

The Mesh Plug Repair for Inguinal Hernia in Adults: An Update: Narrative Review Article

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Abstract: Inguinal hernia repair is one of the most performed surgical procedures worldwide. The introduction of prosthetic mesh has significantly reduced recurrence rates and transformed the management of groin hernias. Among the various tension-free techniques developed, the mesh plug repair, popularized by Rutkow and Robbins in the 1990s, emerged as a simple and effective method that combines a conical polypropylene mesh plug inserted into the hernia defect with supplementary mesh reinforcement when necessary. The procedure gained widespread acceptance because of its technical simplicity, short operative time, low recurrence rates, and suitability for ambulatory surgery. However, concerns regarding mesh-related complications, including migration, chronic pain, erosion into adjacent organs, and foreign body sensation, have led to increasing scrutiny of the technique. Recent international hernia guidelines have increasingly favored flat mesh repairs and laparo-endoscopic approaches over mesh plugs. This review discusses the mesh plug repair, its clinical outcomes, advantages, limitations, complications, and contemporary role of mesh plug repair in inguinal hernia surgery. We also compare the mesh plug repair with the other open mesh inguinal hernia repairs and the laparoscopic inguinal hernia repairs.

Keywords: Mesh Plug, Open Hernia Repair, Tension Free Repair, Plug and Patch, Inguinal Hernia, Chronic Pain, Recurrence.

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INTRODUCTION

Rutkow and Robbins introduced mesh plug repair for inguinal hernia, which involves placing a hand-fashioned umbrella plug mesh into the internal ring and anchoring it to the crura with 2 or 3 interrupted sutures. In direct inguinal hernias, the mesh plug can be inserted through the defect with the narrow end first, and it is secured with multiple interrupted sutures to the surrounding tissues. A flat Marlex mesh is then used to reinforce the repair by fixing it to the anterior and posterior wall of the inguinal canal. The lateral portion of the flat Marlex mesh is divided to include the spermatic cord, and the lateral leaf is anchored to the medial leaf. The external oblique aponeurosis and the skin are then closed. Rutkow and Robbins then used the Prefix Plug, a pre-made mesh plug, to replace the hand-rolled plug mesh (Robbins & Rutkow, 1995; Rutkow, 2003). The mesh Plug repair was associated with a shorter operative time and similar recurrence rates to the Lichtenstein repair, and it could be performed under

local and regional anesthesia (Amid, 2005; Faylona, 2017; Reuben & Neumayer, 2006).

The European Hernia Society guidelines on the treatment of inguinal hernia in adult patients have recommended that Mesh Plug repair can be used as an alternative to the standard Lichtenstein repair in the management of primary inguinal hernias in adults (Simons *et al.*, 2009). The Hernia Surge guidelines of the Australasian Hernia Society stated that despite the comparable recurrence rates and chronic pain between the Mesh Plug and Lichtenstein repair, the Mesh Plug was not recommended for the primary treatment of adult inguinal hernias due to the excessive use of foreign material, the need to enter both the anterior and posterior plane, and the additional cost that was incurred (Tran, 2018).

This review article aims to examine the Plug Mesh repair method in the surgical management of inguinal hernias in adults. We compare Plug Mesh hernia repairs with other mesh-based repairs like the

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Lichtenstein and Prolene hernia systems, and non-mesh-based open 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 1984 to 2026. The search employed the following keywords: "Mesh Plug," "Open hernia repair," "tension-free repair," "Plug and Patch," "Inguinal hernia", "chronic pain," and "recurrence." 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 Mesh Plug Repair for Inguinal Hernia

Rutkow and Robbins introduced mesh plug repair for inguinal hernias in a series of 2403 patients; 1708 underwent the hand-rolled mesh plug, and 695 underwent the Perfix mesh plug. The patients were followed up to 6 years, and there were minimal complications from the procedure, and the recurrence rate was at 1%(Rutkow & Robbins, 1995). A prospective study on the use of the mesh plug repair for inguinal hernias was conducted by Bringman *et al.*, A total of 139 patients were included in this study, and there were 17 minor complications and there were 2 recurrences during a follow-up of 9 months (Bringman *et al.*, 2000). Zieren *et al.*, also conducted a prospective observational study on the Mesh Plug technique for inguinal hernia repair. This study included 359 patients who underwent 400 mesh plug inguinal hernia repairs performed under local anesthesia. The wound infection rate was 1.5%, and at 42 months of follow-up, the recurrence rate was 0.25% (Zieren *et al.*, 2001). Mori *et al.*, also conducted a study on the Mesh plug repair for inguinal hernia. A total of 244 patients were included in this study, and the wound infection rate was 1.6%, and the recurrence rate was 12.7% after a follow-up of 5 years (Mori *et al.*, 2001).

