# Laparoscopic Inguinal Hernia Repair: Transabdominal Preperitoneal (TAPP) and Totally Extraperitoneal (TEP) Repairs

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## Indications

Inguinal hernia (see Chaps. 100, 101, and 102). Laparoscopic repair offers a significant advantage in these special situations:

Recurrent hernia (see Chap. 104). Laparoscopic repair is a logical choice because it avoids the previous surgical field and allows repair to be performed through healthy tissues with potentially better results.

Bilateral hernias. They can be repaired simultaneously without additional incisions or trocar sites.

Incidental herniorrhaphy during another laparoscopic surgery is only possible during TAPP procedure and if the patient is appropriately consented. Incidental herniorrhaphy is generally not recommended.

## Preoperative Preparation

See Chaps. 9 and 100.

Insert a Foley catheter or perform immediate preoperative bladder decompression by voiding or inserting a straight catheter.

Prescribe perioperative antibiotics.

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## Pitfalls and Danger Points

Missed hernia or inadequate mesh fixation resulting in hernia recurrence
Injury to bladder during the totally extraperitoneal approach
Nerve or major vessel injury

## Documentation Basics

Document the type of repair (TEP or TAPP)
Findings at surgery
Type of hernia

## Operative Strategy

There are two general approaches: transabdominal preperitoneal (TAPP) and totally extraperitoneal (TEP). TAPP is the logical choice when inguinal herniorrhaphy is performed after another laparoscopic procedure or when previous preperitoneal dissection limits access to the extraperitoneal space. It offers the additional advantage that the approach and anatomy are familiar to most surgeons, and hernias are readily identified as peritoneal outpouchings. The major disadvantage is penetration of the peritoneal cavity with associated potential for injury or adhesion formation.

The TEP approach avoids entry into the peritoneal cavity and hence minimizes these potential problems; but it requires dissection in the extraperitoneal plane and an excellent understanding of regional anatomy. The TEP approach is contraindicated when previous surgery or radiation therapy may have obliterated the retroperitoneal plane.

Crucial to the success of either approach is accurate identification of anatomy and hernias, accurate placement of mesh, and avoiding injury to adjacent structures. Figure 103.1
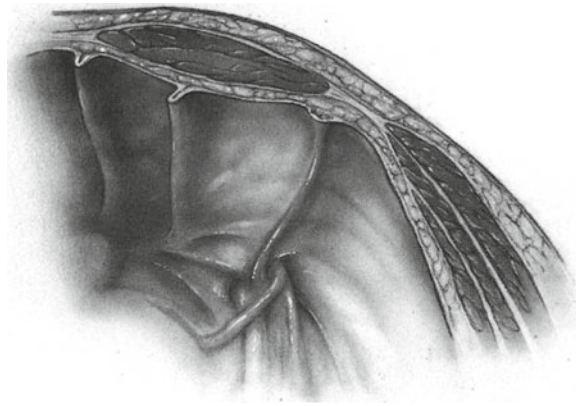
**Fig. 103.1**



**Fig. 103.2**

shows the laparoscopic anatomy of the inguinal region. Figure 103.2 shows two danger areas—the triangle of pain and the triangle of doom—where staple fixation must be avoided. The single most important landmark is the iliopubic tract. If no staples are placed below this structure, major nerves and vessels can be avoided.

When laparoscopic herniorrhaphy follows an unrelated laparoscopic operation on the same patient under the same anesthesia, take the time to optimize the working environment for the second procedure. Additional trocars may be required, monitors moved, equipment procured, and other adjustments made. This is time well spent.

## Operative Technique

### Patient Position and Room Setup: TAPP or TEP

Position the patient supine with arms tucked at the side. Extending the arms on arm boards may not allow enough room for the surgeon to operate comfortably in the lower abdomen. The Trendelenburg position allows the bowel to fall away from the pelvis, providing excellent access. A single video monitor at the foot of the operating table adjusted to a comfortable viewing height serves both surgeon and assistants. The surgeon stands on the side opposite the hernia (Fig. 103.3).

Although a 30° angled laparoscope is preferred by some surgeons, it is certainly not a necessity. A 0° laparoscope can provide as good a view.

