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Review Article

The Total Extraperitoneal Inguinal Hernia Repair: An Update: Narrative Review Article

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Abstract: Inguinal hernia repair is one of the most performed operations worldwide. The development of minimally invasive techniques has significantly altered the surgical management of groin hernias, with Total Extraperitoneal (TEP) repair emerging as a well-established laparoscopic approach. Unlike transabdominal preperitoneal (TAPP) repair, TEP is performed entirely within the extraperitoneal space, avoiding entry into the peritoneal cavity. This approach reduces the risk of intra-abdominal complications like bowel perforation and vascular injuries. Numerous studies have demonstrated that TEP repair achieves recurrence rates comparable to open mesh repair while offering advantages such as reduced postoperative pain, earlier return to normal activities, and lower rates of chronic groin pain. However, the procedure has a steeper learning curve due to the limited working space and complex posterior groin anatomy. This review examines the TEP repair, looking at its indication, mesh fixation methods, and comparison with the TAPP and other open inguinal hernia repairs.

Keywords: TEP, Inguinal Hernia, Laparoscopic, Endoscopic, Recurrence, Chronic Pain, Preperitoneal, Mesh Repair.

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INTRODUCTION

The laparoscopic total extraperitoneal (TEP) inguinal hernia repair was first introduced by Ferzli *et al*., in 1992. This laparoscopic repair involves placing a 10 mm subumbilical port posterior to the rectus muscle and dissecting to create space in the preperitoneal space. Once the space is formed, a 5mm port is inserted in the midline at the suprapubic region, and another 5mm port is inserted at the midpoint between the subumbilical and suprapubic ports. Dissection then begins in the pubis, along Cooper's ligament to open the space of Ritzius. Identify Hasselbach's triangle and identify the potential hernia sites (inguinal, femoral, and obturator). Identify and elevate the inferior epigastric vessels and continue blunt dissection to the space of Borgos towards the anterior superior iliac spine. Dissection of the cord structures and placement of a 10cm by 15 cm polypropylene mesh is then performed after a slit is made for the external iliac vessels and the spermatic cord, and it is anchored with tackers or sutures. Ferzli performed this repair on 25 patients, and there were no morbidities or mortalities, and there was one patient who underwent a conversion to an open procedure(Ferzli *et al*., 1992).McKernan and Laws also performed the total extraperitoneal laparoscopic inguinal hernia repair on 51 patients, and there was hematoma formation in 3 patients, which resolved after 1 week, and there were no recurrences noted(McKernan & Laws, 1993).

The Guidelines on laparoscopic (TAPP) and endoscopic (TEP) treatment of inguinal hernia (International Endo Hernia Society) have the following for the Total Extraperitoneal (TEP), with the patient being positioned in the supine position, the balloon dissection of the extraperitoneal space creation especially during the learning period. The working ports should be in the midline, and midway between the camera port and the pubic symphysis. The dissection should be performed in a plane that is posterior to the inferior epigastric vessels, and a direct sac should be inverted and anchored to Cooper's ligament, while an indirect sac should be ligated proximally and divided distally. A large mesh (15 cm by 13 cm) should be used, and it should cover without wrinkles all the fascial defects in the groin (Hesselbach triangle, indirect ring,

femoral ring, and obturator ring), and fixation is recommended for hernias that are larger than 4cm(Bittner *et al*., 2011). Updates of the guidelines on laparoscopic (TAPP) and endoscopic (TEP) treatment of inguinal hernia (International Endo Hernia Society) have recommended a pre-tied sutured loop to close the direct inguinal hernia defect, and there is an increased risk of seroma formation following the proximal ligation and distal division of the indirect hernia sac, and use of a closed suction drain may reduce this risk. Both the TAPP and TEP are equally effective for the management of primary inguinal hernia(Bittner *et al*., 2015).

