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Laparoscopic Repair of Inguinal Hernias

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Abstract For patients with recurrent inguinal hernia, or bilateral inguinal hernia, or for women, laparoscopic repair offers significant advantages over open techniques with regard to recurrence risk, pain, and recovery. For unilateral first-time hernias, either laparoscopic or open repair with mesh can offer excellent results. The major drawback of laparoscopy is that the technique requires a significant number of cases to master. For surgeons in group practice, it makes sense to have one surgeon in the group perform laparoscopic repairs so that experience can be concentrated. For others, the best technique remains the approach that the surgeon is most comfortable and experienced performing.

Introduction

Since laparoscopic inguinal hernia repair was first reported by Ger and colleagues in 1990 [1], the operation has been refined into an attractive alternative to open hernia repair for many patients and surgeons. Although few would argue that laparoscopic inguinal hernia repair can be performed with excellent results, controversy abounds because the results of open mesh repairs are similarly good, and the learning curve for the laparoscopic technique is long. At the center of the controversy is disagreement over whether laparoscopic and open techniques are equivalent with regard to recurrence risk, pain, and recovery. A balanced view is that both laparoscopic and open techniques play an important role in the successful management of inguinal hernia, and that the best technique for a given patient is determined more by the clinical scenario than technical factors [2]. Common clinical scenarios are discussed below.

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Primary unilateral hernias

There have been a number of well-conducted, large-scale, prospective randomized comparisons of laparoscopic versus open inguinal hernia repair for unilateral hernias published in the last decade. In the largest American trial to-date, the Veterans Affairs Cooperative Study randomized 1,983 patients to open or laparoscopic hernia repair [3]. Two-year follow-up was completed with 85% of the patients. There were twofold more recurrences (10.1% vs. 4.9%), a slightly higher complication rate (39.0% vs. 33.4%), but reduced pain and earlier return-to-work in the laparoscopic group than in the open group. This trial has been criticized because the average age of the trial participants was high, the average health-related quality of life of the participants was low, and the experience of the surgeons involved in the laparoscopic arm may not have been adequate to achieve excellent results. Another large trial from Sweden reported on 1,512 patients with unilateral hernia randomized to laparoscopic totally extraperitoneal patch (TEP) repair or open Lichtenstein repair with a 5-year follow-up [4]. Again, a higher recurrence rate was found in the TEP group (3.5% vs. 1.2%). The patients of one of the laparoscopic surgeons in the trial were found to have an unusually high risk of recurrence, but even after

exclusion of that surgeon's patients from the analysis, the recurrence risk was still 2.4% in the TEP group.

Other well-conducted trials have reported different results, thus fueling the controversy. Wright et al. [5] randomized 300 patients to TEP or open repair and reported similar recurrence rates (2%) in both arms, and similar rates of chronic pain. Johansson et al. [6] randomized 613 patients to laparoscopic transabdominal preperitoneal (TAPP) hernia repair or open repair. TAPP was associated with a 6-day-faster full recovery, a 3-day-earlier return to work, and significantly less restriction on physical activities at 7 days without any significant increase in recurrences. A Cochrane meta-analysis reviewed 41 trials of laparoscopic versus open inguinal hernia repair involving 7,161 patients [7]. The analysis found that operative times were longer for laparoscopic repairs by 15 min, and there was a higher risk of rare serious complications. Return to usual activities was faster, and there was less persistent pain and numbness. There was no significant difference in hernia recurrence rates between laparoscopic and open mesh techniques.

In summary, for the patients with a straightforward, unilateral, first-time hernia, both open mesh and laparoscopic mesh repairs offer excellent results and the choice depends upon surgeon experience and patient preference.

Recurrent hernias

Outcomes for repair of recurrent inguinal hernia have been evaluated in several large-scale studies. The largest of these was a Danish study of hernia registry patients with recurrence after Lichtenstein repair [8]. The operative re-recurrence rate was 11.3% when a second Lichtenstein repair was performed, but only 1.3% when a laparoscopic repair was performed. The laparoscopic approach was better whether the original repair technique was a tissue-only repair (including Bassini, McVay, and Shouldice repairs), an anterior non-Lichtenstein repair with mesh, or even a primary laparoscopic repair.

