**An Update on the Status of Laparoscopic Inguinal Hernia Repairs: Narrative review article**

**Abstract**

The utilization of laparoscopic techniques for inguinal hernia repair has been increasingly adopted in clinical practice. The Transabdominal Preperitoneal (TAPP) and Total Extraperitoneal (TEP) approaches are the predominant procedures employed for the treatment of primary, recurrent, and bilateral inguinal hernias. These techniques, however, necessitate specialized equipment and training, and they present a significant learning curve. This chapter aims to examine the advantages and disadvantages of the TAPP and TEP repair methods. Furthermore, we will compare these laparoscopic techniques with traditional open inguinal repairs and explore the role of robotic-assisted inguinal hernia repair.

Keywords- “Inguinal Hernia”,” Laparoscopic repair”,” Transabdominal preperitoneal”,” Total Extraperitoneal”,” Robotic hernia repair”,” complications”, and “mesh”

**Introduction**

Inguinal hernia repair is one of the most common surgical procedures performed by general surgeons, with up to 200,000 to 800,000 operations performed yearly in Europe and the United States. Male patients account for most cases of inguinal hernia, with a lifetime risk of 27%, and female patients have a risk of 3%. The inguinal hernia repairs can be divided into open repairs, with the Lichtenstein repair being the most common procedure, and the Laparoscopic inguinal hernia repairs are divided into the Transabdominal Preperitoneal (TAPP) and the total extraperitoneal (TEP)(Bittner & Schwarz, 2012)The Transabdominal Preperitoneal(TAPP) repair is performed under general anesthesia, with the hernia being accessed in the peritoneal cavity, and after incision of the peritoneum, the hernia sac is identified and reduced, a mesh is then placed in the preperitoneal space, and closure of the peritoneum is performed. The Total Extraperitoneal repair (TEP) involves approaching the hernia via the preperitoneal space without breaching the peritoneal cavity, and after reduction of the hernia, a mesh is inserted in the preperitoneal space(Yang & Liu, 2016).

Laparoscopic inguinal hernia repair was initially performed for recurrent and bilateral inguinal hernias, but now it is performed for primary inguinal hernias. They are performed under general anesthesia and require training due to the access to the inguinal hernias being different from the open inguinal repairs, the different anatomical structures that are encountered, and the complications that can occur due to damage to the neurovascular structures, bladder, and bowel. Placement of the mesh in the preperitoneal space requires training, as well as the method of its fixation(Arregui & Young, 2005; Cavazzola & Rosen, 2013). Some of the complications of laparoscopic inguinal hernia repairs include injury to the inferior epigastric vessel and external iliac vessels, injury to the spermatic cord, scrotal swelling, and seroma formation. There is also a risk of injury to the cutaneous nerves, like lateral femoral cutaneous nerves(Miguel et al., 1998.).

The Hernia Surge guidelines for the management of inguinal hernias by the Australasian Hernia Society have recommended that both the Transabdominal Preperitoneal (TAPP) and the Total Extraperitoneal (TEP) procedures are effective, and the choice of which procedure to perform will depend on the expertise and skill of the operating surgeon. Both primary and bilateral inguinal hernias can be repaired by these methods(Tran, 2018).The updated guidelines for inguinal hernia management have recommended that primary inguinal hernias in both males and females should be managed by these laparoscopic procedures due to reduced morbidity and chronic pain, provided that the surgeon has the required experience and expertise to perform them(Stabilini et al., 2023).The European Hernia Society on the treatment of inguinal hernia in adult patients has also recommended the same indications for the use of laparoscopic inguinal hernia repairs for the management of primary inguinal hernias in adults(Simons et al., 2009).

Laparoscopic inguinal hernia repairs are increasingly being performed for primary, bilateral, and recurrent inguinal hernias. In this chapter we will investigate the transabdominal preperitoneal (TAPP) and total extraperitoneal repair (TEP) procedures that are now performed for inguinal hernia repair. We have also compared them with standard open inguinal repairs and we will also look at the role of robotic inguinal hernia repairs. We conducted a literature review using PUBMED, Cochrane database of clinical reviews, and Google Scholar, looking for clinical trials, observational studies, cohort studies, systematic reviews, and meta-analyses from 1995 to 2025. We used the following keywords: “Inguinal hernia”, “laparoscopic repair”, “Trans Abdominal Preperitoneal”, “Total Extraperitoneal “,” Robotic hernia repair “,” complications”, and “mesh”. All articles were in the English language only. Further articles were obtained by manual cross-referencing of the literature. Case reports and studies with fewer than 10 patients and editorials were excluded. Adult male and female patients were included in this study.

