Al-Rafidain J Med Sci. 2026;11(2):262-266.
DOI: https://doi.org/10.54133/ajms.v11i2.3263

AJMS

Online ISSN (3219-2789)

Research Article

Evaluating Early Postoperative Outcomes in Uncomplicated TAPP Inguinal Hernioplasty: Suture *versus* Absorbable Tacker Fixation

Omar Tariq Abdel-Moneim Alheti*
Department of Surgery, College of Medicine, Al-Anbar University, Al-Anbar, Iraq
Received: 11 July 2026; Revised: 18 October 2026; Accepted: 25 October 2026

Abstract

Background: Inguinal hernia repair is one of the most common elective general surgical procedures globally. No agreement exists on the optimal mesh fixation method for laparoscopic TAPP repair. Permanent mechanical devices may cause chronic pain, while suture fixation is less costly and avoids metallic implants, though supporting evidence remains limited. ***Objective***: To compare early surgical outcomes—operative time, postoperative pain, hospital stay, complications, return to activity, and 3-month recurrence—between TAPP repair with suture fixation (group A) and absorbable tacker fixation (group B). ***Methods***: A retrospective cohort study of 100 patients undergoing TAPP inguinal hernia repair at a teaching hospital (September 2022–December 2025). Fifty patients received suture fixation (Group A) and 50 received absorbable tacker fixation (Group B). All patients received a standard 10×15 cm polypropylene mesh with a 3-month follow-up period. ***Results***: Groups were comparable in age, hernia type, and laterality. Operative time (64.0±20.0 *vs*. 58.0±30.0 min; p=0.291) and hospital stay (1.5±0.5 *vs*. 1.6±0.3 days; p=0.229) did not differ significantly. Return to full activity was faster in Group A (7.0±2.0 *vs*. 8.0±2.0 days; p=0.014). Scrotal/thigh pain occurred exclusively in Group B (20.0% *vs*. 0%; p=0.001). Wound infection was more frequent in Group A (14.0% *vs*. 0%; p=0.012). No recurrences or chronic pain were observed at 3 months. ***Conclusions***: Suture and absorbable tacker fixation showed comparable operative time, hospital stay, and short-term recurrence. Suture fixation reduced acute neural irritation and shortened recovery but was associated with more wound infections.

Keywords: Absorbable tackers; Laparoscopic inguinal hernia repair; Postoperative pain; Suture fixation; TAPP.

تقييم النتائج المبكرة بعد عملية الفتق الأربية البسيطة بتقنية TAPP الأربية: الدرز *مقابل* تثبيت الشبكة القابلة للامتصاص

الخلاصة

الخلفية: إصلاح الفتق الإربي هو أحد أكثر الإجراءات الجراحية العامة الاختيارية شيوعا على مستوى العالم. لا يوجد اتفاق على الطريقة المثلى لتثبيت الشبك لإصلاح TAPP بالمنظار. قد تسبب الأجهزة الميكانيكية الدائمة ألما مزمنا، بينما تثبيت الغرز أقل تكلفة ويتجنب الزرعات المعدنية، رغم أن الأدلة الداعمة لا تزال محدودة. **الهدف**: مقارنة النتائج الجراحية المبكرة—وقت العملية، الألم بعد العملية، الإقامة في المستشفى، المضاعفات، العودة للنشاط، وعودة العدوى لمدة 3 أشهر—بين إصلاح TAPP مع تثبيت الغرز (المجموعة A) والشبكة القابلة للامتصاص (المجموعة B). **الطرائق**: دراسة جماعية بأثر رجعي شملت 100 مريض يخضعون لإصلاح فتق TAPP الإربي في مستشفى تعليمي (سبتمبر 2022–ديسمبر 2025). تلقى خمسون مريضا تثبيت الغرز (المجموعة أ) و50 تلقوا تثبيت بالشبكة القابلة للامتصاص (المجموعة ب). تلقى جميع المرضى شبكة بولي بروبيلين قياسية بحجم 10×15 سم مع فترة متابعة مدتها 3 أشهر. **النتائج**: كانت المجموعات متقاربة من حيث العمر، نوع الفتق، والجوانب الجانبية. مدة العملية (64.0±20.0 مقابل 58.0±30.0 دقيقة؛ p=0.291) والإقامة في المستشفى (1.5±0.5 مقابل 1.6±0.3 أيام؛ p=0.229) لم تختلف بشكل ملحوظ. كان العودة إلى النشاط الكامل أسرع في المجموعة أ (7.0±2.0 مقابل 8.0±2.0 أيام؛ p=0.014). حدث ألم كيس الصفن/الفخذ حصريا في المجموعة ب (20.0٪ مقابل 0٪؛ p=0.001). كانت عدوى الجرح أكثر شيوعا في المجموعة أ (14.0٪ مقابل 0٪؛ p=0.012). لم تلاحظ أي انتكاسات أو ألم مزمن بعد 3 أشهر. **الاستنتاجات**: أظهرت نتائج الغرز والتثبيت بالشبكة القابلة للامتصاص تماثل وقت العمليات، والإقامة في المستشفى، وتكرار قصير الأمد. تثبيت الغرز قلل من التهيج العصبي الحاد وقصر فترة التعافي، لكنه ارتبط بعدوى جروح أكثر.