Other prospective randomized trials have shown that the laparoscopic approach is better for recurrent hernias. One study randomized 147 patients with recurrent inguinal hernia to either open Lichtenstein or laparoscopic transabdominal preperitoneal (TAPP) repair [9]. The study reported less postoperative pain and fewer days for sick leave with TAPP. Recurrence rates were similar. A second randomized comparison in 235 patients showed fewer complications (4.4% vs. 12.2%) and fewer recurrences (2.2% vs. 5.7%) with the laparoscopic approach [10]. A third study randomized 99 patients with recurrent inguinal hernia to either open Lichtenstein or totally extraperitoneal preperitoneal (TEP) laparoscopic repair and showed less chronic pain, earlier return to work, and a trend toward fewer recurrences (0 vs. 3) [11]. Finally, in subset analysis of the Veterans Affairs Cooperative Trial, 9.3% of participants enrolled with recurrent hernia. The 2-year re-recurrence rate was 10% in the laparoscopic group, which was identical to the recurrence rate for primary laparoscopic repairs. By comparison, the re-recurrence rate was 14% in the open group, more than three times the recurrence rate (4%) observed for primary open repairs [3].

For recurrent hernias, laparoscopy offers several advantages. First, it bypasses the need to dissect in scarred tissue planes, thereby avoiding the 3-5% risk of orchitis and testicular atrophy associated with redo open procedures. Second, there is less risk of chronic inguinodynia and recovery time is shorter. Third, laparoscopy makes it possible to see the myopectineal orifice and better identify femoral hernias, which account for 9% of recurrent hernias. It also allows for mesh to be placed easily over the entire myopectineal orifice. Finally, when the diagnosis of recurrent hernia is uncertain, diagnostic laparoscopy provides a definitive diagnosis and an opportunity to repair the hernia at the same time. This avoids a groin incision and subsequent risk of wound complication [12].

Bilateral hernias

A major benefit of the laparoscopic technique is for patients who present with bilateral inguinal hernias. Laparoscopy allows for both hernias to be repaired in a single operation without need for additional ports or incisions. As a result, recovery time is similar to unilateral laparoscopic hernia repair. Wauschkuhn et al. [13] reviewed 2,880 patients with bilateral hernias repaired by TAPP and compared them to 7,240 patients with unilateral TAPP repairs. Pain, disability, recovery, reoperation, and recurrence rates were similar between the two groups. Feliu et al. [14] performed a prospective controlled trial of TEP versus bilateral Lichtenstein repair with 3-year follow-up. There were threefold more complications in the patients who underwent bilateral Lichtenstein repairs (16% vs. 5%) and twice the average length of stay (1.3 vs. 0.6 days). Recurrence rates were similar.

Other clinical scenarios

Some surgeons believe women should undergo laparoscopic repair for all direct and indirect inguinal hernias, since synchronous femoral hernias are found in up to 40% of cases and are frequently missed. Other good candidates for laparoscopy are patients who engage in intense physical activity, such as professional athletes, since laparoscopy

avoids dividing the aponeurosis of the external oblique and minimizes scar tissue between muscle planes.

Contraindications to laparoscopy

An open approach using local anesthesia should be performed when the patient's medical condition makes general anesthesia risky. Patients with prior or planned pelvic operations (for instance, radical retropubic prostatectomy) or pelvic irradiation should undergo open repair. Patients with recurrence from a prior laparoscopic repair usually should undergo open repair, although good results with a TAPP approach have been reported. Finally, patients with a strangulated hernia should undergo open repair because laparoscopic repair is more dangerous, and a primary sutured hernia repair without mesh may be necessary if the field is contaminated. Incarcerated hernia is a relative contraindication because traction on the intestines risks injury and contamination of an otherwise sterile field.

Technique

The operative steps to perform TEP and TAPP repairs are similar and have been described elsewhere [2, 15]. A detailed description of both techniques is provided below.

Positioning

The patient is placed supine with both arms tucked and general anesthesia induced. The monitor is placed at the foot of the bed. If bilateral inguinal hernias are present, the more symptomatic side is repaired first. After pneumoperitoneum is established and the trocars are inserted, the patient is placed in the steep Trendelenburg position.

Operative steps for transabdominal preperitoneal (TAPP) repair

Three trocars are used for a TAPP repair: one 11-mm subumbilical port and two 5-mm ports placed in the same transverse plane as the subumbilical port, approximately 5-7 cm away. The 5-mm ports are just cephalad and medial to the anterior superior iliac spines (Fig. 1).