This review aims to examine the role of the total extraperitoneal (TEP) repair, looking at the indications and complications. We will compare the TEP with other laparoscopic inguinal hernia repairs, such as the transabdominal preperitoneal (TAPP) repair. The TEP repair will also be compared with the Lichtenstein and other open inguinal hernia repairs. A comprehensive literature review was conducted using PubMed, Google Scholar, Semantic Scholar, and Cochrane databases to identify original research studies, observational studies, clinical trials, clinical reviews, review articles, systematic reviews, and meta-analyses from 1990 to 2026. The search employed the following keywords: "TEP," "Inguinal hernia," "laparoscopic," "endoscopic", "recurrence"," chronic pain"," Preperitoneal" and "mesh repair." All articles were in English, and additional articles were identified through manual cross-checking. Case reports, commentaries, and editorials were excluded, while all articles involving adult patients were included in this review.

DISCUSSION

The Total Extraperitoneal (TEP) Inguinal Hernia Repair

Krishna *et al*., conducted a retrospective study on the total extraperitoneal (TEP) inguinal hernia repair. A total of 841 patients underwent 1249 repairs, and the success rate of the TEP repair was 93.5%. After 10 years of follow-up, the recurrence rate was 1%, and the incidence of chronic pain was 1.4% (Krishna *et al.,* 2019). Swadia conducted a retrospective study of 1042 patients who underwent 1539 TEP repairs. Intraoperative complications were seen in 2.98% of the cases, and the morbidity rate was 8.57%. The recurrence rate at 3-year follow-up was 8%(Swadia, 2011). Dulucq *et al*., conducted a retrospective study on laparoscopic total extraperitoneal inguinal hernia repair. There were a total of 3100 hernia repairs, of which 3007 underwent TEP repair and the overall morbidity rate was 2.2%, and the recurrence rate was 0.35%(Dulucq *et al*., 2009).

Toma *et al*., conducted a retrospective study on 303 patients who had undergone total extraperitoneal (TEP) inguinal hernia repair, and the hematoma rate was 2.6%, and the seroma rate was 1.3%. The recurrence rate after total extraperitoneal (TEP) repair was 1.3%, and the chronic pain rate was 0.3%(Toma *et al*., 2015). Brandt-Kerkhof *et al*., performed the total extraperitoneal (TEP) repair on 313 patients, and after a mean follow-up period of 13 years, the recurrence rate was 8.9%(Brandt-Kerkhof *et al*., 2011). Messenger *et al*., performed a five-year prospective follow-up of 430 patients who had undergone total extraperitoneal (TEP) inguinal hernia repair, and the recurrence rate was 1%, and the incidence of chronic pain was 7.6%(Messenger *et al*., 2010). Reiner *et al.,* conducted a retrospective study on 783 patients who had undergone 1240 TEP repairs, and seroma formation was seen in 3%, and testicular swelling was seen in 1.9% of the cases(Reiner & Bresnahan, 2016). Tamme *et al.,* retrospectively assessed the Total extraperitoneal (TEP) inguinal hernia repair in 3,868 patients over a 7-year period. A total of 5203 repairs were performed, and postoperative complications were noted in 0.3% of cases, and the recurrence rate was 0.6%(Tamme *et al*., 2003).

Saggar *et al*., conducted a retrospective study on selective mesh fixation of the laparoscopic total extraperitoneal (TEP) inguinal hernia repair. 634 patients had undergone 822 TEP repairs, with mesh fixation being performed in 28 repairs. There were no differences regarding postoperative complications between the procedures, and the recurrence rate was 0.7% at 82 months' follow-up (Saggar & Sarangi, 2008). A prospective randomized trial comparing mesh type and fixation in the total extraperitoneal (TEP) inguinal hernia repair was conducted by Cristaudo *et al*., There were 146 patients in this study, and they were divided into 4 groups: Group 1- 10 cm by 15cm mesh with absorbable tacks; Group 2- 10 cm by 15cm folding mesh with absorbable tacks; Group 3- 10 cm by 15cm mesh with non-absorbable tacks; and Group 4 -10cm by 15 cm mesh with fibrin sealant. There were no differences regarding postoperative complications and chronic pain between the groups(Cristaudo *et al*., 2015). A randomized prospective study comparing fixation versus non-fixation of the mesh in the total extraperitoneal (TEP) hernia repair was conducted by Koch *et al*., 40 patients were divided into 20 who underwent mesh fixation and 20 without mesh fixation. There were no differences regarding postoperative pain and recurrence rates between the two methods(Koch *et al*., 2006).