### TAPP Approach

Place the first trocar (10–12 mm) at the umbilicus. Place two additional 10- to 12-mm trocars lateral to the rectus sheath on either side at the level of the umbilicus under direct vision
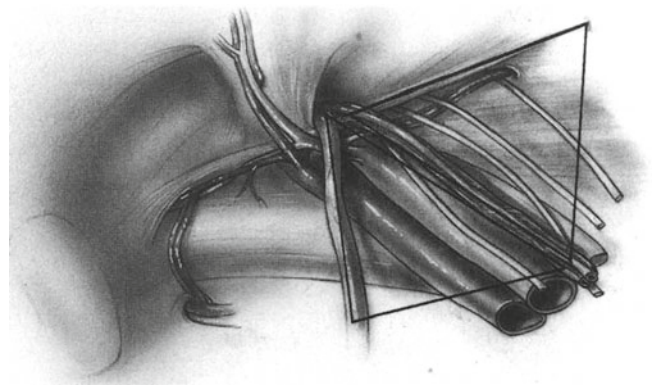
(Fig. 103.4). Large trocars allow the laparoscope and stapler to be moved around for optimal dissection, depending on the anatomy. If 5-mm instruments are available, smaller trocars may be used. For a small, unilateral hernia a 5-mm cannula may be substituted for the 10- to 12-mm cannula on the ipsilateral side.

Inspect both inguinal regions. Identify the median umbilical ligament (remnant of the urachus), the medial umbilical ligament (remnant of the umbilical artery), and the lateral umbilical fold (peritoneal reflection over the inferior epigastric artery). If the median umbilical ligament appears to compromise exposure, divide it. A hernia is visible as an outpouching of the peritoneum (Fig. 103.5a, b).

Incise the peritoneum along a line approximately 2 cm above the superior edge of the hernial defect, extending from the median umbilical ligament to the anterosuperior iliac spine. Mobilize the peritoneal flap inferiorly using blunt and sharp dissection (Fig. 103.6). Some surgeons routinely inject local anesthetic (0. 5 % bupivacaine with epinephrine mixed in an equal amount of normal saline) under the peritoneum before opening it. This makes mobilization of the superior and inferior flaps of peritoneum much easier and provides excellent postoperative pain relief for at least 6 h.

Expose the inferior epigastric vessels and identify the pubic symphysis and lower portion of the rectus abdominis muscle. Dissect Cooper's ligament to its junction with the femoral vein. Identify the iliopubic tract. Continue the dissection inferiorly, with care to avoid an injury to the femoral branch of the genitofemoral nerve and the lateral femoral cutaneous nerve, which enter the lower extremity just below the iliopubic tract (Fig. 103.2). Complete the dissection by skeletonizing the cord structures. A small indirect hernial sac is easily mobilized from the cord and reduced back into the peritoneal cavity. A large sac may be difficult to mobilize because of dense adhesions between the sac and the cord structures due to the chronicity of the hernia. Undue trauma
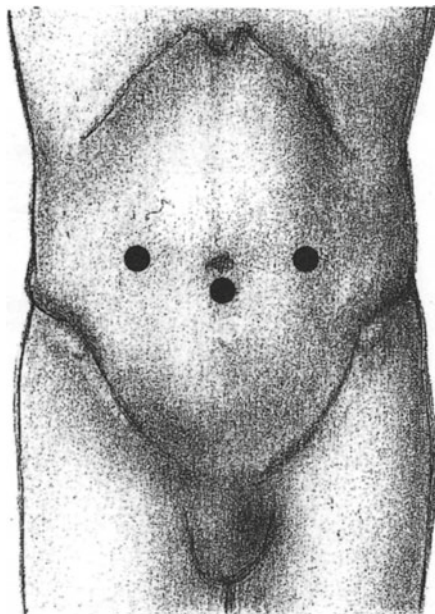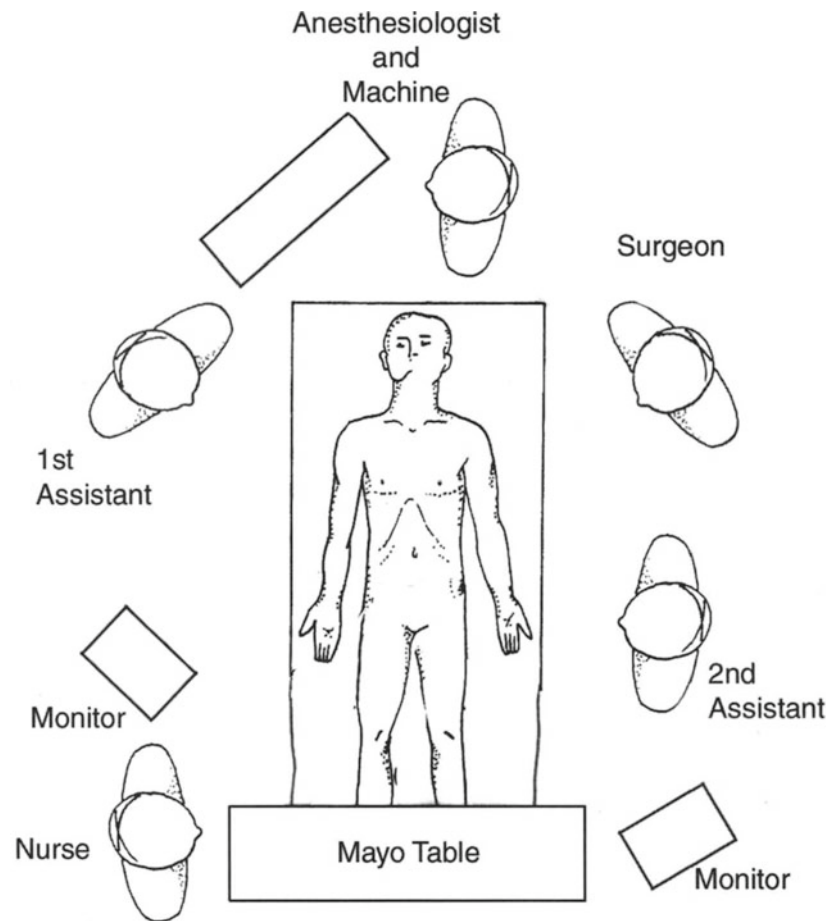
**Fig. 103.3**



