

## Mesh Fixation Techniques for Inguinal Hernia Repair: An Update: Narrative Review Article

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**Abstract:** Inguinal hernia repair is one of the most frequently performed surgical procedures worldwide. The introduction of prosthetic mesh has significantly reduced recurrence rates; however, chronic postoperative inguinal pain remains an important concern. Mesh fixation is a critical component of hernia repair, influencing mesh stability, recurrence, postoperative pain, procedural costs, and patient recovery. Researchers have developed various fixation techniques, including sutures, staples, tacks, fibrin glue, cyanoacrylate glue, self-gripping meshes, and non-fixation approaches. Current evidence suggests that atraumatic fixation methods may reduce postoperative and chronic pain while maintaining recurrence rates comparable to conventional mechanical fixation. Recent systematic reviews and international guidelines support selective rather than routine mesh fixation in many laparoscopic repairs, particularly in small to medium-sized defects. This review discusses current mesh fixation techniques in open and laparoscopic inguinal hernia repair, evaluates their advantages and disadvantages, and examines contemporary evidence regarding clinical outcomes.

**Keywords:** “Inguinal Hernia”, Mesh Fixation”, Glue Fixation”, Cyanoacrylate”, ”Self-gripping mesh”, ”Lichtenstein”, ”TEP”, and “TAPP”.

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## INTRODUCTION

The mesh-based inguinal hernia repairs can be divided into open inguinal hernia repairs, for which the Lichtenstein repair is the most common procedure, and laparoscopic inguinal hernia repairs, which include the Transabdominal Preperitoneal (TAPP) and Total Extraperitoneal (TEP). Mesh can be divided into heavyweight and lightweight. In Lichtenstein repair, mesh fixation is achieved with non-absorbable sutures, although self-gripping mesh or glue fixation are other options to reduce operative time and postoperative pain. The TEP repair often does not require fixation, while the TAPP repair will require fixation, which can be achieved with sutures or tacking devices (Öberg & Rosenberg, 2022). The sutures that are used to anchor the mesh in laparoscopic hernia repairs include non-absorbable and absorbable types. Further methods of mesh fixation include the use of adhesives like fibrin sealant and cyanoacrylate, and tack fixation of the mesh, which

includes titanium and absorbable tacks (Tigora *et al.*, 2025).

The HerniaSurge guidelines by the Australasian Hernia Society have recommended that, due to no differences in the recurrence rate and surgical site infections between sutured and atraumatic mesh fixation techniques like glue fixation, atraumatic mesh fixation has been suggested to reduce early postoperative pain. For laparoscopic inguinal hernia repairs, the total extraperitoneal (TEP) repair does not require mesh fixation, and atraumatic mesh fixation with glue is recommended for laparoscopic inguinal hernia repair. For patients with large inguinoscrotal hernia who undergo laparoscopic inguinal hernia repair, mesh fixation is recommended to reduce the risk of recurrence (Tran, 2018).

This review article aims to examine the mesh fixation techniques that are used for inguinal hernias in

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adults. We will look at the role of sutured mesh fixation and atraumatic mesh fixation, such as glue and self-gripping mesh, that is used for Lichtenstein and laparoscopic inguinal hernia repairs, focusing on complications, chronic pain, and recurrence rates. 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: "Mesh fixation," "Inguinal hernia," "Glue fixation," "Cyanoacrylate," "Self-gripping mesh", "Lichtenstein", "TEP", and "TAPP." 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

### Mesh Fixation in the Lichtenstein Inguinal Hernia Repair

A meta-analysis comparing the use of fibrin glue fixation versus sutured mesh fixation in open inguinal hernia repair was conducted by Liu *et al.*, There were 9 studies with 1623 patients, with 900 patients undergoing fibrin glue fixation and 723 patients undergoing sutured mesh repair. The fibrin glue fixation was associated with a lower chronic pain rate (RR=0.42, 95% CI, 0.22- 0.79) and lower seroma formation (RR=0.43, 95% CI, 0.21-0.87). There were no differences regarding the recurrence rates between the procedures(Liu *et al.*, 2014). A systematic review and meta-analysis comparing sutured mesh fixation with glue mesh fixation in open inguinal hernia repair was conducted by Ladwa *et al.*, A total of 7 studies with 1259 patients were included in this study, with 653 patients undergoing glue fixation and 628 patients undergoing sutured fixation. There were no differences regarding postoperative complications, chronic pain, and length of hospital stay between the procedures, but glue mesh fixation was associated with reduced operative time (SMD-0.15,95%CI,0.03-0.26)(Ladwa *et al.*, 2013).