A systematic review and meta-analysis comparing fixation and non-fixation in laparoscopic total extraperitoneal (TEP) in primary inguinal hernia repair was conducted by Sahebally *et al.,* There were 8 studies with 557 patients in this study, there were no differences regarding recurrence (RD-0.00, 95% CI, 0.01- 0.01) and seroma (OR-0.70, 95% CI, 0.28-1.74), but fixation was associated with higher immediate postoperative pain (MD-0.93, 95% CI, 0.20-1.66)(Sahebally *et al*., 2020). A systematic review and meta-analysis of randomized controlled trials comparing mesh fixation and non-fixation in the total extraperitoneal inguinal hernia repair was conducted by Chaouch *et al*., The review included 16 studies with 1608 patients; mesh fixation was

associated with a higher risk of chronic pain than non-mesh fixation (RR 1.68, 95% CI, 1.29-2.19), but there were no differences in recurrence between fixation and non-fixation (RR 0.53, 95% CI, 0.22-1.23). There were no differences in seroma formation between mesh fixation and non-fixation (RR 1.05, 95% CI, 0.70-1.58) (Mohamed Ali Chaouch *et al.,* 2026).

A meta-analysis of randomized controlled trials on the safety of unfixed mesh in the total extraperitoneal (TEP) inguinal hernia repair was conducted by Dong *et al.,* There were 15 studies with 1629 patients in this review, and non-fixation of mesh was associated with a shorter operative time (MD-1.33,95%CI,2.13-0.53), reduced early postoperative pain (MD-0.50,95%CI,0.98-0.03), reduced chronic pain (RR-0.72,95%CI,0.43-1.19), and reduced recurrence (RR-2.17,95%CI,0.88-5.53). This study showed that non-fixation of the mesh did not increase the risk of recurrence in the total extraperitoneal (TEP) hernia repair(Dong *et al.,* 2023).

Table I

Study	Study Type	N=Numbers	Chronic Pain	Recurrence
Sahebally *et al*., (2020)	Systematic Review & Meta-analysis	557	No differences between fixation & non-fixation of mesh	Non-fixation of mesh had a lower recurrence rate (RD-0)
Dong *et al*., (2023)	Meta-analysis of randomized controlled trials	1629	Non-fixation of mesh had reduced chronic pain (RR-0.72)	Non-fixation of mesh had reduced recurrence (RR-2.17)
Chaouch *et al*., (2026)	Systematic review & meta-analysis of randomized controlled trials	1608	Non-fixation of mesh was associated with reduced chronic pain (RR-1.68)	No differences in the recurrence rate between fixation & non-fixation of mesh (RR-0.53)

Table showing the recurrence and chronic pain between fixation and non-fixation of mesh during laparoscopic inguinal hernia repair

Comparison of the Total Extraperitoneal (TEP) with the Transabdominal Preperitoneal (TAPP) Repairs for Inguinal Hernia in Adults

Varcuae *et al.,* performed a retrospective study comparing the TEP versus TAPP repair for laparoscopic inguinal hernia repair in adults. There were 70 patients in this study, with 36 undergoing TEP and 34 undergoing TAPP repair. There were no differences regarding post-operative complications, recurrence rates, or complications between the procedures(Vărcuae *et al*.,2016.).A prospective randomized controlled trial comparing laparoscopic TEP versus TAPP approaches for inguinal hernia repair was conducted by Krishna *et al*., 100 patients were divided into 53 who underwent TEP and 47 who underwent TAPP. The TEP repair was associated with reduced postoperative pain, but there were no differences in chronic pain and recurrence rates between the procedures(Krishna *et al*., 2012). A prospective randomized study comparing chronic pain and quality of life following the TEP and TAPP laparoscopic inguinal hernia repair was conducted by Bansal *et al*., 314 patients were randomized to 160 who underwent TEP and 154 who underwent TAPP, and there were no differences regarding chronic pain and quality of life between both procedures(Bansal *et al*., 2013).