**Fig. 103.4**



to the cord may result if an attempt is made to remove the sac in its entirety. In this situation, divide the sac just distal to the internal ring, leaving the distal sac in situ. This is most easily accomplished by opening the sac on the side opposite the cord structures and completing the division from the inside. Dissect the proximal sac away from the cord structures. A direct hernia is easily managed by reducing the sac and preperitoneal fat from the hernial orifice by gentle traction (Fig. 103.7).

## Placement of Mesh

Cut a piece of mesh at least 11 × 6 cm (unilateral); use one of the preformed mesh such as Bard 3D Max Mesh which comes in various sizes such as small, medium, and large. The mesh should be able to cover completely the direct, indirect, and femoral spaces. Do not cut a slit for the cord. We prefer to lay the mesh *over* the cord structures, rather than cutting a slit and wrapping the mesh *around* the cord structures. Recurrences have been reported through the orifice created around the new internal ring, even when the mesh has been closed around the cord. A large prosthesis
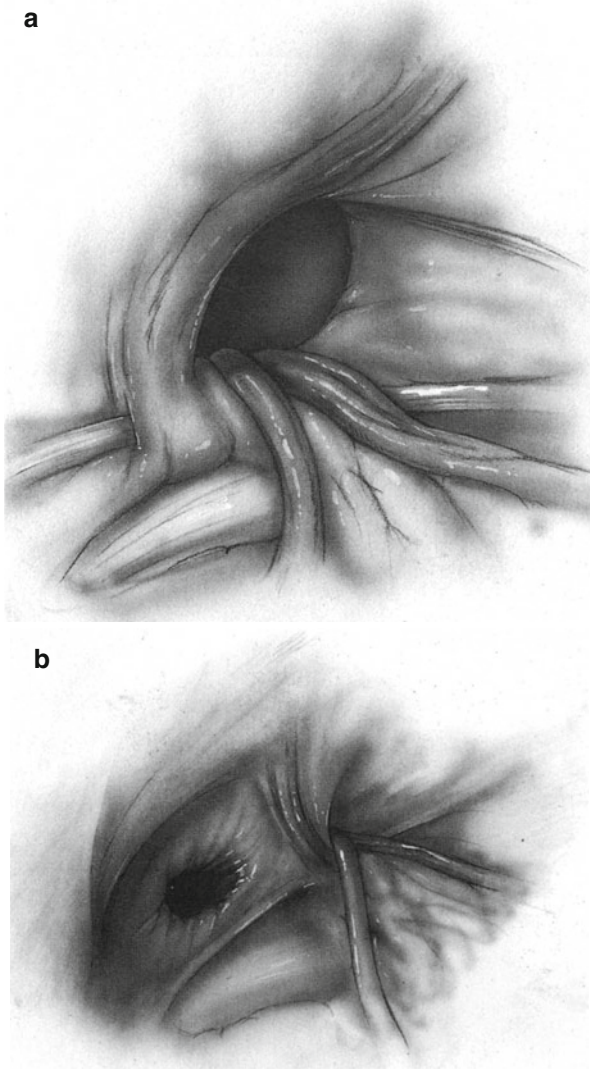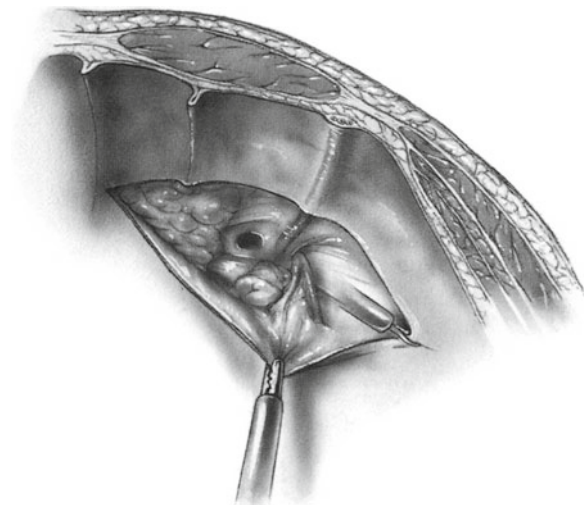
**a**



