META-ANALYSIS

The Efficacy of Lichtenstein Self-Fixation Mesh and Suture Mesh in Inguinal Hernia Repair: A Meta-Analysis

Kun Huang, MM; Caihao Tang, MM; Xiang Wang, MM

ABSTRACT

Objective • To compare the effect of self-gripping mesh and suture mesh in Lichtenstein inguinal hernia repair.

Methods • A computer search of the Cochrane Library, PubMed, Ovid, and Web of Science databases for randomized controlled trials (RCTs) was conducted from January 2010 to October 2021 to compare the efficacy of self-gripping mesh versus suture mesh in Lichtenstein tension-free hernia repair. After screening the literature based on the inclusion and exclusion criteria, the literature was assessed for quality and poor quality literature was excluded and subsequently meta-analyzed using Review Manager 5.3 software.

Results • A total of 4003 patients were included in 15 RCTS, including 1978 patients in the self-gripping mesh group and 2025 patients in the suture mesh group. Meta-analysis showed that compared to the suture mesh group, the operation time of the self-gripping mesh group was significantly shorter (SMD = -0.73, 95%CI = -0.89 to -0.58, $P < .001$), the incidence of postoperative incision infection was significantly reduced (RR = 0.46, 95%CI = 0.27 - 0.80, $P = .006$), but the recurrence rate of postoperative hernia was high (RR = 1.62, 95%CI = 1.09 - 2.40, $P = 0.02$). There was no significant difference in the incidence of postoperative chronic inguinal pain, foreign body sensation, hematoma, and seroma between the 2 groups (all $P > .05$).

Conclusions • Compared to the application effect of traditional suture mesh in Lichtenstein tension-free inguinal hernia repair, self-gripping mesh has the advantage of shortening the operative time and reducing the incidence of postoperative incision infection. However, the recurrence rate of hernia may increase in the short term (within 1 year) after surgery, but this conclusion needs to be verified by a larger sample of high-quality studies. (*Altern Ther Health Med.* [E-pub ahead of print.])

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INTRODUCTION

Inguinal hernia represents a prevalent condition within general surgery, exhibiting a yearly increase in incidence.[1] Surgical intervention remains the predominant treatment strategy for inguinal hernias. However, the recurrence rates following traditional tissue tension suture repair are notably high. The evolution of surgical techniques and biomaterials has elevated Lichtenstein's tension-free repair as the preferred approach for hernia repair, gaining widespread clinical acceptance due to its straightforward procedure, minimal trauma, and reduced recurrence rates. Nevertheless, this technique necessitates a layer-by-layer incision down to the inguinal canal and the placement of a mesh beneath the external oblique muscle aponeurosis, which can introduce complications.[2] Issues such as postoperative groin pain, infection at the incision site, and hernia recurrence significantly impact the post-surgical quality of life for patients.[3] Chronic pain emerges as a frequent yet underappreciated complication, impeding patient recovery and indirectly elevating the risk for systemic complications, including infections and thrombosis.[4,5]

Consequently, the decision to suture-fixate the mesh during Lichtenstein repair has garnered considerable attention in recent years. Polypropylene, the most frequently utilized mesh material in clinical settings, features a large mesh aperture conducive to fibrous tissue growth and fluid drainage, boasting excellent tissue compatibility and stability for inguinal hernia repair.[6,7] This category includes both self-gripping and sutured meshes. The deployment of superior mesh materials, alongside surgical advancements, has significantly reduced the rates of recurrence and complications, mitigating pain levels. However, postoperative pain and other symptoms persist, markedly affecting patient comfort and quality of life.[8,9] In 2006, Chastan et al. introduced a novel fixation approach employing a self-gripping mesh, which simplifies tissue fixation through absorbable polylactic acid microhooks, potentially diminishing the incidence of postoperative groin pain, though conclusive evidence remains limited.[10]

Numerous prospective randomized controlled trials (RCTs) have found no significant difference in postoperative complications between the self-gripping and sutured mesh groups, besides operation time differences.[11-13] Given the ongoing debate over self-gripping versus traditionally sutured meshes, this meta-analysis aims to assess the efficacy of self-fixating meshes compared to sutured meshes in Lichtenstein repairs.