**Corresponding author*: Omar T. A. Alheti. Department of Surgery, College of Medicine, Al-Anbar University, Ramady, Iraq; Email: omaralheatii@uoanbar.edu.iq
Article citation: Alheti OTA. Evaluating Early Postoperative Outcomes in Uncomplicated TAPP Inguinal Hernioplasty: Suture *versus* Absorbable Tacker Fixation. *Al-Rafidain J Med Sci*. 2026;11(2):262-266. doi: https://doi.org/10.54133/ajms.v11i2.3263
© 2026 The Author(s). Published by Al-Rafidain University. This is an open access journal issued under the CC BY-NC-SA 4.0 license (https://creativecommons.org/licenses/by-nc-sa/4.0/).

INTRODUCTION

The operation for repair of inguinal hernias occurs in excess of 20 million times per year globally, being the most common elective procedure of general surgery [1]. Comparative data favor laparoscopy over the open Lichtenstein procedure with regard to less postoperative pain, earlier return to work, and low incidence of chronic groin pain [2,3]. However, a more controversial issue arises: if the choice is made in favor of laparoscopic TAPP repair, how should the mesh be fixed into the preperitoneal space? Laparoscopic TAPP repair proceeds according to the anatomical concept of Stoppa, when the big piece of mesh is introduced into the myopectineal orifice of Fruchaud to cover the internal ring, Hesselbach's triangle, and femoral ring [4]. Proper fixation is necessary for the appropriate positioning of the mesh during the initial weeks until fibrous tissue ingrowth occurs. Titanium tacks have traditionally been used for fixation, providing reliable support; however, the tension required to deploy these tacks is known to increase the risk of periosteal injury and the trapping of the genitofemoral and lateral femoral cutaneous nerves in the triangle of pain [5, 6]. Moderate to severe chronic groin pain after laparoscopic inguinal hernia surgery has been found in 10–12% of patients, often lasting several years [5,7]. Absorbable tackers, made from polyglycolic acid or polylactic acid, have been designed to overcome this problem, removing the metal component of the mesh without compromising its rapidity of application [8,9]. Yet another method is suturing, which involves no metal implants, is known to surgeons, and costs

significantly less than specialized tacking devices [6,10,11]. The 2023 HerniaSurge guideline update has confirmed that non-fixation can be safely utilized for small direct and indirect hernias (EHS grades L I–II and M I–II) without going so far as to recommend against fixation for large defects [12]. Therefore, in most practical medical situations, the surgeon has the discretion to choose the fixation method. Rancke-Madsen et al. performed a systematic review (2025) based on 31 randomized controlled trials and revealed that there was no benefit of any fixation approach with regard to the recurrence, chronic pain, operation duration, and complication rate; however, there were significant differences among the methods, type of meshes, and follow-up periods used in the trials [13]. Comparative data about fixation strategies for Middle East patients, in general, are scarce. Patients in such countries are usually young and work in physically demanding jobs and have limited expenses on the surgical devices; all these factors might affect the choice of fixation procedure and its interpretation. This study fills this gap by retrospectively analyzing a cohort of patients undergoing suture and absorbable tacker fixations in TAPP repair at the tertiary Teaching Hospital for 39 months.