**b**



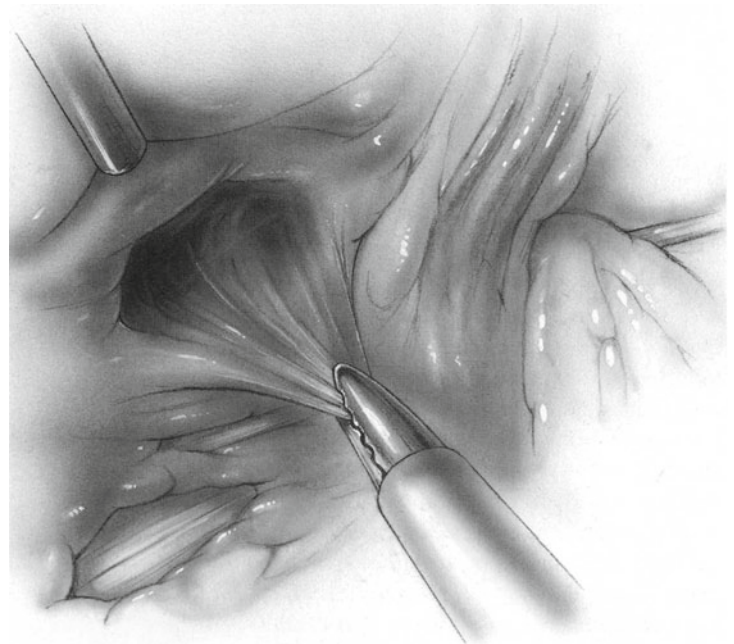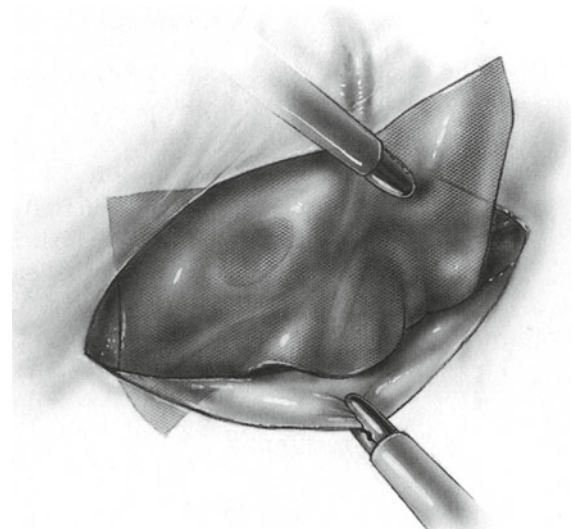**Fig. 103.5**



**Fig. 103.6**



**Fig. 103.7**



**Fig. 103.8**

allows intra-abdominal pressure to act uniformly over a large area, thereby preventing the mesh from conning out through the hernial defect. Roll the mesh longitudinally into a compact cylinder and pass it through one of the trocars. Some surgeons place temporary ties around the cylinder to facilitate handling.

Lie the cylinder at the inferior aspect of the working space and unroll it toward the anterior abdominal wall, smoothing it into place and tucking the corners underneath the peritoneal flap (Fig. 103.8). Take time to lay the mesh carefully
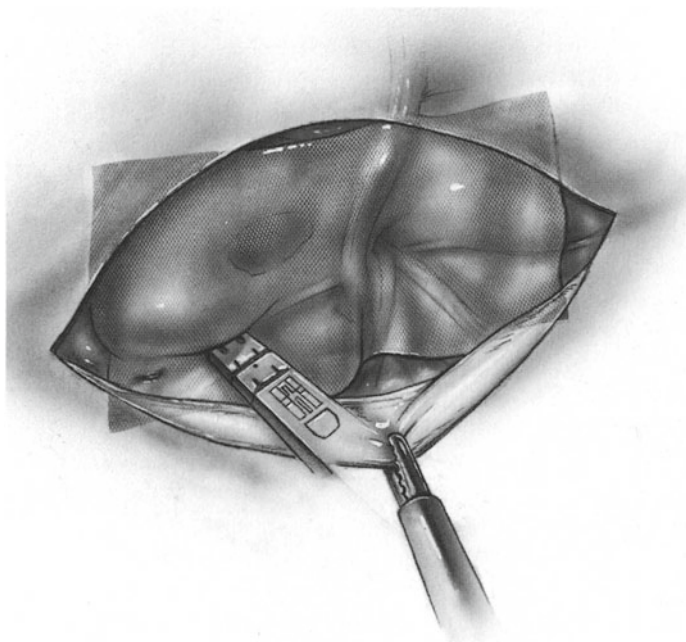
**Fig. 103.9**



over all hernial defects with good overlap. The mesh may be stapled or tacked in place or simply placed as an onlay graft. Both techniques are described here.