A systematic review and meta-analysis of randomized controlled trials on laparoscopic management of inguinal hernia was conducted by Almutairi *et al.,* There were 10 studies with 11,148 patients in this study, and TEP was shown to have reduced postoperative pain and a slightly reduced recurrence rate when compared to the TAPP repair. There were no differences regarding postoperative infection, hematoma, and seroma formation between the procedures(Almutairi *et al.,* 2024). A systematic review comparing the TEP versus TAPP for inguinal hernia repair was conducted by McCormack *et al*., There were 10 studies in this review, and there were no differences regarding postoperative complications, chronic pain, and recurrence between the procedures(McCormack *et al*., 2005).A systematic review and network meta-analysis comparing the TEP and TAPP for the treatment of inguinal hernia in adults. There were 5 studies with 3355 patients in this review, and there were no differences regarding postoperative complications, chronic pain, and recurrence between the TEP and TAPP procedures(Bracale *et al*., 2012).

A meta-analysis comparing the TEP versus TAPP for laparoscopic hernia repair was conducted by Wei *et al*., There were 10 studies with 1047 patients in this review, and there were no differences regarding postoperative complications (RR-0.84, 95% CI, 0.67-1.06), recurrence rates (RR-1.18, 95% CI, 0.47-2.98), and length of hospital stay between the procedures (SMD-0.07,95%CI,0.09-0.23)(Wei *et al*., 2015). A systematic review and meta-analysis of randomized controlled trials comparing the TEP and TAPP inguinal hernia repair was conducted by Chen *et al*., There were 16 studies with 1519 patients in this review, and TEP was associated with a shorter hospital stay (MD-0.87, 95% CI, 1.67-0.07), but longer operative time (MD-3.35, 95% CI, 0.16-6.65)(Chen *et al*., 2019).

A systematic review and meta-analysis comparing TEP versus TAPP for inguinal hernia was conducted by Naim *et al*., Seven studies with 986

patients were included in this review, and there were no differences regarding hospital stay (MD-0.51,95%CI,1.82-0.79) and postoperative pain between the procedures(Naim & Reza, 2026). A systematic review and trial sequential analysis of randomized controlled trials comparing TEP versus TAPP for inguinal hernia was conducted by Aiolfi *et al*., There were 15 studies with 1359 patients (TEP-657 and TAPP-702) in this review, and there were no differences regarding chronic pain (RR-1.51,95%CI,0.54-4.22) and recurrence rates (0.83,95%CI,0.35-1.96) between both procedures(Aiolfi *et al*., 2021).

Comparison of the Total Extraperitoneal (TEP) with the Open Inguinal Hernia Repairs

Gavriilidis *et al*., conducted a systematic review and meta-analysis of randomized controlled trials comparing total extraperitoneal (TEP) versus Lichtenstein inguinal hernia repair. There were 21 studies with 6573 patients in this review, with 3242 patients undergoing TEP repair and 3331 patients undergoing the Lichtenstein repair. The TEP group reported higher vascular injuries (OR: 2.49, 1.05-5.88) and a higher recurrence rate (OR: 1.58, 1.22-2.04), but a lower hematoma formation rate and a faster return to work (Gavriilidis *et al*., 2019). A systematic review and meta-analysis comparing the total extraperitoneal (TEP) versus Lichtenstein repair for inguinal hernia repair was conducted by Koning *et al*., There were 13 studies with 5404 patients in this review, and there were no differences regarding chronic pain (RR-0.80,95%CI,0.61-1.04) and recurrence rate (RR-1.41,95%CI,0.72-2.78) between the procedures. The TEP procedure was associated with reduced severe adverse events (RR 0.91, 95% CI 0.73- 1.12)(Koning *et al*., 2013).