METHODS

Study design and participants

The current retrospective cohort study was performed in the Department of General Surgery, Teaching Hospital, on the patients who underwent treatment between September 2022 and December 2025. One hundred twenty patients operated with the use of the TAPP technique during the study period were selected through reviewing their patient files for inclusion in this study. Twenty patients (16.7%) were not included: eight patients due to extensive previous abdominal/pelvic surgeries, seven due to incomplete records, and five due to advanced age with multiple comorbidities (Figure 1).

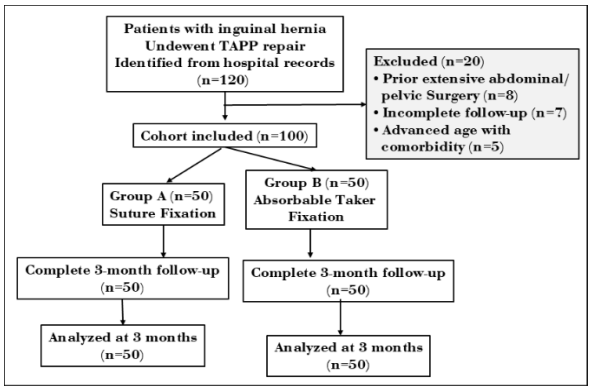


Figure 1: STROBE-style flow diagram of patient identification, group allocation, and follow-up.

The eligible participants had to be ≥18 years old and diagnosed with either a primary or recurrent inguinal hernia through open repair [18,19]. Exclusion criteria comprised any previously performed laparoscopic inguinal hernia repair and/or absolute contraindications for laparoscopy, such as severe cardiopulmonary disease, uncontrolled coagulopathies, and end-stage liver disease with portal hypertension.

Group allocation

Patient classification was retrospective according to the operation notes, whereby Group A consisted of suture fixation, while Group B included absorbable tacker fixation. The selection of the fixation method was based on surgeon preference and device availability rather than any predefined allocation method. Neither patient received both methods, and all 100 patients had full operative and follow-up notes.

Preoperative assessment

All patients underwent a standard preoperative assessment comprising complete blood count, coagulation screen, liver and kidney function tests, fasting blood sugar, chest X-ray, and abdominopelvic ultrasound. Electrocardiography was performed for patients above 40 years of age. Patients with symptoms of chronic airway obstruction underwent spirometry. The type of hernia (indirect or direct) and laterality (unilateral or bilateral) were determined clinically; ultrasound was added in cases of unclear anatomy.

Surgical procedure

The surgeries were performed under general anesthesia by two surgeons, each with experience of more than 50 TAPP operations, using a three-port technique. An infraumbilical 10 mm port was used for a 30-degree laparoscope, and two 5 mm lateral ports were placed at the umbilical level lateral to the rectus sheath. Pneumoperitoneum was created with 12 mmHg of CO_2 pressure. Diagnostic laparoscopy was performed first, followed by a transverse peritoneal incision approximately 2–3 cm above the hernial defect. Preperitoneal dissection was performed medially and laterally, carefully avoiding the triangle of doom and triangle of pain [4]. The hernia sac was reduced under gentle traction; long sacs were dissected where complete reduction risked injury to the vas deferens or nearby vessels. A standard 10×15 cm polypropylene mesh from the same manufacturer was placed over the myopectineal orifice with 2 cm overlaps in all directions (Figure 2) [20]. In group A (suture fixation), the mesh was fixed with 2-0 non-absorbable polypropylene sutures (Prolene or equivalent) from Cooper's ligament inferiorly to the conjoint tendon superiorly (Figure 2B) [15,21]. The peritoneal flap was closed using a continuous 3-0 absorbable polyglactin suture. No tacking devices were used. In group 2 (absorbable tacker fixation), the mesh was fixed using an absorbable polyglycolic acid tacker from Cooper's ligament and the conjoint

tendon, and the peritoneal flap was closed with the same tracker. The maximum number of tackers per patient was restricted to ≤ 8.0 [8,22].