A systematic review and meta-analysis comparing cyanoacrylate versus sutures for mesh fixation during the Lichtenstein repair was conducted by Trisca *et al.*, A total of 19 studies with 3578 patients were included in this study, and glue fixation was associated with reduced immediate postoperative pain (OR-0.158,95%CI,0.0684-0.386) and reduced operative time. There were no differences regarding chronic pain and recurrence rates between the procedures(Trisca *et al.*, 2024). A meta-analysis of glue versus sutured mesh fixation for the Lichtenstein inguinal hernia repair was conducted by De Goede *et al.*, There were 7 studies with 1185 patients, and glue fixation had a shorter duration of operation(MD-2.57,95%CI,4.88-2.66) and reduced early chronic pain (RR-0.52, 95% CI, 0.31-0.87) when compared to sutured fixation(De Goede *et al.*, 2013).

A Cochrane review on mesh fixation with glue versus suture for chronic pain and recurrence in the Lichtenstein inguinal hernia repair was conducted by Sun *et al.*, There were 12 studies with 1932 patients that were included in this study, and glue fixation was associated with a reduced chronic pain rate (OR=0.63, 95% CI, 0.44-0.91). Still, there were no differences regarding recurrence rate and length of hospital stay between the procedures(Sun *et al.*, 2017). A systematic review of randomized controlled trials assessing mesh fixation in open hernia repair was conducted by Sanders *et al.*, There were 12 studies with 1992 patients in this review, and there were no differences regarding postoperative complications, recurrence, and chronic pain between glue fixation and sutured fixation for open inguinal hernia repair(Sanders & Waydia, 2014). A meta-analysis of randomized controlled trials assessing mesh fixation with glue versus suture in the Lichtenstein hernia repair was conducted by Lin *et al.*, The study included 13 studies with 2375 patients, and glue fixation was associated with a reduced incidence of early chronic pain (OR=0.41, 95% CI, 0.19-0.90) and reduced hematoma formation (OR=0.56, 95% CI, 0.34-0.95) compared with sutured fixation (Lin *et al.*, 2018).

A systematic review and meta-analysis of randomized controlled trials comparing self-gripping mesh against sutured mesh fixation in patients undergoing open inguinal hernia repair was conducted by Sajid *et al.*, There were 4 studies with 1115 patients, with 553 patients undergoing self-gripping mesh repair and 562 patients undergoing sutured mesh repair. There were no differences regarding chronic pain (OR 1.04, 95% CI, 0.72- 1.40) and recurrence rate (OR 0.76, 95% CI, 0.14-4.08) between the two methods of mesh fixation. Self-gripping mesh was, however, associated with a reduced operative time(Sajid *et al.*, 2014). Zhang *et al.*, also conducted a systematic review and meta-analysis comparing the self-gripping mesh with the sutured mesh for inguinal hernia repair. There were 7 studies with 1353 patients, and there were no differences regarding chronic pain and recurrence rates between the two procedures(C. Zhang *et al.*, 2013). Another systematic review and meta-analysis comparing self-gripping mesh and sutured mesh in open inguinal hernia repair by Fang *et al.* also concluded the same(Fang *et al.*, 2014).

A meta-analysis comparing self-gripping and sutured mesh in open inguinal hernia repair was conducted by Li *et al.*, There were 5 studies with 1353 patients, and there were no differences regarding chronic pain (OR=0.74, 95% CI, 0.51-1.08) and hematoma/seroma rate (OR=0.89, 95% CI, 0.56-1.41) between the procedures(Li *et al.*, 2014). A systematic review and meta-analysis with trial sequential analysis comparing self-gripping mesh and suture fixation for open inguinal hernia repair was conducted by Bullen *et al.*, There were 14 studies with 3180 patients, and there were no differences regarding chronic pain (RR 1.10,

95% CI, 0.83-1.46), and recurrence rates (RR 1.13, 95% CI, 0.84-2.04) between the procedures (Bullen *et al.*, 2021). A systematic review of clinical trials and observational studies comparing self-gripping versus sutured mesh fixation for open inguinal hernia repair was conducted by Ismail *et al.*, There were 17 studies with 3722 patients in this review, and there were no differences regarding the postoperative complications, chronic pain, and recurrence rates between both fixation methods (Ismail *et al.*, 2017). Another systematic review by Anurag *et al.*, which compared self-gripping mesh and sutured mesh in inguinal hernia repair, also concluded the same (Singh *et al.*, 2024).