**Fig. 103.10**

### Stapling Technique

Staples or a hernia-tacking device may be used to affix the mesh. Begin stapling along the superior border of the prosthesis (Fig. 103.9) at the medial aspect of the contralateral pubic tubercle. Place the staples horizontally, progressing laterally along the superior border to the anterosuperior iliac spine. Horizontal staple placement minimizes the chance of injury to the deeper ilioinguinal or iliohypogastric nerves.

Staple the inferior border to Cooper's ligament medially using a horizontal or vertical orientation depending on the patient's characteristics (i.e., how the staples best attach). Again, the opposite pubic tubercle marks the area to begin placing staples for the inferior border, and stapling is continued over the area of the ipsilateral pubic tubercle to the femoral vein. Do not place staples directly into either pubic tubercle because chronic postoperative pain (osteitis pubis) can result. Always respect the triangles of doom and pain by not placing any staples below the iliopubic tract (Fig. 103.2).

Affix the medial and lateral borders using vertically placed staples, as this is the direction of the lateral cutaneous nerve of the thigh and the femoral branch of the genitofemoral nerve. Lateral to the internal spermatic vessels, place all staples above the iliopubic tract. This avoids neuralgia due to injury to the lateral cutaneous nerve of the
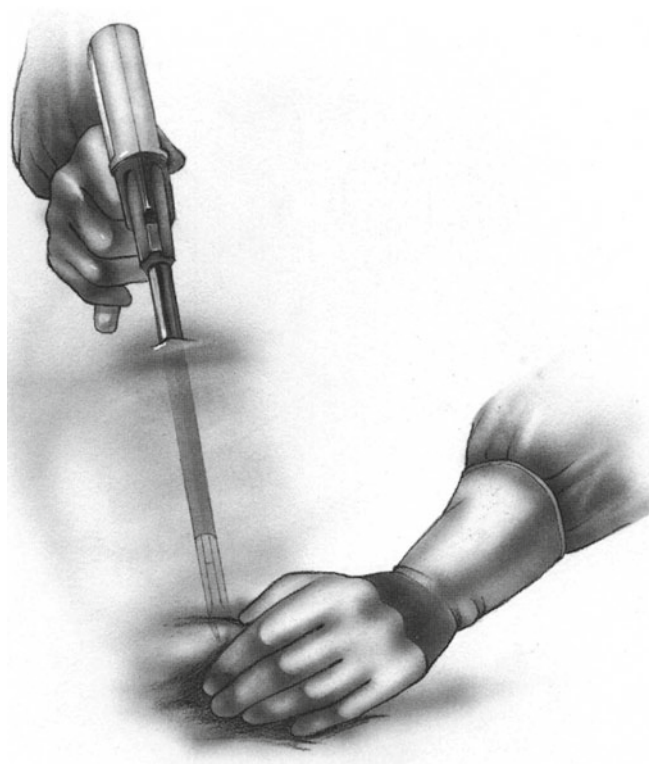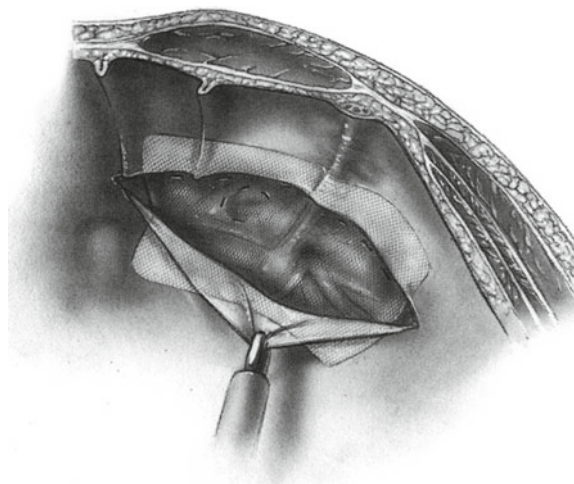


**Fig. 103.11**

thigh or the femoral branch of the genitofemoral nerve (Fig. 103.2).

It is useful to palpate the head of the stapler or tacker through the abdominal wall with the nondominant hand, ensuring that stapling is done above the iliopubic tract (Fig. 103.10). It also allows counterpressure to be applied, ensuring better purchase of the staples.