A 10-mm, 30°-angle laparoscope should be used to inspect the groin anatomy. The inferior epigastric vessels, the spermatic vessels, and the vas deferens should be identified. These three structures form the so-called "Mercedes-Benz" sign (Figs. 2, 3). The peritoneum is incised several centimeters above the myopectineal orifice, from the edge of the medial umbilical ligament laterally toward the anterior superior iliac spine. Working inferiorly,

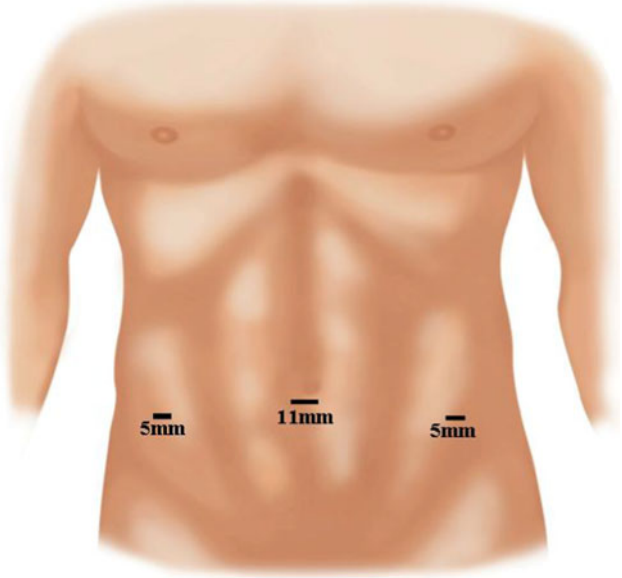


Fig. 1 Port placement for TAPP and TEP hernia repair

in a motion similar to opening a piece of pita bread, the surgeon should bluntly dissect the peritoneum off the transversus abdominus and transversalis fascia until the pubis, Cooper's ligament, and iliopubic tract are seen.

An indirect hernia sac is usually found on the anterolateral side of the cord. When dissecting the sac, it is important to minimize trauma to the vas deferens and the spermatic vessels. If the sac is sufficiently small, it should

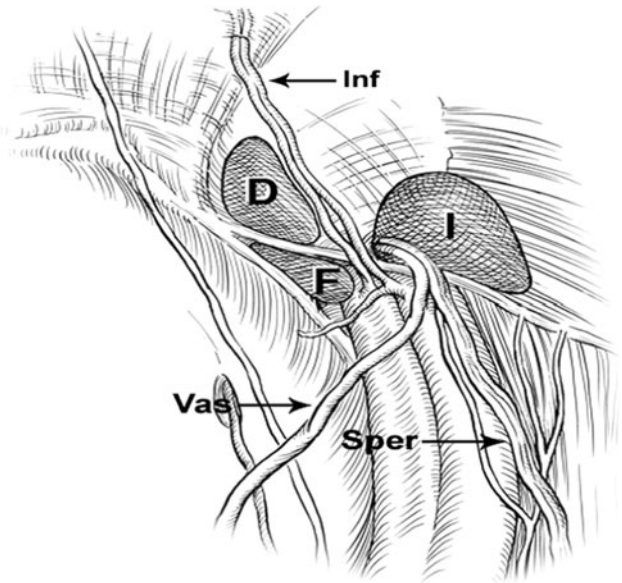


Fig. 2 Right groin anatomy. The intersection of these three structures forms the "Mercedes-Benz" sign. *D* direct hernia, *F* femoral hernia, *I* indirect hernia, *Inf* inferior epigastric vessels, *Sper* spermatic vessels, *Vas* vas deferens