MATERIALS AND METHODS

Inclusion and exclusion criteria

Inclusion criteria: (1) Inguinal hernia patients treated with Lichtenstein repair (self-fixating mesh was used in the experimental group, and the ordinary sutured mesh was used in the control group); (2) prospective randomized controlled trial comparing two groups of outcomes; (3) English literature.

Exclusion criteria: (1) Other laparoscopic hernia repairs, other open procedures, and patch repairs with unrelated procedures; (2) case reports, animal experiments, reviews, expert opinions, and uncontrolled trials; (3) incomplete data; (4) unfavorable for those who obtain data; (5) duplicate publications from the same research center or the same author.

Search strategy

The databases included Cochrane Library, PubMed, Ovid, and Web of Science, and the last retrieval date was October 30, 2021. Keywords: ProGrip, Self-fixating, Sutureless, Self-gripping, Self-adhesive, Auto-gripping, Sutured, Fixation, Fixed, Lichtenstein, Inguinal Hernia Repair, Inguinal Hernioplasty, Groin Hernia Repair. Based on the retrieved literature, the references are retrieved together to improve the recall rate of the literature.

Literature screening and data extraction

The titles and abstracts of the initially obtained articles were first read, and then eligible studies were screened by reading the full text. Further screening of references was conducted to identify eligible studies. In this study, two investigators independently conducted back-to-back screening and resolved differences through comparative discussion, and the third investigator decided on inconsistencies. Data extraction was performed on all randomized controlled trials that met the inclusion criteria. The extracted data included: first author and publication time, number of cases, follow-up time, postoperative complications such as chronic pain in the groin area, hernia recurrence, incision infection, foreign body sensation in the surgical area of hematoma and seroma, and operation time. The primary outcome indicators included operation time, recurrence, acute and chronic pain, and wound infection; secondary outcome indicators included foreign body sensation, hematoma, and seroma.

Quality analysis and bias evaluation of included literature

Quality and risk of bias assessments of all RCTs were performed following the Cochrane Collaboration's Cochrane Handbook on Interventions for Systematic Reviews, Version 5.1.[14] Items included: random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data, selective reporting, and other bias. Each item was classified as low risk of bias, uncertain risk of bias, and high risk of bias.

Statistical treatment

Statistical analysis of indicator data was performed using Review Manager 5.3 software provided by the Cochrane Collaboration. For continuous variables and dichotomous variables, the standard mean difference (SMD) and relative risk (RR) were used as combined effect sizes, respectively, and were expressed as a 95% confidence interval (CI). Heterogeneity analysis was calculated by pooling SMD and RR values, along with I^2 and Z values. If there was no significant heterogeneity between studies ($P > .1$, $I^2 \leq 50\%$), a fixed-effect model was used for meta-analysis; while, if there was significant heterogeneity ($P < .1$, $I^2 > 50\%$), the difference was analyzed. The qualitative and meta-analysis was performed using a random-effects model. The heterogeneity of all trials was tested by Q-test and I^2 statistic. Two-tailed probabilities were used in all trials, and the test level of the outcome indicators was $\alpha = 0.05$.

RESULTS

Literature retrieval results

Through computer search, 15 RCTs[15-29] were finally included in this meta-analysis. A total of 4003 patients were included, including 1978 in the self-gripping mesh group and 2025 in the sutured mesh group. The flow chart and results of the literature screening are shown in Figure 1.