Excise any redundant mesh (Fig. 103.11) and close the peritoneal flap over the mesh with staples (Fig. 103.12). The

**Fig. 103.12**



**Fig. 103.13**

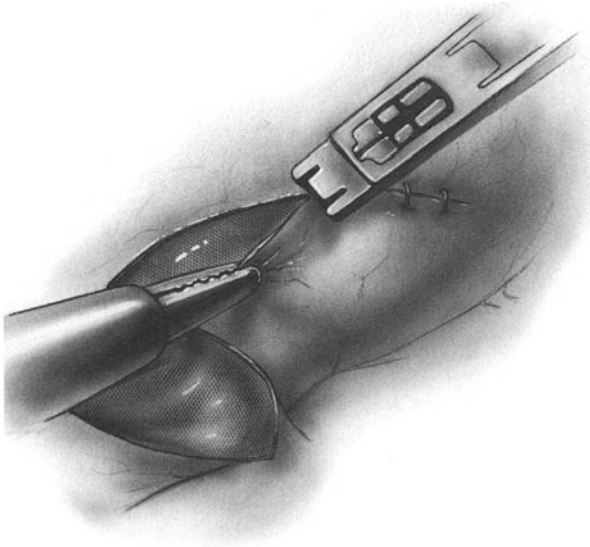goal is to isolate the mesh prosthesis from intra-abdominal viscera. Avoid excessive tension, which could tent the peritoneum over the mesh, creating a potential space into which bowel may herniate. It may be helpful to decrease the pneumoperitoneum before flap closure. Occasionally, it is necessary to simply cover the mesh with the inferior flap, leaving exposed transversalis fascia. Avoid excess gaps between staples, as bowel can herniate or adhere to the mesh through these defects. Inject a long-acting local anesthetic such as bupivacaine into the preperitoneal space before closure to decrease postoperative pain.

### Onlay Graft (Nonstapled) Technique

Simply onlay the mesh in the preperitoneal space created earlier. Make sure the mesh lies perfectly flat with no rolled edges. Excise any redundant mesh and close the peritoneal flaps over the mesh with a continuous simple running intracorporeal suture of 3-0 PG. The goal is to isolate the mesh prosthesis from intra-abdominal viscera.

### Bilateral Hernias

Bilateral hernias can be repaired using one long transverse peritoneal incision extending from one anterosuperior iliac spine to the other and a single large piece (30.0 × 7.5 cm) of mesh, or it can be done with two peritoneal incisions and two pieces of mesh. We favor the latter approach for the following reasons. First, it is easier to manipulate two small pieces of mesh and tailor them accurately to fit the preperitoneal spaces than a single large piece. Second, there is no potential for damage to a patent urachus if one exists. Finally, there is

less concern about interfering with bladder function when two pieces of mesh are used.

### TEP Approach

Make the skin incision for the first trocar (10–12 mm) at the umbilicus. Open the anterior rectus sheath on the ipsilateral side and retract the muscle laterally to expose the posterior rectus sheath. Following the incision of the anterior rectus sheath and retraction of the muscle laterally, insert a finger over the posterior rectus sheath and gently develop this space.

Insert a transparent balloon-tipped trocar into this space directed toward the pubic symphysis. Place the laparoscope in the trocar. Under direct vision, inflate the balloon to create an extraperitoneal tunnel or space (Fig. 103.13). Note that dissection in the correct plane mobilizes the bladder downward. This is followed by the insertion of a structural trocar which keeps the peritoneum pushed cranially.

Place two additional trocars in the midline under direct vision: one (5 mm) at the pubic symphysis and the other (10–12 mm) midway between the first and second (Fig. 103.14). Place these trocars by incising the skin with a scalpel.

Complete the dissection of the preperitoneal space, mesh placement, and stapling in a manner similar to that described for the TAPP procedure (Fig. 103.15). Bilateral hernias can be repaired with the use of a single large prosthesis or two pieces as previously discussed.
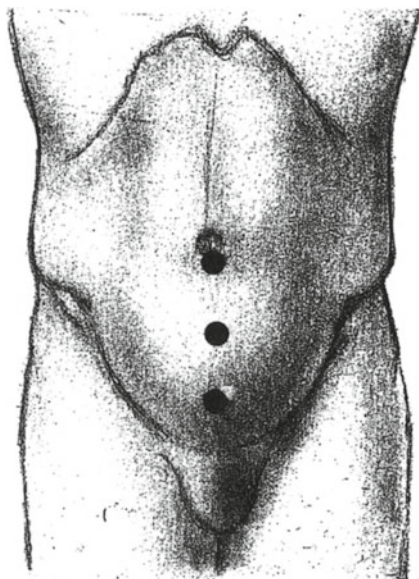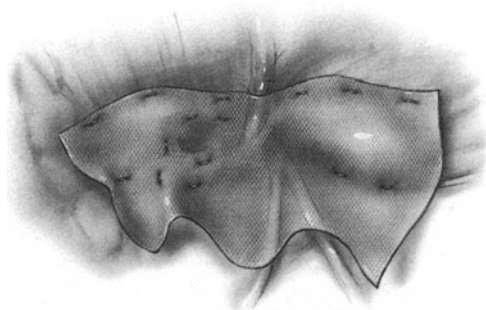
**Fig. 103.14**