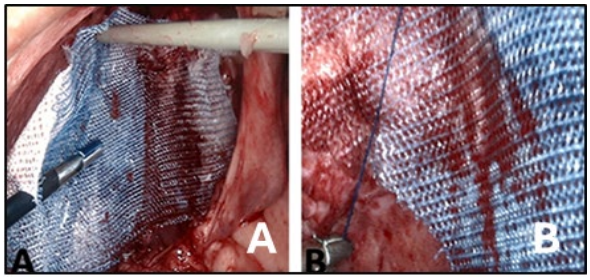


Figure 2: Intraoperative views of polypropylene mesh placement in the preperitoneal space (**A**), and suture fixation of the mesh (**B**).

Outcome measurements

Primary outcomes were operative duration in minutes (incision to closure), immediate postoperative pain measured using the Visual Analog Scale (VAS, 0–10) at 6 and 24 hours, and duration of hospital stay [21,23]. Secondary outcomes included intraoperative complications (visceral injury, vascular bleed, open conversion), postoperative complications (wound infection per CDC criteria, seroma, hematoma, urinary retention), scrotal and thigh pain at one week and one month, chronic pain (VAS >3 after 3 months), groin or scrotal numbness, hernia recurrence (clinical and ultrasonographic) at one and three months, and time to resume regular daily activities [24].

Ethical considerations

The local institutional ethics committee had approved this research (IRB Ref: 223, approved on 22 November 2022) and waived individual written informed consent for retrospective analysis of de-identified clinical data in accordance with the Declaration of Helsinki [14]. Informed consent for surgery had been signed by all patients during their surgery.

Statistical analysis

The study included all consecutive patients who underwent TAPP repair at the study center within the review period, yielding 100 patients (50 per group). Data analysis was performed using IBM SPSS Statistics version 23. Continuous normally distributed variables are reported as mean ± standard deviation (SD). Categorical variables are expressed as numbers (n) and percentages. Between-group comparisons used an independent-samples t-test for continuous variables and a chi-square test (Fisher's exact test when expected cell count <5) for categorical variables. Statistical significance was set at $p< 0.05$.

RESULTS

All 100 participants had complete data with no losses to follow-up. Age ranged from 18 to 60 years, with a mean of approximately 40 years in each group (p= 0.853). Sex distribution differed significantly: Group A included 7 females (14.0%), while Group B comprised only males (p= 0.006) (Table 1). Indirect hernia was the predominant type (70/100, 70.0%), and the majority had unilateral hernia (83.0%). No other baseline differences were statistically significant. The mean operative time for unilateral cases was 64 ± 20 minutes in group A versus 58 ± 30 minutes in group B (p= 0.291); for bilateral cases it was 120.85 ± 22.5 versus 108.17 ± 25.1 minutes (p= 0.294). Minor intraoperative bleeding occurred in three Group B patients (6.0%), managed laparoscopically without conversion (p= 0.242).

Table 1: Baseline demographics and hernia characteristics by fixation group (n=50 in each group)

Variable	Group A (Suture)	Group B (Tacker)	*p*-value
Age (year)	40.2±10.4	39.8 ± 11.1	0.853**
Age range	18–58	20–60	—
Sex: Male/Female (%)	43/7(86/14)	50/0(100/0)	0.006*
Hernia type: Indirect	33(66)	37(74.0)	0.383*
Hernia type: Direct	17(34)	13(26)	—
Laterality: Unilateral	43(86)	40(80)	0.424*
Laterality: Bilateral	7(14)	10(20)	—

Values are presented as frequency, percentage, and mean±SD. * Fisher exact test; ** unpaired t-test.