Lau *et al*., conducted a systematic review and meta-analysis of clinical trials comparing the Total extraperitoneal (TEP) and the Open inguinal hernia repair. There were 10 studies with 3212 patients in this review; the TEP repair was associated with a lower wound infection rate (OR 0.50, 95% CI 0.37- 0.69), and a faster return to work (WMD -0.23, 95% CI 0.31-0.15). The recurrence rate of the TEP repair was superior to the sutured open inguinal repairs (OR-0.54,95%CI,0.31-0.96), but comparable to the open mesh inguinal hernia repairs (OR-1.76,95%CI,0.60-5.22)(Lau *et al.,* 2003). A systematic review comparing open or endoscopic extraperitoneal inguinal hernia repair was conducted by Khury *et al.,* There were 23 studies in this review, and the total extraperitoneal (TEP) repair was associated with a shorter hospital stay and faster return to work, but the operative time was longer than the open repair(Kuhry *et al*., 2007). Zhu *et al*., conducted a meta-analysis comparing the laparoscopic total extraperitoneal (TEP) versus the open extraperitoneal approach for inguinal hernia repair. There were 12 studies with 1157 patients in this review, and the TEP repair was associated with lower postoperative complications (OR=0.544, 95% CI, 0.365-0.803) and shorter hospital stay. There were no differences regarding chronic pain and recurrence rates between the TEP and open extraperitoneal repair(Zhu *et al*., 2014).

A randomized clinical trial comparing the total extraperitoneal (TEP) approach with the Lichtenstein inguinal hernia repair was conducted by Gutlic *et al*., There were 416 patients in this study, with 202 undergoing TEP and 214 undergoing Lichtenstein repair. There was no difference in the incidence of postoperative pain between TEP and Lichtenstein repair at 1 year (6.9% vs 9.8%). The rate of chronic pain and recurrence was similar between the procedures(Gutlic *et al*., 2019). Eklund *et al*., conducted a randomized controlled trial comparing the total extraperitoneal (TEP) repair with the Lichtenstein repair for inguinal hernia. There were 1512 patients in this study, with 665 undergoing TEP and 705 undergoing Lichtenstein repair. After a follow-up of 5 years, the recurrence rate for TEP was 2.4%, and for Lichtenstein repair was 1.2%. There were no differences in the recurrence rate between the two procedures(Eklund *et al*., 2009).

Table II

Study	Study Type	N=numbers	Chronic Pain	Recurrence Rate
Lau *et al*., (2003)	Systematic review & Meta-analysis	3212	No differences between TEP & Open inguinal hernia repair	TEP had reduced recurrence rates with open sutured repairs (OR-0.54) & comparable recurrence rates with open mesh-based repairs (OR-1.76) _
Koning *et al*., (2013)	Systematic review & meta-analysis	5404	No differences between TEP & Lichtenstein repair (RR-0.80)	No differences between TEP & Lichtenstein repair (RR-1.44)
Zhu *et al*., (2014)	Meta-analysis	1157	No differences between TEP & open preperitoneal repair	No differences between TEP & open preperitoneal repair
Gavrilidis *et al*., (2019)	Systematic review & meta-analysis	6573	No differences between the TEP & Lichtenstein repair	Higher recurrence rate in the Lichtenstein repair (OR-1.58)

Table showing the recurrence rate and chronic pain between the TEP and open inguinal hernia repairs

CONCLUSION

Total Extraperitoneal (TEP) repair is a safe, effective, and evidence-based laparoscopic approach for adult inguinal hernia repair. By avoiding entry into the peritoneal cavity, TEP minimizes the risk of visceral injury while providing excellent coverage of the myopectineal orifice. Numerous studies have demonstrated recurrence rates comparable to open mesh repair and TAPP repair, while offering significant advantages in terms of postoperative pain, recovery time, and patient satisfaction. Although the procedure requires advanced laparoscopic skills and has a significant learning curve, it remains an important component of modern hernia surgery. Continued developments in mesh technology, surgeon training, and robotic-assisted techniques may further enhance the outcomes of TEP repair in the future.

Conflict of Interest: There is no conflict of interest.

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