Figure 1. Literature Screening Flow Chart

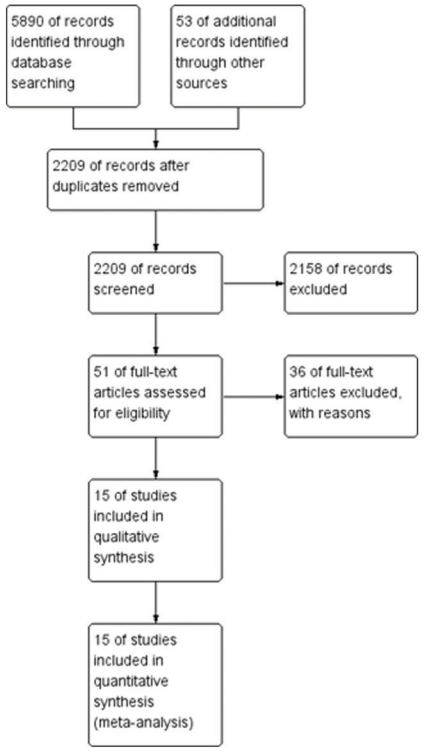


Table 1. Characteristics of the Studies Included

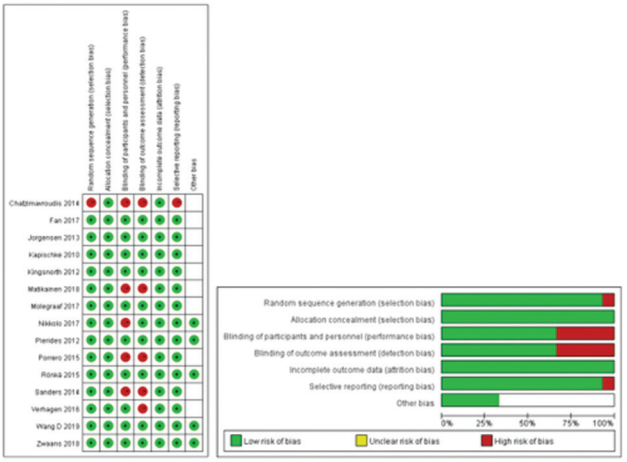
First author, Year	Design	Experimental/ Control group (n)	Mesh type (Experimental/ Control group)	Follow-up time (months)	Outcome	Anesthesia	Surgeon	The pubic tubercle was secured with additional sutures	Nerve treatment
Chatzimavroudis, 2014	RCT	25/25	ProGrip/ Heavyweight mesh	3, 12, 24	1, 3, 4, 5, 6	1	Experienced	Yes	Retain
Fan, 2017	RCT	22/23	ProGrip/ Traditional mesh	0.25, 1, 3, 12, 24, 72	1, 3, 4, 5, 6	1, 2	Experienced	No	Retain
Jorgensen, 2013	RCT	163/171	ProGrip/ Lightweight mesh	1, 12	1, 3, 4, 6	1, 2, 3	Experienced	No	Retain
Kapischke, 2010	RCT	24/26	ProGrip/ Traditional mesh	6	4, 5, 6	1	Experienced	No	Retain
Kingsnorth, 2012	RCT	149/153	ProGrip/ Traditional mesh	3	3, 4, 6	1, 3	Experienced	Yes	Retain
Matikainen, 2018	RCT	202/207	ProGrip/ Traditional mesh	12, 24	1, 3, 4	3	Experienced	Yes	Retain
Molegraaf, 2017	RCT	166/164	ProGrip/ Lightweight mesh	0.5, 3, 12, 24	1, 2, 3, 4, 5, 6	1, 2	Experienced/Trained	Yes	Retain
Nikkolo, 2017	RCT	70/75	ProGrip/ Traditional mesh	6, 36	1, 2, 3	Unknown	Unknown	Unknown	Retain
Pierides, 2012	RCT	198/196	ProGrip/ Lightweight mesh	0.5, 12	1, 2, 3, 5, 6	1, 2, 3	Experienced	Unknown	Retain
Porrero, 2015	RCT	89/89	ProGrip/ Heavyweight mesh	0.25, 12	1, 3, 4, 5, 6	2	Experienced	No	Retain
Rönkä, 2015	RCT	202/207	ProGrip/ Ultrapro mesh	0.25, 1, 12	2, 3, 4, 5, 6	3	Experienced	Unknown	Retain
Sanders, 2014	RCT	270/287	ProGrip/ Lightweight mesh	0.25, 1, 3, 12	1, 3, 4, 5, 6	1, 2, 3	Experienced	Yes	Retain
Verhagen, 2016	RCT	182/181	ProGrip/ Traditional mesh	3, 12	3, 4, 6	1, 2	Experienced/Trained	Unknown	Retain
Wang, 2020	RCT	48/51	ProGrip/ Traditional mesh	1, 3, 12, 24	1, 2, 3, 4, 5, 6	1, 3	Unknown	Yes	Retain
Zwaans, 2018	RCT	168/170	ProGrip/ Heavyweight mesh	12, 36	1, 2, 3, 4, 6	1, 2	Experienced/Trained	No	Retain

