is nearly constant in form and extent; it covers and is densely adherent to the periosteum on the upper internal margin of the superior ramus of the pubis. Cooper's ligament is covered by endoabdominal fascia which, of course, is continuous with transversalis fascia. In cases of large direct inguinal hernias, Cooper's ligament forms the inferior margin of the direct hernia defect.

The lateral portion of Cooper's ligament is carried posteriorly, away from the plane of the abdominal wall by the curving bone structure of the pelvis. This divergence exposes pectineus fascia in the floor of the femoral canal. In cases of femoral hernia, both Cooper's ligament and pectineus fascia form portions of the inferior margin of the hernial orifice.

Transversalis Fascia

The transversalis fascia is a part of the continuous layer of endoabdominal fascia enclosing the abdominal cavity. Transversalis fascia covers the internal surface of the transversus abdominis muscle and aponeurosis, separating them from the under-

lying preperitoneal fat and peritoneum. The structure of the transversalis fascia in the lower portion of the groin, that part between the transversus abdominis arch superiorly and the iliopubic tract and Cooper's ligament inferiorly, is of anatomic importance to the surgeon, since this is the "weak area" in which inguinal hernias occur.

The deep inguinal ring occupies the lateral half of the weak area. The margins of the ring are formed by aponeurotic structures: the transversus abdominis arch superiorly and the iliopubic tract inferiorly. The transversalis fascia about the deep inguinal ring is redundant and is thrown into a double fold around the spermatic cord structures as they pass through the ring. This fold, the *transversalis fascia sling*, provides the functional basis for the inguinal "shutter" mechanism. As transversus abdominis muscle contracts during coughing or other activity which raises intra-abdominal pressure, the arms of the transversalis fascia sling are pulled together and the entire sling is drawn laterally. This motion increases the obliquity of exit of the spermatic cord structures through the ring and provides protection from forces tending to cause a hernia.

The posterior wall of the inguinal canal occupies the medial half of the weak area. The posterior wall is buttressed medially by the rectus tendon and sheath, inferiorly by Cooper's ligament, at the margin of the femoral canal by the iliopubic tract and superiorly by the strong aponeurotic arch of transversus abdominis. Between these structures, the posterior wall of the inguinal canal is formed by transversalis fascia, reinforced in varying degrees by aponeurotic fibers. It is through this weak area that direct hernias occur. The superior margin of a direct hernia defect is formed by the transversus abdominis arch; the inferior margin is formed by iliopubic tract and Cooper's ligament.

Application of Anatomic Principles to Groin Hernia Repair

Repair of any groin hernia involves four essential features: 1—reduction (and excision when appropriate) of the peritoneal sac; 2—excision of attenuated tissues around the hernial orifice to expose clean, strong fascial and aponeurotic margins; 3—closure of the hernial orifice by suturing together its fascial margins; 4—relief of tension by a relaxing incision placed in the rectus sheath in all repairs, excepting only small indirect and femoral hernias.

Indirect Inguinal Hernia. The first step in repair is high ligation of the peritoneal sac. In small infants with small hernias, this is all that is needed for cure. In an occasional infant and in most adults, the deep inguinal ring must be repaired in addition. If the hernia has enlarged medially, the repair may also involve a part or all of the posterior wall of the inguinal canal.

The superior margin of an indirect hernia defect is the transversus abdominis arch; the inferior margin is the iliopubic tract. Repair of the hernia is accomplished by suturing these structures together snugly about the cord, inserting sutures both medial and lateral to the cord and replacing the exit of cord into its normal position in the groin. The sutures must be placed through aponeurosis; closure of transversalis fascia, alone, is not sufficient.

Direct Inguinal Hernia. The peritoneal sac should be reduced but needs to be excised only in exceptional cases in which a narrow sac neck is present. A direct hernia occurs at the weak area of the posterior wall of the inguinal canal by ballooning and stretching of the transversalis fascia. The transversalis fascia comes to form a second sac, covering the peritoneal sac, and is thickened and opaque. It looks strong, but it is not. All of the redundant transversalis fascia should be excised and the aponeurotic margins of the hernia clearly identified.

The superior margin of a direct hernia defect is the transversus abdominis arch; medially, the lateral edge of the rectus sheath may form a small part of the superior border. The inferior margin of a direct hernia defect is the iliopubic tract; medially, Cooper's ligament may form a portion of the inferior border. Repair of the hernia is accomplished by suturing these aponeurotic structures together; closure of transversalis fascia, alone, is not sufficient.

Femoral Hernia. The peritoneal sac is reduced and excised. If needed to release the sac, the insertion of iliopubic tract into the superior ramus of the pubis on the medial side of the femoral canal can be cut. The superior margin of a femoral hernia is the iliopubic tract; the inferior margin is pectineus fascia and Cooper's ligament. Repair of the hernia is accomplished by suture approximation of these two structures resulting in closure of the femoral canal without constricting the femoral vein.

Summary

The three common groin hernias (indirect, direct and femoral) each represent an abnormal defect in the deep or transversus abdominis layer of the groin. The surgical anatomy of the transversus abdominis muscle and aponeurosis and their associated structures is described in this paper and the application of the anatomic features to repair of groin hernias is reviewed.

References

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