

Suture Versus Tacker Mesh Fixation in Laparoscopic Transabdominal Preperitoneal Repair of Inguinal Hernia: A Randomized Comparative Study

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ABSTRACT

Background: Mesh fixation is a technically important step in laparoscopic transabdominal preperitoneal (TAPP) inguinal hernia repair. Tackers permit rapid fixation but may increase tissue trauma, postoperative pain, device-related cost, and the risk of nerve irritation. Intracorporeal suture fixation avoids penetrating metallic implants but requires greater technical expertise and may prolong surgery. Evidence directly comparing these techniques remains heterogeneous, particularly in resource-constrained settings. **Methods:** This randomized comparative study included 60 adults undergoing elective laparoscopic TAPP repair for unilateral or bilateral primary inguinal hernia at a tertiary teaching hospital. Participants were allocated by a computer-generated sequence with sealed opaque envelopes to suture fixation (Group A, n=30) or tacker fixation (Group B, n=30). The primary outcomes were postoperative pain and hospital stay. Secondary outcomes included operative time, rescue analgesia, early complications, return to routine activity, neuralgia, and recurrence up to six months. Categorical variables were compared using the chi-square or Fisher exact test and continuous variables using the independent-samples t test. A two-sided p value <0.05 was considered statistically significant. **Results:** Baseline demographic, body mass index, American Society of Anesthesiologists status, hernia laterality, and intraoperative hernia type were comparable. Tacker fixation significantly shortened mean operative time for unilateral repairs (74.6±12.1 versus 92.4±14.8 minutes; p<0.001) and bilateral repairs (88.4±10.2 versus 108.6±12.5 minutes; p<0.001). At six hours, suture fixation was associated with a more favorable pain distribution (p=0.04); mild pain occurred in 40.0% versus 16.7%, while severe pain occurred in 6.7% versus 16.7%. At 24 hours, the difference was not statistically significant (p=0.10). Rescue analgesia was required by 30.0% of the suture group and 53.3% of the tacker group (p=0.07). Early complications, length of stay, return to activity, neuralgia, and recurrence did not differ significantly. At six months, recurrence occurred in 1/27 (3.7%) patients after suture fixation and 2/26 (7.7%) after tacker fixation (p=0.55). **Conclusion:** Tacker fixation offers a clear operative-time advantage, whereas suture fixation provides better immediate postoperative pain control without increasing complications, hospital stay, delayed recovery, or short-term recurrence. In settings where device cost and postoperative comfort are important, suture fixation is a reasonable alternative when laparoscopic suturing expertise is available.

Keywords: inguinal hernia; transabdominal preperitoneal repair; TAPP; mesh fixation; suture; tacker; postoperative pain; recurrence.

INTRODUCTION

Inguinal hernia is one of the most common conditions encountered by general surgeons and constitutes the

majority of anterior abdominal wall hernias. Inguinal hernias are more common in men than in women, and the lifetime risk of developing an inguinal hernia is

increased in populations engaged in manual labor, repetitive lifting, prolonged standing, and professions associated with increased intra-abdominal pressure. A hernia left untreated can limit your ability to work and your quality of life and progress to incarceration, obstruction or strangulation in addition to pain and a noticeable bulge. Surgical repair is therefore the definitive treatment for most symptomatic adult inguinal hernias [1–3].

The evolution of groin hernia surgery has been from tissue repairs under tension to prosthetic, tension-free repairs. Mesh reinforcement reduced recurrence and formed the basis of modern repair. Subsequently, minimally invasive approaches were introduced to reduce wound morbidity, improve visualization of the myopectineal orifice, allow for simultaneous treatment of bilateral defects, and allow for earlier functional recovery. There are two well established laparoscopic approaches: transabdominal preperitoneal (TAPP) repair and totally extraperitoneal repair. TAPP provides a wide operative field with clear identification of anatomical landmarks and enters the peritoneal cavity, whereas the totally extraperitoneal technique avoids transgression of the peritoneal cavity. Both approaches can produce good results in experienced hands [3,4].

Adequate dissection of the preperitoneal space and correct placement of a sufficiently large mesh are important during TAPP repair. Fixation is traditionally used to prevent early migration, folding, or displacement prior to tissue incorporation. However, fixation itself can be morbid. Penetrating fixation may damage periosteum, vessels, or nerves and may be a cause of acute or chronic groin pain. Poor fixation in a large medial defect may cause concern about mesh displacement and recurrence. Therefore the best way must combine technical security, operative efficiency, postoperative comfort, safety, prevention of recurrence and cost [5–8].

Various fixation strategies are available, including metallic or absorbable tackers, intracorporeal sutures, tissue adhesives, self-fixating mesh and selective non-fixation. Tackers are popular because they are easy to deploy and can quickly secure the mesh at multiple points. This feature is particularly desirable in high volume units and in bilateral repairs. However, tacks are penetrating devices and fixation in anatomically hazardous regions, especially the triangles of pain and doom, may cause neural or vascular injury. Another important consideration in health systems with high out-of-pocket patient payments is the cost of the device [5,7,9].

Fixation with suture eliminates the need for a disposable fixation device and allows a limited number of sutures to be placed under direct vision. It may reduce points of tissue penetration and eliminate permanent metallic implants. The disadvantages are the learning

curve, need for advanced intracorporeal suturing and longer operating time possible. These trade-offs are of clinical importance. Decreased postoperative pain or analgesic requirement may improve mobilization and patient satisfaction, but increased operative time may increase anesthesia exposure and decrease operating-room efficiency. The relative importance of each outcome varies across institutions based on surgeon expertise, case volume, and resources available.