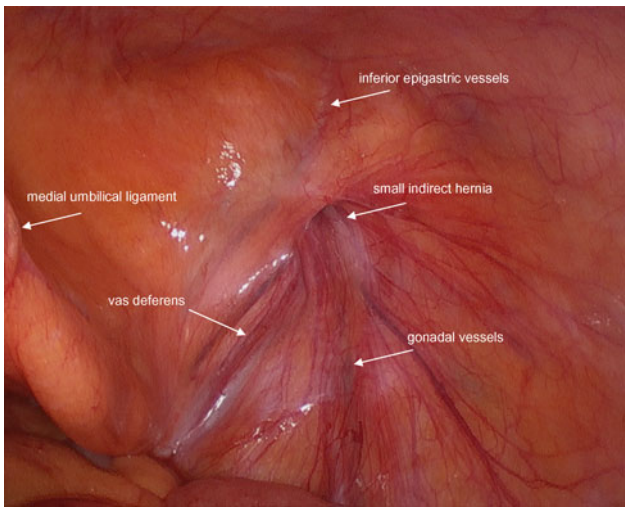


Fig. 3 Photograph of right-sided inguinal anatomy with small indirect hernia

be completely dissected free from the cord and returned to the peritoneal cavity. Occasionally, a large sac will be encountered, in which case it should be dissected and divided beyond the internal ring. The subsequent peritoneal defect should be closed with an endoloop suture, because the intestine can herniate into the preperitoneal space through the peritoneal defect and become obstructed. The distal end of the transected sac should be left open to avoid formation of a hydrocele. The vas deferens and spermatic vessels are isolated and dissected free from the surrounding tissues circumferentially, creating a window inferiorly, to allow for passage of the lower tail of the mesh.

For indirect hernias, we use a 12-cm × 16-cm flat mesh with rounded corners and slit *medially* so that the tails wrap around the cord structures (Fig. 4). The slit in the mesh allows it to lie flat in the preperitoneal space and avoids indirect recurrence. The tails are fixed to Cooper's ligament with two tacks, avoiding the accessory obturator vein which courses in the region. One additional tack is placed laterally above the iliopubic tract. When fixing the mesh laterally, it is important to feel the tip of the device on the outside of the abdomen with the opposite hand to ensure that fixation occurs above the iliopubic tract. This avoids injury to the lateral femoral cutaneous nerve. It is also important to completely dissect the preperitoneal space so that the edge of the mesh does not fold. The mesh should be placed with a slight overlap of the midline to ensure adequate coverage of the myopectineal orifice. Finally, the peritoneal flap is placed back in its original position to cover the mesh. We use closely spaced tacks so that intestines cannot herniate through the peritoneum into the preperitoneal space.

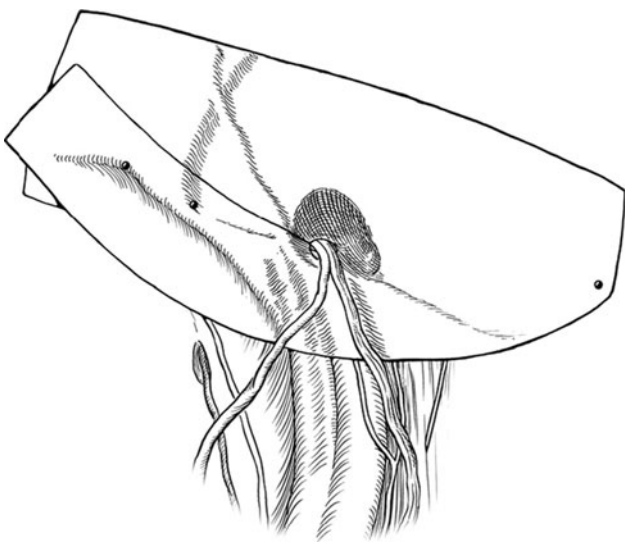


Fig. 4 Mesh repair of right-sided indirect hernia

Direct hernia sacs are reduced. When the peritoneum of a direct hernia sac is being reduced, a "pseudosac" may be present, which is actually adherent transversalis fascia that invaginates into the preperitoneal space during the dissection. This layer must be separated from the true hernia sac in order for the peritoneum to be released back into the peritoneal cavity. Once the pseudosac is freed, it will typically retract anteriorly into the direct hernia defect. For direct hernias, we use a preformed, contoured mesh (e.g., Bard 3D Max Mesh or Covidien Parietex Mesh) and anchor it with two tacks to Cooper's ligament and with one tack laterally above the iliopubic tract (Fig. 5). Again, peritoneum is replaced over the mesh and anchored with tacks.

Operative steps for totally extraperitoneal (TEP) repair

Port placement for a TEP repair is similar to that for a TAPP repair, except all ports are placed in the preperitoneal space. The first 11-mm port is placed using an open technique. A subumbilical transverse skin incision is made and then advanced slightly off the midline, in front of the anterior rectus sheath. If the fascial incision is placed in the midline, it will enter the peritoneal cavity. The anterior sheath is opened transversely and the rectus muscle is swept laterally and retracted anteriorly. The posterior rectus sheath is seen and left intact. The 11-mm balloon-tip port is then inserted bluntly into the preperitoneal space and inflated. A 10-mm, 30°-angle laparoscope is inserted and used to bluntly dissect the areolar tissue in the preperitoneal space, using a gentle sweeping motion. The preperitoneal space is dissected laterally to the anterior superior iliac spine in order to place the 5-mm ports. Alternatively, a balloon dissector can be used to bluntly dissect out the preperitoneal space.