No visceral injuries or conversions occurred in either group (Table 2). Port-site wound pain at 24 hours was universal in both groups (100%). Scrotal and thigh pain occurred in 10 group B patients (20.0%) versus none in group A (p= 0.001). All affected patients recovered by 2 months, and no patient met criteria for chronic pain at the 3-month follow-up (Table 3).

Table 2: Operative outcomes and intraoperative complications by fixation group (n=50 in each group)

Variable	Group A	Group B	*p*-value
Op. time Unilateral (min)	64±20 (n=43)	58±30 (n=40)	0.291**
Op. time Bilateral (min)	120.85±22.5 (n=7)	108.17±25.1 (n=10)	0.294**
Intraoperative complications: None	50(100)	47(94)	0.242*
Intraoperative bleeding	0(0.0)	3(6.0)	—
Visceral injury	0(0.0)	0(0.0)	—
Conversion to open	0(0.0)	0(0.0)	—

Values are presented as frequency, percentage, and mean±SD. * Fisher exact test; ** unpaired t-test.

Table 3: Postoperative pain outcomes by fixation group (n=50 in each group)

Variable	Group A	Group B	*p*-value*
Wound pain (24h): Yes	50(100)	50(100)	1.0
Scrotal/thigh pain: Yes	0(0.0)	10(20)	0.001
Chronic pain at 3 months: Yes	0(0.0)	0(0.0)	1.0
Pain requiring analgesia >2 weeks	0(0.0)	0(0.0)	—

Values are presented as frequency and percentage. * Fisher exact test.

The mean hospital stay was 1.5 ± 0.5 days in group A *versus* 1.6 ± 0.3 days in group B (p= 0.229). Time to return to full daily activities was significantly shorter in group A (7.0 ± 2.0 *vs*. 8.0 ±2.0 days, p= 0.014). Wound infection occurred in 7 group A patients (14.0%) and none in group B (p= 0.012). No seroma, hematoma, urinary retention, or hernia recurrences were recorded in either group (Table 4**,** Figure 3).

Table 4: Postoperative recovery and complications by fixation group (n=50 in each group)

Variable	Group A	Group B	*p*-value
Hospital stays (day)	1.5±0.5	1.6±0.3	0.229**
Return to activity (day)	7.0±2.0	8.0±2.0	0.014**
Wound infection	7(14)	0(0.0)	0.012
Seroma	0(0.0)	0(0.0)	—
Hematoma	0(0.0)	0(0.0)	—
Urinary retention	0(0.0)	0(0.0)	—
Hernia recurrence at 3 months	0(0.0)	0(0.0)	1.0

Values are presented as frequency, percentage, and mean±SD. *Fisher exact test; ** unpaired t-test.

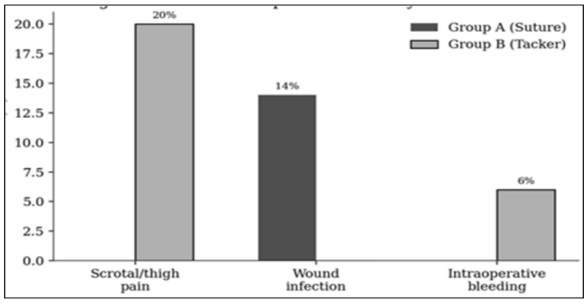


Figure 3: Incidence of scrotal/thigh pain, wound infection, and intraoperative bleeding by fixation method.