**Laparoscopic Transabdominal Preperitoneal (TAPP) repair**

The Transabdominal Preperitoneal (TAPP) procedure is performed under general anesthesia with the patient in the supine position. A 12mm supra-umbilical port is inserted, followed by a right and left lateral port insertion. The peritoneal flap is incised and created, and the critical view of the myopectineal orifice is done by identifying the inferior epigastric vessels. The dissection should extend medially to the Retzius space with identification of the Cooper's ligament and pubic symphysis. The next part of the dissection proceeds lateral to the inferior epigastric vessels and spermatic vessels and extends to the anterior superior iliac spine, with the dissection being superficial to the preperitoneal fat to avoid nerve damage. A 10cm by 15cm polypropylene mesh is then laid in the preperitoneal space, and it is fixed with either tackers or sutures, and the peritoneal flap is then closed with absorbable sutures. The gas is removed, and the facial layers and skin are closed(Castorina et al., 2012; Iossa et al., 2024; Rivas et al., 2021).

Some of the complications that can occur include injury to the inferior epigastric vessels during incision of the peritoneal flap, injury to the bladder and iliac vessels during dissection of Cooper’s ligament, injury to the cord structures, and seroma formation after transection of the sac. Injury to the genitofemoral and lateral femoral cutaneous nerve during fixation of the mesh and intestinal occlusion during closure of the peritoneal flap(Lovisetto et al., 2007).A prospective study by Thanh on 38 patients who had undergone the Transabdominal Preperitoneal repair found that it had a success rate of 96.8%(Thanh Xuan & Huu Son, 2020).Liu et al. assessed the clinical value of the Transabdominal Preperitoneal repair for recurrent inguinal hernias. A total of 354 patents underwent this procedure, and the rate of intra-operative injury was 4.5% and post-operative complications were 13.6%. This study showed that the Transabdominal Preperitoneal (TAPP) was safe and effective for recurrent inguinal hernias(Liu et al., 2020).

Muschalla et al looked at the early and long-term effects of the Transabdominal Preperitoneal (TAPP) repair in 1208 patients who were then followed up to five years. The recurrence rate was 0.4% and chronic pain was 0.59%(Muschalla et al., 2016).A review of 2500 cases of inguinal hernia who had undergone the Transabdominal Preperitoneal (TAPP) repair was conducted by Schultz et al. The patients were followed up to 7 years, and the recurrence rate was 1.04% and the complication rate was 3.56%(Schultz et al., 2001).Kapiris et al also followed up 3017 patients who had undergone the Trans abdominal Preperitoneal(TAPP) repair over 7 years, and post postoperative seroma and hematoma rate was 8% and the recurrence rate was 0.12%(Kapiris et al., 2001).

The necessity of performing mesh fixation in Transabdominal Preperitoneal (TAPP) was assessed by the Hernia-med registry analysis of 11,230 cases, with 7422 undergoing mesh fixation and 3806 undergoing no fixation. The patients were followed up for five years, and the recurrence rate was 0.88% for mesh fixation and 1.1% for non-fixation. This study concluded that mesh fixation may be required for large inguinal-scrotal hernias(Mayer et al., 2016).Habeeb et al looked at the short and long-term outcomes of mesh fixation in the Transabdominal Preperitoneal (TAPP) repair in a randomized controlled trial comparing tacker fixation, glue fixation, and no fixation in 789 patients. The patients who had undergone tacker fixation were associated with higher complications and chronic pain when compared to the other groups(Habeeb et al., 2020). Another study of the Danish Hernia Database was conducted by Mortensen et al, which looked at the choice of fixation device for the Transabdominal Preperitoneal (TAPP) and recurrence rates. A total of 49,029 patients were included in this study, and the recurrence rate was 3.6% over a 5-year follow up with the highest recurrence rate in tacker fixation group(Mortensen et al., 2025). Elhadidi et al compared stapler and sutured fixation of mesh for the Transabdominal Preperitoneal repair (TAPP) on chronic pain over three years, and the patients who underwent stapler fixation had a chronic pain rate of 12.3% against a 9.2% of sutured fixation(Elhadidi et al., 2024).