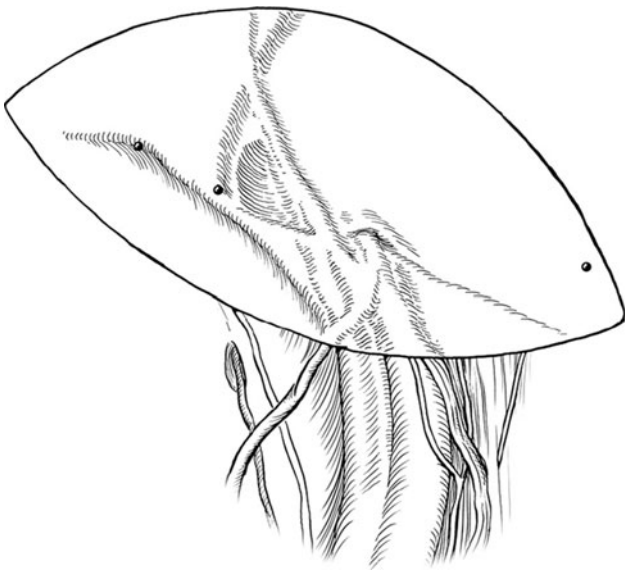


Fig. 5 Mesh repair of right-sided direct hernia

After the two 5-mm ports are placed, the inferior epigastric vessels, the pubic bone, and Cooper's ligament are identified. This dissection should be done under direct vision to avoid injury to the small veins that overlie the pubic bone and the bladder. As Cooper's ligament is exposed, a direct hernia, if present, will generally be reduced and a pseudosac may be found. Indirect hernia sacs are managed the same as for TAPP repairs. Cord lipomas are usually found laterally along the spermatic vessels and should be reduced.

Mesh strategy is the same as for a TAPP procedure. For direct hernias, we use a preformed, contoured mesh. The contoured surface of the mesh makes it easy to manipulate and it tends not to move within the preperitoneal space. For an indirect hernia, we use a large (16 cm $\times$ 12 cm) piece of flat mesh that is slit medially, passing the lower tail under the spermatic cord structures. The two tails are then overlapped and fixed to Cooper's ligament medially.

Special considerations

Some open repairs, such as the Kugel mesh repair, plug repairs, and the Prolene Hernia System repair, place mesh in the preperitoneal space. This scars the peritoneum to the mesh and increases the difficulty of laparoscopic repair for recurrent hernia. Attempts to remove the prior mesh endanger cord structures, the bladder, and the iliac vessels. If the previously placed mesh is flat, we leave it in place and place new mesh on top of the old. If it protrudes, the protruding segment should be trimmed with electrocautery or shears. If a Kugel mesh is present, the ring should be inspected and, if fractured, it should be removed to avoid future complications. Access to the scarred preperitoneal space via TEP repair is difficult; a TAPP approach is safer when there is posterior mesh. Figure 6 illustrates TAPP repair of a recurrent inguinal hernia with posterior mesh present from the first repair.