DISCUSSION

The main finding of this study was the absence of a significant difference between suture and absorbable tacker fixation for primary outcomes (operative time, length of stay, and 3-month recurrence) in 100 patients followed for up to 3 months. Although this may suggest clinical equivalence, it must be interpreted cautiously given the non-randomized retrospective design and the absence of a formal equivalence or non-inferiority framework. The relatively small per-group sample size and non-random assignment of the fixation method raise the possibility of type II error. Nevertheless, the finding aligns with prior meta-analyses [6,23]. Riemenschneider *et al*. [25] found no additional recurrence risk with non-fixation in TAPP repair, and Dong *et al*. [26] reported similar findings for TEP repair. The updated 2023 HerniaSurge guidelines similarly support non-fixation for selected small defects [12,27,28]. The current data showed a clear early neural irritation signal, which is consistent with genitofemoral or lateral femoral cutaneous nerve irritation caused by tacker deployment near the triangle of pain [5,6]. While all cases resolved within 2 months as the tackers degraded, this short-term morbidity is clinically meaningful [8]. Ferrarese *et al*. [15] similarly reported fewer neural pain events in suture cohorts. Operative time comparison aligns with available literature. The mean unilateral operative time of 64 minutes in group A is consistent with 74.4 minutes reported by Ferrarese *et al*. [15] and 83 minutes in the suture arm of Aziz *et al*. [21]. The shorter mean time in Group B (58 minutes) reflects the known efficiency advantage of mechanical fixation, though the difference was not statistically significant [6,23]. The demographic profile of this cohort—mean age approximately 40 years, 93% male—is markedly younger than the European series. Del Papa *et al*. [29] reported a mean age of 54 years, while Satapathy *et al*. [16] observed peak incidence in the 46–60-year-old age group in South Indian populations [17]. The earlier onset in Al-Anbar likely reflects the physically demanding occupational profile of the region. The wound infection rate of 14.0% in group A (versus 0% in group B) warrants careful attention. All infections were superficial port-site infections managed conservatively with local wound care and oral antibiotics; no mesh infections occurred. The increased instrument handling inherent to intracorporeal suturing may contribute to this finding. Strict aseptic port techniques are particularly important in suture-based repairs. Device cost is an established consideration in resource-limited healthcare settings. Literature consistently reports absorbable tacker systems to be significantly more expensive than suture fixation [6,11]. As cost data from the study institution were unavailable, no formal cost comparison was performed; however, the inherent cost advantage of sutures over proprietary tacker devices is worth noting as a contextual consideration.

Study limitations

Several limitations must be acknowledged. First, the fixation method was selected at the operating surgeon's discretion rather than randomly allocated, introducing potential confounding by indication. Second, no a priori sample size or power calculation was performed, and no equivalence margin was pre-specified; thus, non-significant findings should be interpreted as lack of evidence of a difference rather than proof of equivalence. Third, outcome data were extracted from medical records by a non-blinded reviewer, which may limit data validity. Fourth, the follow-up period of three months is insufficient to definitively characterize chronic pain outcomes. Fifth, the significant sex disparity between groups (all females in Group A, no females in Group B)—attributable to non-randomized fixation selection—restricts generalizability. Finally, the study was conducted at a single center by two surgeons, was not registered in any clinical trial registry, and the elevated wound infection rate in Group A has not been replicated in comparable literature, all of which are inherent limitations of retrospective observational studies.

Conclusion

There is no significant difference between suture and absorbable tacker fixation with respect to operative time, hospital stay, or 3-month hernia recurrence; however, it lacks sufficient power to establish equivalence. While sutures are inherently less costly than proprietary tacker devices, the cost difference was not quantitatively assessed. Based on available data, experienced laparoscopic surgeons may consider suture fixation as a viable alternative, with careful attention to port-site wound management. Adequately powered, prospective, multicenter, randomized studies are needed to confirm these findings.

Conflict of interests

The author declares no conflict of interest.

Funding source

The author did not receive any source of funds.

Data sharing statement

The data that supports the findings of this study are available from the corresponding author upon a reasonable request.