**Laparoscopic Total Extra Peritoneal (TEP) repair**

The Total Extra Peritoneal (TEP) repair was first introduced by McKernan and Laws, and this procedure involves placing a supraumbilical incision, and the rectus muscle is retracted and inserting the trocar in the space behind the rectus muscle and anterior to the peritoneum. A tunnel is then dissected, and two additional ports are placed in the midline, one half-way from the umbilicus and pubis, and another 1 cm above the pubic symphysis. A 12mm port is inserted in the supraumbilical site, a 10mm port is inserted in the midline, and a 5mm port is inserted just above the suprapubic region. The dissection is then carried out over the Cooper’s ligament and the hernia sac from the deep ring. The hernia is reduced, and then a 10cm by 15cm mesh is inserted and placed over the preperitoneal space and anchored with tackers over the Cooper's ligament and the ilio pubic tract. The gas is removed, followed by the camera removal. Closure of the fascia over the rectus at the supra-umbilical port is performed with absorbable sutures, and the skin is also closed with absorbable sutures(Mckernan & Laws, 1993).

This has the advantage of accessing the hernia in the preperitoneal space without breaching the peritoneal cavity. Still, it requires longer training due to the limited space in the preperitoneal space. Swadia et al performed 1539 Total Extraperitoneal (TEP) repairs, and the overall morbidity was 8.57% and a recurrence rate of 2.05% at three-year follow-up(Swadia, 2011)Dulucq et al. also performed a total of 3,100 Total Extraperitoneal (TEP) repairs over 15 years, and the postoperative morbidity was 2.2%, and the recurrence rate was 0.35%(Dulucq et al., 2009).Krishna et al had retrospectively assessed 1249 total extraperitoneal(TEP) repairs over twenty years, and the success rate was 93.5% and seroma formation was the most common complication. The incidence of chronic pain was 1.4%(Krishna et al., 2019).Toma et al also followed up 303 patients who had undergone a total extraperitoneal repair over 10 years, and the recurrence rate was 1.3%(Toma et al., 2015).Another study by Brandt-Kerkhof et al followed up 318 patients who had undergone a total extraperitoneal repair(TEP) over 13 years, and the overall recurrence rate was 8.9%(Brandt-Kerkhof et al., 2011).

Some of the complications that can occur during the Total Extraperitoneal (TEP) repair include bleeding or injury to the inferior epigastric artery, perforation of the peritoneum and bowel injury, seroma formation, and chronic pain(Ulutas & Yılmaz, 2024). Obesity is an important factor that can influence difficulty during the learning phase of the Total Extraperitoneal(TEP) repair, especially in patients with a Body Mass Index(BMI) of more than 25(Park et al., 2014). The need for routine fixation of mesh is another area of debate. Saggar et al performed selective mesh fixation for hernia defects that are larger than 5cm, have a large internal ring, are recurrent, and sliding hernias, and the recurrence rate was 0.3%(Saggar & Sarangi, 2008). Cristaudo et al conducted a prospective randomized trial comparing mesh fixation in total extraperitoneal (TEP) repair. A total of 146 patients were randomized to tack fixation and glue fixation of the mesh. and the patients who underwent glue fixation had the lowest pain score(Cristaudo et al., 2015). Another randomized prospective study by Koch et al comparing fixation and non-fixation of mesh during the Total extraperitoneal (TEP) repair also found no difference in recurrence rate and chronic pain, and they recommended non-fixation of mesh(Koch et al., 2006). A systematic review and meta-analysis of randomized controlled trials comparing fixation and non-fixation of mesh during Total Extraperitoneal repair was conducted by Sahebally et al. Eight randomized controlled trials with 557 patients were included in this study, and there was no difference in recurrence, seroma formation, or urinary retention. Mesh fixation was associated with increased postoperative pain. This study favors non-fixation of mesh during Total Extraperitoneal (TEP) repair(Sahebally et al., 2020).