Controversies and future directions

TAPP versus TEP

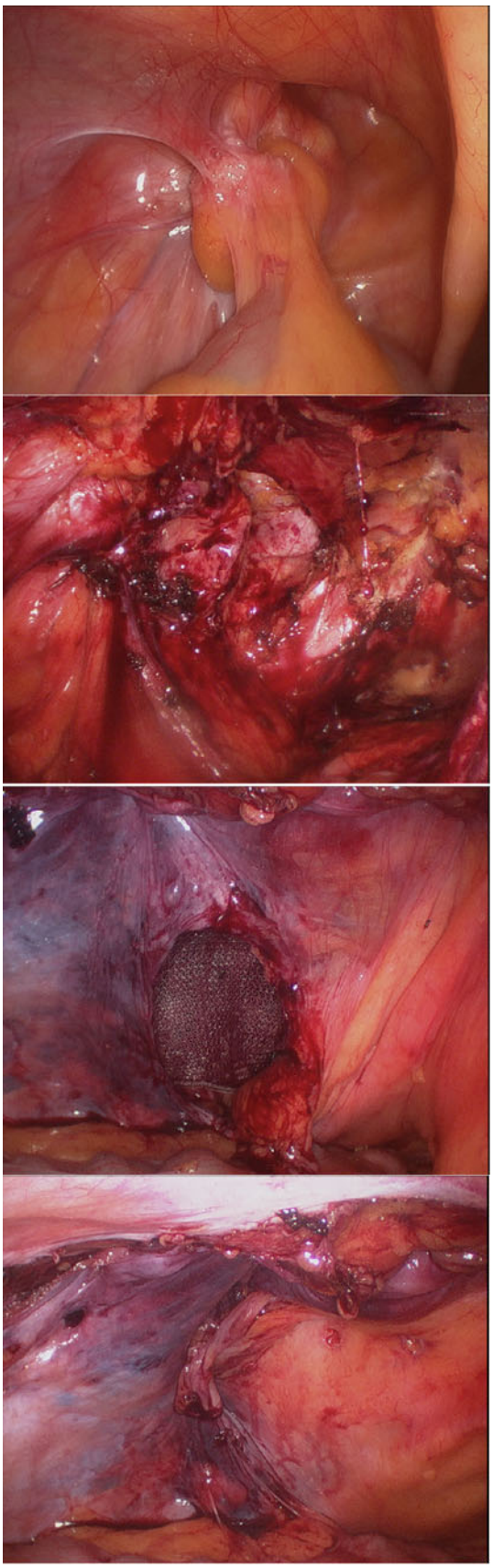
TAPP versus TEP have been compared head-to-head in one randomized trial and several nonrandomized trials for primary hernias. The topic has also been the subject of a Cochrane review. Most studies report no difference between TAPP and TEP in length of procedure, hematomas, vascular injuries, infections, length of stay in the hospital, return to normal activity, or recurrence rate. In nonrandomized studies, more port-site hernias and visceral injuries have been associated with the TAPP approach. On the other hand, more conversions to another procedure have been reported with TEP. The major difference between the two approaches is the time it takes to learn them. When length of procedure is used as a surrogate marker for proficiency, the learning curve for TAPP is about 50 cases, whereas for TEP it is closer to 100.

Lightweight versus standard mesh

Lightweight, wide-knit polypropylene and polyester mesh have been studied in several randomized, prospective studies of open hernia repairs. When compared to standard mesh, lightweight mesh is associated with a similar rate of recurrence but less pain, less sensation of a foreign body, faster return to work, and faster return to normal activity. Since lightweight mesh shrinks less, some surgeons believe that future trials with more statistical power will show fewer recurrences. Unfortunately, there are few data available on the use of lightweight mesh in laparoscopic hernia repair.

Mesh fixation

Several investigators have questioned the need for mesh fixation, which has been implicated as a source of chronic inguinodynia. Two randomized trials have demonstrated no difference in recurrence rates and postoperative pain after repairs with fixation versus no fixation, suggesting that fixation may not be necessary and also that it does not contribute to chronic pain. Fibrin glue may also be used to fix mesh. In a recent comparison, there was less chronic inguinal pain when fibrin glue was used to fix the mesh compared to conventional stapling. No significant differences in recurrence were found, although mean follow-up



◀ **Fig. 6** TAPP repair of recurrent inguinal hernia in the presence of posterior mesh from a failed open repair. **a** A left-sided direct hernia is seen just medial to posterior mesh from the Prolene Hernia System, which is adherent to sigmoid colon. **b** Completed dissection. The protruding mesh has been trimmed back flat, and the hernia is seen just medial to the internal ring. Gonadal vessels and vas deferens are visible in the lower left and Cooper's ligament is seen in the lower right. **c** Peritoneum is tacked over the mesh repair. The peritoneal defect created by removing the protrudent posterior mesh is evident. This can be closed with an endoloop suture, or, as in this case, redundant peritoneum stretched and tacked over the defect. **d** Completed TAPP repair

was only 24 months. No published data show that absorbable tack fixation (AbsorbaTack, PermaSorb, SorbaFix) reduces pain or improves outcomes.

Conclusions

For patients with recurrent inguinal hernia, or bilateral inguinal hernia, or for women, laparoscopic repair offers significant advantages over open techniques with regard to recurrence risk, pain, and recovery. For unilateral first-time hernias, either laparoscopic or open repair with mesh can offer excellent results. The major drawback of laparoscopy is that the technique requires a significant number of cases to master. For surgeons in group practice, it makes sense to have one surgeon in the group perform laparoscopic repairs, so that experience can be concentrated. For others, the best technique remains the approach that the surgeon is most comfortable and experienced performing.

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