Fasih *et al.*, also evaluated the mesh plug inguinal hernia repair by looking at the early results of this repair. 200 patients had undergone the mesh plug repair, and after a follow-up of one-year, minor complications were seen in 2%, and the recurrence rate was at 0.5%(Fasih *et al.*, 2000). Abu-Own *et al.*, also looked at the mesh plug technique for the management of inguinal hernias in adults and found that the mesh plug was associated with a shorter operative time, reduced postoperative pain, and a faster return to work (Abu-Own *et al.*, 2000). Palot *et al.*, followed up 140 patients who had undergone the mesh plug repair for inguinal hernia for 3 years, and they noted that groin pain was seen in 6.3% of the cases and the recurrence rate was at 0.9%(Palot *et al.*, 1998). Dieudonne *et al.*, performed the mesh plug repair for inguinal hernias in 3990 patients, and they were followed up to 10 years; the wound

infection rate was 0.6%, testicular atrophy was seen in 0.8%, and the recurrence rate was 1.4%(Dieudonné, 2001).

Comparison of the Plug Mesh Repair with the Lichtenstein Repair and Prolene Hernia System Repair

A randomized controlled study comparing the mesh plug repair against the Lichtenstein inguinal repair was conducted by Singh *et al.*, A total of 200 patients were randomized to 100 patients who underwent the mesh plug repair and 100 patients who underwent the Lichtenstein hernia repair. The patients were followed up to 6 months, and postoperative complications and recurrence rates were similar between the groups (Singh *et al.*, 2016). Frey *et al.*, conducted a randomized clinical trial comparing the Lichtenstein repair with the mesh plug repair for inguinal hernias. A total of 595 patients were included in this study, with 297 patients in the Lichtenstein repair group and 298 patients in the Mesh plug group. The patients were followed for 12 months, and there were no differences regarding the postoperative complications and recurrence rates between the procedures, but the reoperation rate was higher in the Lichtenstein group when compared to the Mesh plug (4.2% vs 1.4%)(Frey *et al.*, 2007). A prospective randomized study comparing the Lichtenstein repair with the Mesh plug repair for the management of inguinal hernia was conducted by Destek *et al.*, A total of 102 patients were included in this study, with 52 patients undergoing the Mesh plug repair and 50 undergoing the Lichtenstein repair. There were no differences regarding the postoperative complications and recurrence rates between the procedures. The mesh plug was, however, associated with a reduced operative time when compared to the Lichtenstein repair(Destek & Gul, 2018).

A prospective double-blind randomized controlled trial comparing the Lichtenstein repair versus the Perfix plug and patch repair in inguinal hernia was conducted by Kingsnorth *et al.*, A total of 141 patients were randomized to 68 patients who underwent the Lichtenstein repair and 73 patients who underwent the plug and patch repair. The plug and patch repair was associated with a shorter operative time and reduced postoperative pain when compared with the Lichtenstein repair. There were no differences regarding recurrence rates between the procedures (Kingsnorth *et al.*, 2000). A prospective study comparing the Mesh plug repair with the Prolene Hernia System for the treatment of inguinal hernia was conducted by Huang *et al.*, A total of 393 patients were included in this study, with 192 patients undergoing mesh plug repair and 234 undergoing Prolene hernia system repair. The mesh plug repair was associated with a shorter operating time (25 mins vs 34 mins), but the chronic groin pain was higher in the mesh plug group (8.9% vs 2.8%), and the recurrence rate was similar between the groups (Huang *et al.*, 2005). The long-term follow-up of a randomized

controlled trial comparing the Lichtenstein repair versus the Plug and Patch repair for inguinal hernia was conducted by Droezer *et al.*, There were 595 patients in this study, and at a median follow-up of 6.5 years, the recurrence rate was similar between the groups (mesh plug-7.8% vs Lichtenstein-8.2%), there were no differences regarding chronic pain (Droezer *et al.*, 2014). The short- and long-term outcomes following the use of the Mesh plug and Prolene hernia system for the treatment of inguinal hernia were assessed by a retrospective study by Hayashi *et al.*, There were 1141 patients in this study, with 184 patients undergoing the Mesh plug repair and 957 patients undergoing the Prolene hernia system. There was no difference regarding postoperative complications between the procedures, and the recurrence rates were similar between the groups (Hayashi *et al.*, 2014).

A meta-analysis of randomized controlled trials on the open mesh techniques for inguinal hernia repair was conducted by Zhao *et al.*, A total of 10 studies with 2708 patients were included in this study, and there were no differences regarding the recurrence rate between the mesh plug, Lichtenstein, and Prolene hernia system (RR-0.71, 95%CI, 0.32-1.56). The mesh plug and Prolene hernia system were associated with a shorter operative time (Zhao *et al.*, 2009). A meta-analysis of mesh plug repair and the Lichtenstein repair in the management of inguinal hernia was conducted by Yu *et al.*, A total of 11 studies with 2929 patients were included, with 1457 patients undergoing the mesh plug repair and 1472 patients undergoing the Lichtenstein repair. Mesh plug repair was associated with shorter operating time but a longer time to return to work (MD 1.48, 95% CI, 0.58, 2.38). There were no differences regarding the postoperative complications and recurrence rates between the procedures (Yu *et al.*, 2021).