**Comparison between the Transabdominal Preperitoneal (TAPP) and Total Extraperitoneal (TEP) repairs**

Varcous et al. compared the Transabdominal Preperitoneal (TAPP) and Total Extraperitoneal (TEP) repairs for inguinal hernia, and there were no major complications from either procedure. There were minor complications like bleeding and seroma formation, but there was no difference in the recurrence rate(Vãrcous et al., 2016.)Krisna et al. conducted a prospective randomized controlled trial comparing the Transabdominal Preperitoneal (TAPP) and Total Extraperitoneal (TEP) procedures for laparoscopic inguinal hernia repair. A total of 100 patients were divided into 53 who underwent the TEP procedure and 47 who underwent the TAPP procedure. There were no differences regarding the recurrence rate, but the TEP procedure was associated with a higher seroma rate, and the TAPP was associated with a higher scrotal edema rate. This study concluded that both repairs were effective(Krishna et al., 2012).A prospective study by Patel et al, who compared both the Transabdominal Preperitoneal (TAPP) and Total Extraperitoneal (TEP), also concluded that there was no difference in outcomes (Patel et al., 2020).

Sharma et al conducted a prospective randomized trial comparing the laparoscopic Transabdominal Preperitoneal (TAPP) and Total Extra Peritoneal (TEP) approach for bilateral inguinal hernias. 60 patients were randomized to receive the TAPP and TEP procedures. There were no differences regarding the postoperative complication rates and recurrence rates, and the TEP procedure to slightly longer to perform than the TAPP procedure (Sharma et al., 2015). A Cochrane review was conducted by Andresen et al to compare the Transabdominal Preperitoneal (TAPP) versus the Total Extraperitoneal (TEP) repairs for inguinal hernia. A total of 23 studies with 1156 patients who underwent the TAPP and 1110 who underwent the TEP. There were no differences in the adverse events and recurrence rates between the procedures, and this study concluded that there was no difference in outcomes between the procedures in inguinal hernia repairs(Andresen & Rosenberg, 2024).

A meta-analysis comparing Transabdominal Preperitoneal (TAPP) versus Total Extraperitoneal (TEP) for laparoscopic hernia repair was conducted by Wei et al. A total of 1047 patients were included in this study, and there was no difference in the complications, operative time, and recurrence rates between the two procedures(Wei et al., 2015). A systematic review and trial sequential analysis of randomized controlled trials comparing both the Transabdominal Preperitoneal (TAPP) and Total Extraperitoneal (TEP) was conducted by Aiolfi et al. Fifteen trials with 1359 patients were included in this study, and they also concluded that there was no difference regarding the complication rates, operative time, and recurrence rate(Aiolfi et al., 2021). A systematic review of the literature with a network meta-analysis on which is the best laparoscopic inguinal hernia repair: TEP or TAPP was conducted by Bracale et al, and they concluded that both procedures were effective in the management of inguinal hernias(Bracale et al., 2012). Kockerling et al performed a study on the HerniaMed registry on 17,587 patients, of which 10,877 underwent TAPP and 6700 underwent TEP. There was no difference regarding the intra-operative and post-operative complications between the two procedures(Köckerling et al., 2015).

**Comparison of the Transabdominal Preperitoneal (TAPP) and Total Extraperitoneal (TEP), and Open inguinal hernia repairs**

An overview of systematic reviews of randomized controlled trials comparing open versus laparoscopic repairs for inguinal hernias was conducted by Haladu et al. A total of 21 studies were included, and there were no differences regarding the recurrence rates, but the laparoscopic inguinal hernia repair was associated with reduced chronic pain(Haladu et al., 2022).A meta-analysis of patient-reported outcomes after laparoscopic versus open inguinal hernia repair was conducted by Patterson et al. A total of 58 studies were included, and laparoscopic inguinal hernia repair was associated with reduced postoperative pain(Patterson et al., 2019).A systematic review with meta-analysis and trial sequential analysis comparing open versus laparoscopic mesh repair for uncomplicated inguinal hernia repair was conducted by Bullen et al. Twelve studies with 3966 patients were included in this study, and there was no difference in the recurrence rates between the procedures, but laparoscopic hernia repair was associated with reduced chronic pain(Bullen et al., 2019).