A network meta-analysis comparing self-gripping mesh, sutured fixation, and glue fixation for open inguinal hernia repair was conducted by Rausa *et al.*, There were 28 studies with 5495 patients, and the

self-gripping mesh and glue fixation were associated with a shorter operative time when compared to sutured fixation. There were no differences in chronic pain and recurrence rates between the procedures of self-gripping mesh and glue fixation. This study showed that there is no superiority regarding these mesh fixation techniques (Rausa *et al.*, 2019). A randomized multicenter trial comparing glue fixation, self-gripping mesh, and suture fixation of mesh in the Lichtenstein repair (FinnMesh Study) was conducted by Rönkä *et al.*, 625 patients were randomized to 216 patients who underwent glue fixation, 202 patients who underwent self-gripping mesh, and 207 who underwent sutured fixation. There were no differences regarding postoperative complications, seroma formation, chronic pain, and recurrence rates between these mesh fixation techniques (Rönkä *et al.*, 2015).

Table 1

| Study                           | Study Type                        | N=Numbers                                          | Recurrence rate                                         | Chronic Pain                                                     |
|---------------------------------|-----------------------------------|----------------------------------------------------|---------------------------------------------------------|------------------------------------------------------------------|
| Ladwa <i>et al.</i> , (2013)    | Systematic Review & Meta-analysis | 1259-900(glue fixation), and 723(sutured fixation) | No difference between the two mesh fixation methods     | No differences in chronic pain between the procedures            |
| De Goede <i>et al.</i> , (2013) | Meta-analysis                     | 1185                                               | No differences between the two mesh fixation methods    | Reduced chronic pain in glue fixation (RR-0.52)                  |
| Liu <i>et al.</i> , (2014)      | Meta-analysis                     | 1623                                               | No difference between the two mesh fixation methods     | Glue fixation was associated with reduced chronic pain (RR-0.42) |
| Sajid <i>et al.</i> , (2014)    | Systematic review & Meta-analysis | 1115-553-self-gripping mesh and 562-sutured mesh   | No differences between the two mesh fixation techniques | No differences between the two mesh fixation techniques          |
| Bullen <i>et al.</i> , (2021)   | Systematic review & meta-analysis | 3180                                               | No differences between the mesh fixation methods        | No differences between the mesh fixation methods                 |

Table showing the recurrence rate and chronic pain between the different mesh fixation techniques for open inguinal hernia repair

### Mesh Fixation in the Transabdominal Preperitoneal (TAPP) and Total Extraperitoneal (TEP) Inguinal Hernia Repair

A meta-analysis and trial sequential analysis of randomized controlled trials comparing glue versus mechanical fixation in laparoscopic inguinal hernia repair was conducted by Bedwani *et al.*, There were 15 studies with 2109 patients included in this study, and glue fixation was associated with a reduced incidence of chronic pain (RR 0.36, 95% CI, 0.19-0.69) and reduced risk of hematoma formation (RR-0.29, 95% CI, 0.10-0.82). There were no differences regarding seroma formation and recurrence between the two mesh fixation methods (Habib Bedwani *et al.*, 2021). A Meta-analysis of randomized controlled trials on the efficacy and safety of glue mesh fixation for laparoscopic inguinal hernia was conducted by Hu *et al.* There were 16 studies with 2409 patients, and glue fixation of mesh was associated with reduced incidence of chronic pain (RR=0.40, 95% CI, 0.28-0.57), and reduced hematoma formation (RR=0.23, 95% CI, 0.09-0.58). There were no

differences regarding the recurrence rate (RR=0.72, 95% CI, 0.35-1.47) (Hu *et al.*, 2023). A meta-analysis and trial sequential analysis comparing glue versus tack fixation in laparoscopic inguinal hernia repair was conducted by Kitching *et al.*, There were 18 studies with 2312 patients, and glue fixation was associated with reduced risk of chronic pain (MD-0.42, 95% CI, 0.27-0.64) and hematoma formation (MD-0.35, 95% CI, 0.17-0.73) (Kitching *et al.*, 2025).

Shah *et al.*, conducted a meta-analysis comparing tissue glue fixation with tack fixation for laparoscopic inguinal hernia repair. Ten studies with 1525 patients found no differences in hematoma formation, chronic pain, or recurrence between the two fixation methods (Shah *et al.*, 2015). Antoniou *et al.*, conducted a meta-analysis of randomized controlled trials comparing non-penetrating and mechanical mesh fixation in laparoscopic inguinal hernia repair. There were 9 studies with 1454 patients, and non-penetrating mesh fixation, like glue, was associated with reduced

chronic pain (OR 0.46, 95% CI, 0.22-0.93), but there were no differences regarding seroma formation and recurrence rates between the methods of mesh fixation (Antoniou *et al.*, 2016).