Note: Outcomes: 1 chronic groin pain, 2 foreign body sensation, 3 recurrence, 4 operative time, 5 acute pain, 6 wound complications (hematoma, seroma, and infection); Anesthesia: 1 general anesthesia, 2 intrathecal anesthesia, 3 local anesthesia; Nerve treatment: identification and treatment of iliohypogastricus, ilioinguinal nerve, and reproductive branch of the femoral nerve during the operation

Basic characteristics of the included studies and literature quality evaluation

Fifteen RCTS were published between 2010 and 2019. They were published in Germany,[18] Finland, [19,20,23,25] Denmark,[17] Greece,[15] Britain,[26] Spain,[24] Italy,[27] Hong Kong,[16] Estonia,[22] Holland,[21,29] and China.[28] The characteristics of all RCTs are summarized in Table 1. The evaluation of bias included in the RCT is shown in Figure 2.

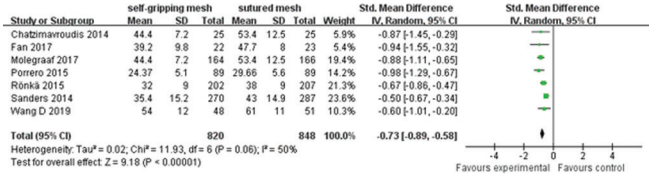
Figure 2. Risk of Bias for RCTs



Results of meta-analysis

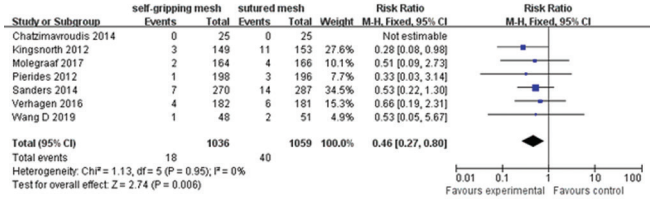
Operation time. Seven of the 15 RCTs[12,15,21,24-26,28] (1668 patients) included compared the operative time between the two groups. There was heterogeneity among the studies (P = .006, I^2 = 50%), so a random effects model was used. Meta-analysis results showed that compared to the suture mesh group, the operation time of the self-gripping mesh group was significantly shorter (SMD = -0.73, 95% CI = -0.89 ~ -0.58, P < .00001) (Figure 3).

Figure 3. Comparison of the Operative Time Between Self-Gripping Mesh Group and Sutured Mesh Group



Postoperative wound infection. There were 7 RCTs[15,19,21,23,26-28] (2429 patients) that compared the postoperative wound infection of the two groups of patients. There was no significant heterogeneity among the studies (P = .96, I^2 = 0%), so a fixed-effects model was used. Meta-analysis results showed that compared to the suture mesh group, the incidence of wound infection in the self-gripping mesh group was significantly lower (RR = 0.46, 95% CI = 0.27-0.80, P = .006) (Figure 4).

Figure 4. Comparison of the Postoperative Wound Infection Between Self-Gripping Mesh Group and Sutured Mesh Group



Postoperative chronic groin pain. Six RCTs[15-17,22,23,28] (1067 patients) described the incidence of postoperative chronic groin pain. There was no significant heterogeneity among the studies (P = .49, I^2 = 0%), so a fixed-effects model was used. Meta-analysis results showed that compared to the suture mesh group, there was no significant difference in the incidence of postoperative chronic groin pain in the self-gripping mesh group (RR = 0.88, 95% CI = 0.62-1.26, P = .50) (Figure 5).