Scheuermann et al conducted a systematic review and meta-analysis of randomized controlled trials comparing the Transabdominal preperitoneal (TAPP) versus the Lichtenstein repair for primary inguinal hernias. Eight studies with 860 patients were included in this study, and there was no difference regarding recurrence rate, but the TAPP procedure was associated with reduced chronic pain(Scheuermann et al., 2017). Gavrillidis et al conducted a systematic review and meta-analysis of randomized controlled trials comparing the Total Extraperitoneal (TEP) versus the Lichtenstein repair. A total of 21 studies with 6573 patients were included in this study, and this study showed that TEP was associated with reduced hematoma formation and faster recovery, but it was associated with a higher recurrence rate(Gavriilidis et al., 2019).

**Table Ⅰ**

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| **Study** | **Study Type** | **N=numbers** | **Year** | **Recurrence Rate for Open repairs (%)** | **Recurrence Rate for laparoscopic repairs (%)**  |
| Gavriilidis et al | Systematic review & Meta-analysis | 6573 | 2019 | 4% | 6% |
| Patterson et al | Meta-analysis | 17,510 | 2019 | 3.9% | 4.4% |
| Agrawal et al | Retrospective analysis | 838 | 2025 | 4% | 13% |

Table showing the recurrence rates after open and laparoscopic inguinal hernia repairs.

**Robotic laparoscopic inguinal hernia repairs**

The first robotic inguinal hernia repair was performed by Dominguez et al, and they performed a robotic Transabdominal preperitoneal(rTAPP). The patient is positioned, and ports are placed, and once the robot is docked, the surgeon can perform the surgery in their console. The advantage of this method is the movement of the robotic arms, the ease of performing the surgery, and the placement and suturing of the mesh. But the disadvantage is the training and the cost of the robot(Escobar Dominguez et al., 2015).The Danish Inguinal Randomized controlled trial compared robotic-assisted transabdominal preperitoneal(rTAPP) with laparoscopic Transabdominal preperitoneal (TAPP). A total of 138 patients were randomized to 74 who underwent rTAPP and 64 TAPP. The operative time was shorter with the rTAPP than with the laparoscopic TAPP(Arunthavanathan et al., 2025).

An updated systematic review and meta-analysis were conducted by Solaini et al comparing robotic versus laparoscopic inguinal hernia repair. A total of 9 articles with 64,426 patients were included in this study. Robotic repair was associated with a longer time and cost, but had similar postoperative complications, recurrence, and chronic pain as laparoscopic repair(Solaini et al., 2022). A systematic review and meta-analysis on robotic inguinal hernia repair was conducted by Qabbani et al. Nineteen studies with 8987 patients were included in this study, and there were no differences in postoperative complications, although the operative time was longer and the cost was higher compared to open and laparoscopic hernia repair(Qabbani et al., 2021).Further systematic review and meta-analyses on robotic inguinal hernia repair by Aiolfi et al and Xi Li also found that it was safe and effective in the management of inguinal hernias(Aiolfi et al., 2019; Li et al., 2024).

**Conclusion**

Laparoscopic inguinal hernia repairs are slowly emerging as an alternative to open inguinal hernia repairs. Both the Transabdominal Preperitoneal (TAPP) and Total Extra Peritoneal (TEP) are now the most common laparoscopic procedures. They are equally effective in the management of inguinal hernias, with the Total extraperitoneal repair (TEP) requiring a longer learning curve. Both are associated with reduced postoperative complications, recurrence rate, and chronic pain. The Total Extraperitoneal (TEP) repair is gaining favor because there is no breach of the peritoneal cavity. Both these procedures require training and expertise, as well as advanced laparoscopic training. The choice of which procedure to perform will depend on the experience and should be tailored to the operating surgeon. Robotic laparoscopic inguinal hernia repair is now being performed and will herald the progression of laparoscopic inguinal hernia repairs. The barrier to this is the cost of the robot and the training that will be required to use the robot.

Conflict of interest-There is no conflict of interest.

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