A systematic review and meta-analysis of randomized controlled trials comparing non-fixation and fixation of mesh in the laparoscopic TAPP repair for inguinal hernia was conducted by Zhang *et al.*, A total of 6 studies with 1643 patients were included, with 674 patients undergoing non-fixation of mesh and 964 patients undergoing mesh fixation. Non-fixation of mesh reduced postoperative pain (MD-0.16, 95% CI, 0.23-0.10), but there were no differences regarding recurrence in both groups (RR-0.83, 95% CI, 0.29-2.39) (C. X. Zhang *et al.*, 2024). A systematic review and meta-analysis comparing the chronic pain and recurrence rate between fixation and non-fixation of mesh in TAPP inguinal hernia repair was conducted by Riemenschneider *et al.*, There were 7 studies with 1732 patients (737 non-fixation & 995 fixation) included in this study, and there were no differences regarding chronic pain and recurrence rate between fixation and non-fixation of mesh in the TAPP repair (Riemenschneider *et al.*, 2023). An updated meta-analysis on the safety of non-fixation of mesh in the TAPP inguinal hernia repair was conducted by Jiang *et al.*, There were 9 studies with 1879 patients, and non-fixation of mesh was associated with a lower seroma rate (RR=0.43, 95% CI, 0.20-0.89), but there were no differences regarding postoperative complications, chronic pain, and recurrence rate (Jiang *et al.*, 2024). A systematic review and meta-analysis comparing fibrin glue and staple for mesh fixation in laparoscopic TAPP repair was conducted by Shi *et al.*, There were 9 studies with 9067 patients, and there were no differences regarding seroma formation (OR=0.55, 95% CI, 0.27-1.14) and recurrence rates (OR=2.10, 95% CI, 0.61-7.22) between the two fixation methods (Shi *et al.*, 2017).

A meta-analysis of randomized controlled trials of fixation versus no fixation of mesh in laparoscopic total extraperitoneal (TEP) inguinal hernia repair was conducted by Teng *et al.*, There were 6 studies with 772 patients, and no fixation of mesh was associated with reduced length of hospital stay (MD-0.37, 95% CI, 0.57-0.17), and reduced operative time (MD-4.19, 95% CI, 7.77-0.61). There were no differences regarding postoperative complications, seroma formation, and recurrence rates between the methods of mesh fixation (Teng *et al.*, 2011). A meta-analysis of the mesh fixation techniques in total extraperitoneal repair (TEP) for inguinal hernia was conducted by Techapongsatom *et al.*, There were 15 studies with 1783 patients, and glue fixation was associated with a lower risk of recurrence (0.29, 95% CI, 1.30). This study showed that glue fixation was associated with a lower risk of recurrence and complications (Techapongsatom *et al.*, 2019).

A systematic review and meta-analysis comparing staples versus fibrin glue fixation in laparoscopic total extraperitoneal (TEP) repair for inguinal hernia was conducted by Kaul *et al.*, There were 4 studies with 662 patients, with 394 undergoing tack fixation and 268 undergoing glue fixation. There were no differences regarding recurrence rates between the various fixation techniques (OR 2.13, 95% CI, 0.60-7.36), and the chronic pain rate was higher in the tack fixation method (OR 3.25, 95% CI, 1.62-6.49). There were no differences regarding seroma formation and length of hospital stay (Kaul *et al.*, 2012). Tam *et al.*, conducted a meta-analysis of randomized controlled trials on staple fixation of mesh versus non-fixation in the laparoscopic total extraperitoneal (TEP) inguinal hernia repair. There were 6 studies with 932 patients, with 469 patients undergoing non-fixation and 463 patients undergoing fixation of mesh, and there were no differences regarding recurrence rate (OR 2.01, 95% CI, 0.37-11.02) and postoperative complications (OR -0.73, 95% CI, 0.51-1.05) between the methods of mesh fixation (Tam *et al.*, 2010).

## CONCLUSION

Mesh fixation remains a key determinant of outcomes following inguinal hernia repair. Traditional suture and tack fixation techniques provide durable repair but may contribute to postoperative and chronic pain through tissue and nerve injury. Atraumatic fixation methods, including fibrin glue, cyanoacrylate glue, and self-gripping meshes, have emerged as attractive alternatives with evidence supporting reduced pain and equivalent recurrence rates. Furthermore, selective non-fixation has become an accepted strategy in appropriately chosen laparoscopic repairs. Contemporary evidence increasingly supports individualized fixation strategies based on surgical approach, hernia characteristics, and patient factors to optimize outcomes while minimizing complications.

**Conflict of Interest:** There is no conflict of interest

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