Postoperative hematoma. Nine RCTs[15,18,19,21,23,25-27] (2554 patients) described the incidence of postoperative hematoma. There was no significant heterogeneity among the studies (P = .46, I^2 = 0%), so a fixed effect model was used. Meta-analysis results showed that compared to the suture mesh group, there was no significant difference in the incidence of postoperative hematoma in the self-gripping mesh group (RR = 1.02, 95% CI = 0.70-1.50, P = .90) (Figure 6).

Figure 5. Comparison of Incidence of Postoperative Chronic Groin Pain Between Self-Gripping Mesh Group and Sutured Mesh Group

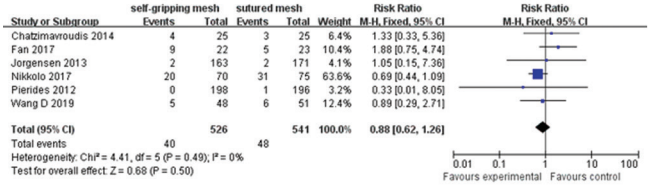


Figure 6. Comparison of Incidence of Postoperative Hematoma Between Self-Gripping Mesh Group and Sutured Mesh Group

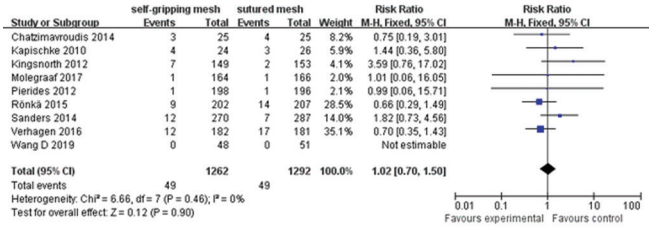


Figure 7. Comparison of Incidence of Postoperative Seroma Between Self-Gripping Mesh Group and Sutured Mesh Group

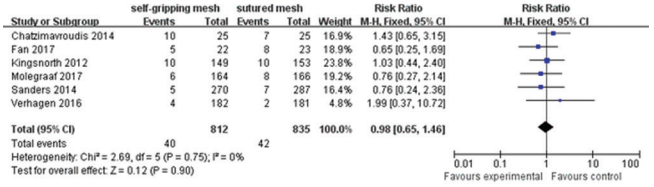


Figure 8. Comparison of Hernia Recurrence Rates on Different Postoperative Times Between Self-Gripping Mesh Group and Sutured Mesh Group

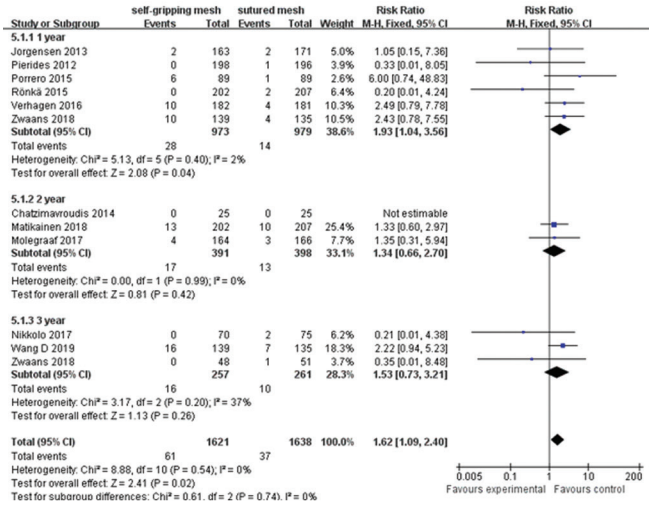
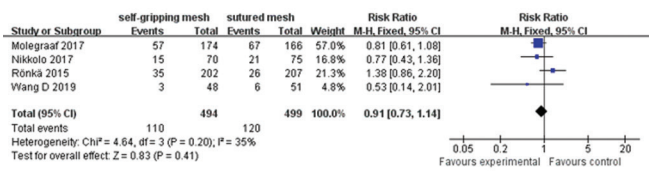