Table 1

Study	Study type	Operative techniques compared	Overall Complications	Recurrence Rate	Chronic Pain
Singh <i>et al.</i> , 2016	Randomized controlled study	Mesh plug repair vs Lichtenstein repair	Negligible postoperative complications; no significant difference between groups.	No significant difference; recurrence rates were very low during 6-month follow-up.	Not specifically reported; postoperative pain similar between groups.
Féry/Dalenbäck <i>et al.</i> , 2007-2009 (BOOP Trial)	Randomized clinical study	Lichtenstein Repair vs Mesh Plug Repair vs Prolene Hernia System	No statistically significant difference in early or late complications among the three groups.	7 recurrences among 472 patients (1.5%), evenly distributed between groups.	No significant differences in long-term pain outcomes between techniques.
Destek <i>et al.</i> , 2018	Randomized clinical study	Mesh Plug Repair vs Lichtenstein repair	Similar complication rates	Similar recurrence rates are at 2-year follow-up.	Significantly less pain in MPR patients at day 1, 2 weeks, and 6 months.
Zhao <i>et al.</i> , 2009	Meta-analysis	Lichtenstein Repair (LR) vs Mesh Plug Repair (MPR) vs Prolene Hernia System (PHS)	No significant differences in complications.	No significant differences in recurrence between LR, MPR and PHS	No significant differences in chronic pain between techniques

Table showing the complication rate, recurrence rate and chronic pain between the mesh plug repair, the Lichtenstein and Prolene hernia system

Comparison of the Mesh Plug Repair with the Trans-Abdominal Preperitoneal (TAPP) and Total Extraperitoneal (TEP) Repairs

A randomized prospective controlled trial comparing the laparoscopic extraperitoneal hernia repair with the mesh plug hernia repair was conducted by Khoury *et al.*, A total of 292 patients were included in this study, with 150 patients undergoing the laparoscopic extraperitoneal repair and 142 patients undergoing the

mesh plug repair. There were no major complications seen, but minor complications were seen in the mesh plug compared to the laparoscopic extraperitoneal repair (23% vs 13%). There were no differences regarding recurrence rates between the procedures (Khoury, 1998). A prospective non-randomized study comparing the laparoscopic preperitoneal mesh repair and the Mesh plug inguinal hernia repair was conducted by Pikoulis *et al.*, There were 471 patients in this study, with 237

patients undergoing the laparoscopic preperitoneal repair and 234 patients undergoing the mesh plug repair. The postoperative complications were similar between the groups, and the recurrence rate was higher in the laparoscopic preperitoneal repair (2.5%vs0.4%). The mesh plug repair was associated with reduced cost and a faster return to normal activity (Pikoulis *et al.*, 2002).

A prospective randomized controlled trial comparing the mesh plug inguinal hernia repair with the Transabdominal Preperitoneal (TAPP) and Total extraperitoneal (TEP) was conducted by Gong *et al.*, A total of 164 patients were randomized to 62 patients who underwent the mesh plug repair, 50 patients who underwent the TAPP repair, and 52 patients who underwent the TEP repair. There were no differences regarding postoperative complications and recurrence rates between the procedures, but the mesh plug repair was associated with a shorter operative time and reduced cost (Gong *et al.*, 2011). A network meta-analysis comparing the mesh plug, Lichtenstein, transabdominal preperitoneal, and total extraperitoneal hernia repair was conducted by Shi *et al.*, A total of 38 studies with 3255 patients were included in this study, and there were no differences regarding the post-operative complication, wound infection rates, seroma formation, and recurrence rates between the Lichtenstein repair, the Mesh plug repair, the Transabdominal Preperitoneal and Total extraperitoneal repairs (Shi *et al.*, 2020).

CONCLUSION

The mesh plug technique represented an advancement in the evolution of tension-free inguinal hernia repair and contributed significantly to the reduction of recurrence rates achieved during the prosthetic era of hernia surgery. The procedure offers technical simplicity, short operative times, rapid recovery, and durable outcomes comparable to those of other open mesh techniques. Nevertheless, increasing recognition of plug-related complications, particularly migration, erosion, chronic pain, and foreign body sensation, has led many surgeons to favor flat mesh repairs and minimally invasive approaches. Although mesh plug repair remains an effective option for selected patients, its role in inguinal hernia surgery has become more limited. Future studies focusing on long-term outcomes and newer prosthetic designs may further clarify its place within modern inguinal hernia management

Conflict of Interest: There is no conflict of interest.

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