REFERENCES

1. Haladu N, Alabi A, Brazzelli M, Imamura M, Ahmed I, Ramsay G, et al. Open versus laparoscopic repair of inguinal hernia: an overview of systematic reviews of randomised controlled trials. *Surg Endosc*. 2022;36(7):4685-4700. doi: 10.1007/s00464-022-09161-6.
2. Hidalgo NJ, Guillaumes S, Bachero I, Butori E, Espert JJ, Ginestà C, et al. Bilateral inguinal hernia repair by laparoscopic totally extraperitoneal (TEP) vs. laparoscopic transabdominal preperitoneal (TAPP). *BMC Surg*. 2023;23:270. doi: 10.1186/s12893-023-02177-2.
3. Andresen K, Rosenberg J. Transabdominal pre-peritoneal (TAPP) versus totally extraperitoneal (TEP) laparoscopic techniques for inguinal hernia repair. *Cochrane Database Syst Rev*. 2024;7(7):CD004703. doi: 10.1002/14651858.CD004703.pub3.
4. Felix E, Lourié D, Daes J. Understanding the critical view of the myopectineal orifice (MPO) for safe minimally invasive surgical inguinal hernia repair. In: Baig SJ, Bhandarkar D, Priya P, (Eds.), Newer Concepts and Procedures in Hernia Surgery. Springer, Singapore; 2022. doi: 10.1007/978-981-19-5248-7_1.
5. Gram-Hanssen A, Öberg S, Rosenberg J. A critical appraisal of the chronic pain rate after inguinal hernia repair. *J Abdom Wall Surg*. 2023;2:10972. doi: 10.3389/jaws.2023.10972.
6. Pompeu BF, Soares GAR, Silva MP, Pereira Silva M, Ponte Farias AG, Oliveira de Sousa Silva R, et al. Suture versus tacks in minimally invasive transabdominal preperitoneal inguinal repair: a meta-analysis of randomized controlled trials. *Surg Endosc*. 2024;38(9):4858-4868. doi: 10.1007/s00464-024-11138-6.
7. Öberg S, Andresen K, Klausen TW, Rosenberg J. Chronic pain after mesh versus nonmesh repair of inguinal hernias: A systematic review and a network meta-analysis. *Surgery*. 2018;163(5):1151-1159. doi: 10.1016/j.surg.2017.12.017.
8. Anwar A, Ghareeb WM, Yasser O, Shaban H, Abu-Elela ST. Quality of life after laparoscopic totally extraperitoneal (TEP) inguinal hernia repair with fibrin glue versus tack mesh fixation. *Sci Rep*. 2025;15:41167. doi: 10.1038/s41598-025-26626-5.
9. Aiolfi A, Cavalli M, Ferraro SD, Manfredini L, Bonitta G, Bruni PG, et al. Treatment of inguinal hernia: Systematic review and updated network meta-analysis of randomized controlled trials. *Ann Surg*. 2021;274(6):954-961. doi: 10.1097/SLA.0000000000004735.
10. Techapongsatorn S, Tansawet A, Pattanaprateep O, Attia J, Mckay GJ, Thakkinstian A. Mesh-fixation technique for inguinal hernia repair: umbrella review. *BJS Open*. 2022;6(4):zrac084. doi: 10.1093/bjsopen/zrac084.
11. Takegawa Y, Tsutsumi N, Yamanaka K, Koga Y. Impact of different fibrin glue application methods on inguinal hernia mesh fixation capability. *Sci Rep*. 2024 Jun 4;14(1):12773. doi: 10.1038/s41598-024-63682-9.
12. Stabilini C, van Veenendaal N, Aasvang E, Agresta F, Aufenacker T, Berrevoet F, et al. Update of the international HerniaSurge guidelines for groin hernia management. *BJS Open*. 2023;7(5):zrad080. doi: 10.1093/bjsopen/zrad080.
13. Rancke-Madsen P, Öberg S, Rosenberg J. Mesh fixation in laparoscopic groin hernia repair: a comprehensive review. *Hernia*. 2025;29(1):105. doi: 10.1007/s10029-025-03276-0.
14. World Medical Association. Declaration of Helsinki: Ethical principles for medical research involving human participants. *JAMA*. 2024. doi: 10.1001/jama.2024.21972.