**Fig. 103.15**

## Complications

*Vascular injuries*. Injury to the inferior epigastric and spermatic vessels is the most common vascular complication. Other vessels at risk include the external iliac, circumflex iliac profunda, and obturator vessels. Use of the open laparoscopic technique for inserting the initial cannula, meticulous dissection, and absolute identification of important landmarks are essential for preventing these injuries.

*Urinary retention*, *urinary infection*, *hematuria*. These are usually secondary to urinary catheterization, extensive preperitoneal dissection, general anesthesia, and administration of large volumes of intravenous fluids. These problems generally respond promptly to the usual treatments.

*Bladder injury*. This is one of the more common complications of laparoscopic herniorrhaphy. It is seen most commonly

in patients with previous "space of Retzius" surgery. Previous surgery in this space (e.g., a prostate operation) should be considered a relative contraindication to laparoscopic hernia repair. If a bladder injury is recognized during hernia repair, it should be repaired immediately laparoscopically or via laparotomy if necessary. Repair the hernia by a conventional anterior approach to avoid placing a foreign body next to the bladder repair. A high index of suspicion is the key to the diagnosis of a missed urinary tract injury. Lower abdominal pain, a distended bladder, dysuria, and hematuria should be promptly investigated. Other signs may include azotemia, electrolyte abnormalities, and ascites. Indwelling catheter drainage alone may suffice for retroperitoneal bladder injuries, but intraperitoneal perforations are best closed laparoscopically or by laparotomy.

*Nerve injury*. The femoral branch of the genitofemoral nerve, the lateral cutaneous nerve of the thigh, and the intermediate cutaneous branch of the anterior branch of the femoral nerve are at risk of damage during laparoscopic herniorrhaphy because of (1) failure to appreciate the anatomy from the posterior aspect, (2) difficulty visualizing the nerves preperitoneally, (3) the variable course of the nerves in this region, (4) improper staple placement, or (5) extensive preperitoneal dissection. Symptoms of burning pain and numbness usually develop after a variable interval during the postoperative period. If neuralgia is present in the recovery room, immediate re-exploration is the best course of action. When the onset of the symptoms is delayed, the condition is usually self-limiting. In most cases nonsteroidal anti-inflammatory drugs (NSAIDs) are sufficient. Re-exploration and removal of the offending staple is occasionally required.

*Vas deferens and testicular complications*. Testicular pain may be the result of trauma to the genitofemoral nerve or to the sympathetic innervation of the testis during dissection around the cord structures or during separation of the peritoneum from the cord structures. Testicular swelling may be secondary to narrowing of the deep inguinal ring, ischemia, or interruption of lymphatic or venous vessels resulting from attempts at complete removal of a large indirect inguinal hernial sac. Pain and swelling are usually transient and self-limiting. Transection of the vas deferens and testicular atrophy are seen in about the same incidence as during conventional surgery. The risk of these complications may be significantly decreased if the surgeon avoids excessive tightening of the deep inguinal ring, gently dissects around the cord structures, and does not attempt complete removal of large indirect hernial sacs. Minor cord and testicular complications are treated by supportive care, such as testicular support, limitation of activities, and analgesics. If the vas deferens is transected, the cut ends should be repaired with

fine, interrupted sutures unless fertility is not a consideration. There is no treatment for unilateral testicular atrophy. The hypogonadism produced by bilateral testicular atrophy is treated by supplemental testosterone.

*Complications related to the mesh*. Migration, infection, mass lesions representing palpable mesh, adhesion formation, and erosion of the mesh into intra-abdominal organs have been reported following laparoscopic herniorrhaphy. Fixation of the mesh prevents migration. Perioperative prophylactic antibiotics are recommended to prevent mesh infection. Adhesion formation is least likely to occur after the TEP procedure, as the mesh is never in contact with intra-abdominal organs unless there are unrecognized peritoneal perforations. Following the TAPP procedure, adequate closure of the peritoneum over the mesh is the most important factor in preventing complications such as bowel herniating through large gaps or becoming adherent to exposed mesh. Minimizing trauma, avoiding infection, sparing the blood supply, and avoiding exposed mesh decrease the incidence of adhesion formation. Mesh complications usually manifest weeks to years after the repair in the form of small bowel obstruction, abscess, or fistula. They may respond to conservative management or may require formal laparotomy.