Figure 9. Comparison of Incidence of Postoperative Foreign Body Sensation Between Self-Gripping Mesh Group and Sutured Mesh Group

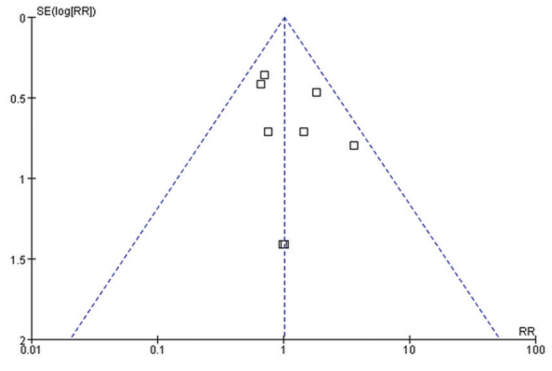


Postoperative seroma. There are 6 RCTs[15,16,19,21,26,27] (1602 patients) describing the incidence of postoperative seroma. There was no significant heterogeneity among the studies (P = .75, I^2 = 0%), so a fixed effect model was used. Meta-analysis results showed that compared to the suture mesh group, there was no significant difference in the incidence of postoperative seroma in the self-gripping mesh group (RR = 0.98, 95% CI = 0.65-1.46, P = .90) (Figure 7).

Postoperative hernia recurrence. Eleven RCTs[15,17,21-25,27] (3049 patients) described postoperative hernia recurrence. There was no significant heterogeneity among the studies (P = .54, I^2 = 0%), so a fixed effect model was used. The overall meta-analysis showed that the postoperative recurrence rate of the self-gripping mesh group was significantly higher than the sutured mesh group (RR = 1.62, 95% CI = 1.09-2.40, P = .02). Since the recurrence rate varies at different periods after surgery, subgroup analyses based on follow-up times in the literature of 1, 2, and 3 years were performed. The results of the meta-analysis showed that compared to the suture mesh group, the recurrence rate within 1 year after surgery in the self-gripping mesh group was significantly higher (RR = 1.93, 95% CI = 1.04-3.56, P = .04). There was no significant difference in the recurrence rate between the two groups at 2 and 3 years after surgery (RR = 1.34, 95% CI = 0.66-2.70, P = .42; RR = 1.53, 95% CI = 0.73-3.21, P = .26) (Figure 8).

Foreign body sensation. Four RCTs[21,22,25,28] (983 patients) described foreign body sensations in the surgical site. There was no heterogeneity among studies (P = .20, I^2 = 35%), so a fixed-effects model was used. Meta-analysis results showed that compared to the suture mesh group, there was no significant difference in the incidence of foreign body sensation in the operation area between the self-gripping mesh group (RR = 0.91, 95% CI = 0.73-1.14, P = .41) (Figure 9).

Figure 10. Funnel Plot



Publication bias

The funnel plots were essentially symmetrical, indicating no apparent publication bias (Figure 10). Due to the relatively small number of studies included in this paper, the reference value and practical significance of the funnel chart produced are limited.

DISCUSSION

Current evidence underscores that inguinal hernia repair utilizing repair materials has become the consensus approach.[30] The advent of self-gripping mesh, characterized by its low density, large pores, partial absorbability, and self-gripping properties, marks a significant innovation in this field.[31] The incidence of postoperative complications following Lichtenstein tension-free hernia repair is influenced by various factors, including mesh material type, measures for nerve protection in the inguinal region during surgery, mesh suture fixation, and the mesh's inflammatory response.[32] Contemporary studies yield inconsistent results when comparing the outcomes of self-gripping mesh to suture mesh following Lichtenstein repairs.[33-35] Despite the advocacy for a self-gripping mesh from expert consensus, caution is still advised. This study embarked on a comprehensive search of RCT studies both domestically and internationally, comparing and analyzing the clinical efficacy between Lichtenstein repairs using self-gripping mesh and suture mesh groups.