15. Thölix AM, Kössi J, Grönroos-Korhonen M, Harju J. Laparoscopic inguinal hernia repair with self-fixated meshes: a randomized controlled trial. *Surg Endosc*. 2025;39(4):2425-2435. doi: 10.1007/s00464-025-11616-5.
16. Satapathy P, Jena A, Gaidhane AM, Vadia N, Menon SV, Chennakesavulu K, et al. Burden of inguinal, femoral, and abdominal hernias in India: A systematic analysis of prevalence, incidence, mortality, and DALYs from global burden of disease study 1990-2021 with projections to 2031. *Hernia*. 2025;29(1):158. doi: 10.1007/s10029-025-03343-6.
17. Wani UH, Alam SS, Bhat BB, Bhat AA. A demographic analysis of inguinal hernia patients: A retrospective study in Southern Karnataka. *Diversity*. 2025;5(2). doi: 10.24252/diversity.v5i2.51434.
18. Yang C, Deng S. Laparoscopic versus open mesh repair for the treatment of recurrent inguinal hernia: a systematic review and meta-analysis. *Ann Palliat Med*. 2020;9(3):1164–1173. doi: 10.21037/apm-20-968.
19. Ogbuanya AU, Dilibe U. Bilateral inguinal hernia: Epidemiology and outcomes of surgical treatment in Southeast Nigeria. *Niger J Med*. 2020;29(3):401-406. doi: 10.4103/NJM.NJM_28_20.
20. Thölix AM, Kössi J, Grönroos-Korhonen M, Harju J. Laparoscopic inguinal hernia repair with self-fixated meshes: a randomized controlled trial. *Surg Endosc*. 2025;39(4):2425-2435. doi: 10.1007/s00464-025-11616-5.
21. Aziz SS, Jan Z, Ijaz N, Zarin M, Toru HK. Comparison of early outcomes in patients undergoing suture fixation versus tack fixation of mesh in laparoscopic TAPP repair. *Cureus*. 2022;14(7):e26821. doi: 10.7759/cureus.26821.
22. Singh A, Subramanian A, Toh WH, Bhaskaran P, Fatima A, Sajid MS. Comprehensive systematic review on the self-gripping mesh vs sutured mesh in inguinal hernia repair. *Surg Open Sci*. 2023;17:58-64. doi: 10.1016/j.sopen.2023.12.010.
23. Alabi A, Haladu N, Scott NW, Imamura M, Ahmed I, Ramsay G, et al. Mesh fixation techniques for inguinal hernia repair: an overview of systematic reviews of randomised controlled trials. *Hernia*. 2022;26(4):973-987. doi: 10.1007/s10029-021-02546-x.
24. Calderon SJB, Lyra HF, Onzi TR, Kremer G, de Miranda FF, de Oliveira Filho GR. Quality of life and post-operative pain following laparoscopic inguinal hernia repair with self-fixating mesh: A prospective observational study. *J Abdom Wall Surg*. 2025;4:15203. doi: 10.3389/jaws.2025.15203.
25. Riemenschneider KA, Lund H, Pommergaard HC. No evidence for fixation of mesh in laparoscopic TAPP inguinal hernia repair: a systematic review and meta-analysis. *Surg Endosc*. 2023;37(11):8291-8300. doi: 10.1007/s00464-023-10237-0.
26. Dong H, Li L, Feng HH, Wang DC. Safety of unfixed mesh in laparoscopic total extraperitoneal inguinal hernia repair: A meta-analysis. *Surg Open Sci*. 2023;16:138-147. doi: 10.1016/j.sopen.2023.10.006.
27. Zhang C, Li J, Suo H, Bai J. Non-fixation versus fixation of mesh in laparoscopic transabdominal preperitoneal repair of inguinal hernia: A systematic review and meta-analysis of randomized controlled trials. *PLoS One*. 2024;19(12):e0314334. doi: 10.1371/journal.pone.0314334.
28. Zamkowski M, Śmietański M. Mesh fixation in laparoendoscopic repair of large M3 inguinal hernias (MEFI Trial) – study protocol. *Trials*. 2023;24:572. doi: 10.1186/s13063-023-07601-9.
29. Del Papa M, D'Amata G, Manzi F, Carnì P, Florio G, Crovaro M, et al. Open inguinal hernia repair with self-gripping Parietex ProGrip mesh: a retrospective study of 204 cases. *G Chir*. 2019;40(1):26-31. PMID: 30771795.