*Recurrence of the hernia*. Potential mechanisms for recurrence include missed hernias or failure of the mesh to cover all hernial defects adequately. The latter may occur when the mesh rolls, migrates, is too small, or is improperly secured. We believe that thorough dissection of the preperitoneal space with identification of all the landmarks followed by fixation of a large piece of mesh that adequately covers and overlaps the entire myopectineal orifice without slitting or folding is the best way to avoid recurrence. A repeat laparoscopic repair or a conventional repair (see Chap. 104) is needed to correct the recurrence.

*Osteitis*. Pelvic or pubic osteitis results from staples placed directly into bone. Placing staples on the anterior and superior portion of Cooper's ligament or avoiding fixing mesh altogether prevents these complications. The diagnosis is essentially one of exclusion. NSAIDs may help.

*Wound infection*. This may be prevented by using meticulous sterile technique.

## Further Reading

Arregui ME, Navarrete J, Davis CJ, Castro D, Nagan RF. Laparoscopic inguinal herniorrhaphy: techniques and controversies. Surg Clin North Am. 1993;73:513.

Camps J, Nguyen N, Annibali R, Filipi CJ, Fitzgibbons Jr RJ. Laparoscopic inguinal herniorrhaphy: current techniques. In: Arregui ME, Fitzgibbons Jr RJ, Katkhouda N, McKernan JB, Reich H, editors. Principles of laparoscopic surgery: basic and advanced techniques. New York: Springer; 1995. p. 400–8.

Colborn GL, Brick WG. Inguinal region. In: Scott-Conner CEH, Cuschieri A, Carter FJ, editors. Minimal access surgical anatomy. Philadelphia: Lippincott Williams & Wilkins; 2000. p. 239–66.

Crawford DL, Phillips EH. Laparoscopic repair and groin hernia surgery. Surg Clin North Am. 1998;78:1047.

Filipi CJ, Fitzgibbons Jr RJ, Salerno GM. Laparoscopic herniorrhaphy. In: Hulka JF, Reich H, editors. Textbook of laparoscopy. 2nd ed. Philadelphia: Saunders; 1994. p. 313–26.

Fitzgibbons Jr RJ, editor. Nyhus and Condon's hernia. 5th ed. Philadelphia: Lippincott Williams & Wilkins; 2002.

Fitzgibbons Jr RJ, Camps J, Cornet DA, et al. Laparoscopic inguinal herniorrhaphy: results of a multicenter trial. Ann Surg. 1995;1:3.

Katkhouda N. Avoiding complications of laparoscopic hernia repair: laparoscopic inguinal herniorrhaphy: current techniques. In: Arregui ME, Fitzgibbons Jr RJ, Katkhouda N, McKernan JB, Reich H, editors. Principles of laparoscopic surgery: basic and advanced techniques. New York: Springer; 1995. p. 435–8.

Lowham AS, Filipi CJ, Fitzgibbons Jr RJ, et al. Mechanisms of hernia recurrence after preperitoneal mesh repair: traditional and laparoscopic. Ann Surg. 1997;225:422.

Memon MA, Fitzgibbons Jr RJ. Assessing risks, costs and benefits of laparoscopic hernia repair. Annu Rev Med. 1998;49:63.

Memon MA, Fitzgibbons Jr RJ. Laparoscopic inguinal hernia repair: transabdominal preperitoneal (TAPP) and totally extraperitoneal (TEP). In: Scott-Conner CEH, editor. The SAGES manual: fundamentals of laparoscopy and GI endoscopy. New York: Springer; 1999. p. 364–78.

Memon MA, Feliu X, Salient F, Camps J, Fitzgibbons Jr RJ. Laparoscopic repair of recurrent hernias. Surg Endosc. 1999;13:807.

Memon MA, Rice D, Donohue JH. Laparoscopic herniorrhaphy. J Am Coll Surg. 1997;184:325.

Memon MA, Cooper NJ, Memon B, Memon MI, Abrams KR. A meta-analysis of randomized controlled trials comparing open and laparoscopic inguinal herniorrhaphy. Br J Surg. 2003;90(12):1479–92.

Rosser Jr JB. Laparoscopic inguinal hernia repair: transabdominal and balloon-assisted extraperitoneal approaches [CD-ROM]. New York: Springer; 1999.

Tetik C, Arregui ME. Prevention of complications of open and laparoscopic repair of groin hernias. In: Arregui ME, Fitzgibbons Jr RJ, Katkhouda N, McKernan JB, Reich H, editors. Principles of laparoscopic surgery: basic and advanced techniques. New York: Springer; 1995. p. 439–49.