This meta-analysis revealed that self-gripping mesh significantly reduces operation time, likely due to the diminished time needed for mesh suturing. Comparable outcomes were noted in other reports evaluating Lichtenstein repairs using self-gripping versus suture mesh.[7,12,22-24] Additionally, a lower incidence of postoperative incision infection in the self-gripping mesh group might stem from reduced exposure to the operative field. RCTs led by Kingsnorth et al.[19] and Sanders et al.[26] indicated that self-gripping mesh could diminish the incidence of postoperative incision infection compared to the suture mesh group. Other studies[39] suggest that incision infection post-inguinal hernia repair correlates with multiple factors, such as gender, hernia type, surgical techniques, and mesh type. According to Li et al.,[40] the reduced surgical duration, thereby shortening the mesh exposure time, could be pivotal in lowering the incidence of postoperative incision infection. Hence, to mitigate postoperative incision infections, researchers lean towards the use of self-gripping mesh, though its higher cost warrants further cost-utility analysis.

Since mesh introduction in inguinal hernia repairs, the recurrence rate post-surgery has plummeted to below 1%. However, postoperative chronic groin pain has emerged as a significant detractor in patient quality of life. It is widely believed that mesh rejection and the dissection and irritation of the pain triangle during surgery are primary contributors to postoperative pain. In this meta-analysis, 6 RCTs[15,16,22,23,26,28] compared postoperative chronic groin pain incidence, revealing no statistical difference between the groups. This may be attributed to the intraoperative identification and preservation of the inguinal nerve, reducing nerve entrapment risks in the suture mesh group. Alternatively, pain may arise from suturing the mesh to the surface of the pubic tubercle in the self-gripping mesh group.

The polylactic acid microhooks in self-gripping mesh, designed for tissue capture and fixation, are generally effective for 12 months before being absorbed. Among the 15 articles included in this study, 10 focused on recurrent hernia. After adjusting for postoperative recurrence timing, the recurrence rate in the self-gripping mesh group was notably higher than in the suture mesh group. However, subgroup analyses at different postoperative intervals showed that this higher recurrence rate in the self-gripping mesh group was only significant within the first year following surgery, with no statistical difference 2 and 3 years post-surgery. This suggests that self-gripping mesh may carry a higher recurrence risk in the short term (e.g., 1 year) but aligns with sutured meshes over time. Thus, modifying surgical details (like additional suture fixation after repeated mesh placement) or standardizing postoperative care could effectively prevent recurrence. Patients free from recurrence in the first year after using self-gripping mesh had a comparable likelihood of recurrence after 1 year to those who underwent suturing.

Advantages of this meta-analysis include amalgamating current high-level evidence RCT studies comparing self-gripping and sutured mesh after Lichtenstein repair, offering valuable insights for clinical practice. However, this meta-analysis faces limitations. Firstly, objective factors such as varied doctor experience in anesthesia methods and surgical skills across groups led to inevitable heterogeneity. Additionally, the inclusion of a small number of cases[15,16,18] might have impacted the reliability of the conclusion. Variations in postoperative follow-up durations among the included studies could introduce bias. Moreover, the lack of long-term prognosis reports (beyond 3 to 5 years) in the included literature precludes a comparison of the long-term effects between the two surgical methods, necessitating future research. Finally, the high heterogeneity observed in operation times and postoperative foreign body sensation might relate to differing professional levels and mesh materials used across different countries and regions.

In conclusion, Lichtenstein's self-gripping mesh demonstrates advantages in reducing operative time and the incidence of incision infection but does not show significant benefits in mitigating postoperative chronic pain in the groin, hematoma, seroma, foreign body sensation, and other complications. Therefore, self-gripping mesh may offer benefits for patients unable to tolerate lengthy surgeries and those at high risk of incision infection. Nonetheless, due to the limited number and quality of the included literature, these findings require confirmation through further high-quality studies.

DATA AVAILABILITY

The simulation experiment data used to support the findings of this study are available from the corresponding author upon request.

AUTHOR DISCLOSURE STATEMENT

The authors declare that there are no conflicts of interest regarding the publication of this paper.

ACKNOWLEDGEMENT

Not applicable.

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