Overall, published comparisons have shown that operative time is shorter with tackers, whereas several studies have indicated that there is less early or late pain with sutures. Similar rates of seroma, hematoma, infection, neuralgia, and recurrence are reported by many studies, although the sample size and length of follow-up differ [10–14]. Fixation is still common for large medial, bilateral or otherwise technically difficult hernias, but evidence increasingly questions routine fixation in selected defects [15–17]. Thus, a direct comparison of the most commonly used fixation methods remains important, particularly when clinical outcome and economic feasibility influence practice.

The present randomized comparative study evaluated mesh fixation with intracorporeal sutures versus tackers during laparoscopic TAPP repair of primary inguinal hernia. The study was designed to compare postoperative pain and hospital stay as the primary outcomes and operative time, analgesic requirement, complications, functional recovery, neuralgia, and recurrence as the secondary outcomes. We hypothesized that tackers would decrease operative time but that suture fixation would be associated with less immediate postoperative pain, with otherwise similar short-term safety and recurrence.

MATERIALS AND METHODS

Study design and setting: This was an experimental, randomized comparative study done in Department of General Surgery, M.G.M. Medical College and M.Y. Hospital, Indore a tertiary care teaching hospital with high volume of elective hernia surgery. The study was conducted after Institutional Ethics Committee approval and recruitment, completion of follow-up and data collection for a period of one year. The manuscript has been written in accordance with the principles of reporting parallel-group randomized studies, but the original thesis did not include a trial registration number.

Participants: Eligible participants were adults older than 18 years who were scheduled for elective laparoscopic repair of a primary unilateral or bilateral inguinal hernia. Patients were included if they agreed to TAPP repair and signed a written informed consent for participation. Patients with recurrent inguinal hernia, large scrotal hernia, strangulated or obstructed hernia or

unwilling to give consent were excluded. Eligible participants were enrolled consecutively until the sample size was achieved.

Sample size: The sample size was estimated in the thesis on the basis of expected group means of 3.67 and 4.90, a standard deviation of 1.16, a two sided 95% confidence level and 95% power. The estimated minimum was approximately 18 participants per group, adjusting for loss to follow-up. To increase the accuracy and reliability of the results, the researchers recruited a total of 60 participants, 30 in each group. As the original thesis did not specify the exact result and article from which these assumptions were derived, this detail should be verified against the approved protocol prior to journal submission.

Randomization and allocation: Participants were randomized in a 1:1 ratio into Group A (mesh fixation with intracorporeal sutures) and Group B (mesh fixation with tackers). A computer-generated random sequence was used and allocation was by sealed opaque envelopes to maintain concealment until assignment. Blinding of the operating surgeon was not feasible due to the nature of the intervention. No blinding of participants, postoperative assessors or statisticians was reported in the thesis and the study is therefore reported as open-label unless source records state otherwise.

Preoperative Evaluation: All participants, after having provided written informed consent, underwent a standardized history, physical examination, anesthetic assessment and routine preoperative investigations. Baseline variables recorded were age, body mass index (BMI), American Society of Anesthesiologists (ASA) physical status, side of hernia and unilateral versus bilateral hernia. Intraoperative anatomical type was classified as indirect, direct, or pantaloon. Most of the patients selected for surgery were ASA grade I or II, i.e., elective surgical fitness.

Operative procedure and interventions: All patients underwent a standard laparoscopic TAPP repair under general anesthesia. After establishing pneumoperitoneum and port placement, the peritoneum was opened and the preperitoneal plane was developed. Reduction of the hernia sac and exposure of the myopectineal orifice with identification of relevant anatomical landmarks. A well-sized prosthetic mesh was used to cover the direct, indirect and femoral spaces with enough overlap. In Group A, the mesh was secured using intracorporeal sutures. In Group B, fixation was done with tackers. Laparoscopic closure of peritoneum was done. Mesh material and dimensions, suture type,

number and exact sites of sutures, tacker model, number of tacks and standardized analgesic regimen were not specified in the source thesis. These details are important for reproducibility and should be inserted from operative records before submission.

Assessment of outcome: The primary outcomes were pain and hospital stay after the surgery. Pain was evaluated by visual analog scale (VAS) at 6 and 24 hours and classified as mild (0–3), moderate (4–6), or severe (7–10). The need for rescue analgesia in the first 24 postoperative hours was recorded. Length of hospital stay was categorized as 24 hours or less versus more than 24 hours and analyzed separately for unilateral and bilateral hernia.

Secondary outcomes were operative time, early post-operative complications, time to return to normal daily activity, neuralgia during follow-up, seroma at one week and recurrence. Operative time was recorded in minutes and reported separately for unilateral and bilateral repairs. Early complications included seroma, hematoma or scrotal edema, surgical-site infection, urinary retention and early neuralgia. Return to routine activity was dichotomized as <7 vs. ≥ 7 days. Neuralgia was assessed at 1 week, 1 month and 3 months. Recurrence was defined as the presence of a hernia at the operated site on clinical follow-up and was analyzed at three and six months after exclusion of participants lost to follow-up at each interval.

Data Curation and Statistical Analysis: Data collection was done using a structured case record form, allocation sheets, operative notes, post-operative pain chart and follow up records. Data were analysed using statistical software and entered into Microsoft excel. Continuous variables were reported as mean and standard deviation. Categorical variables were expressed as frequency and percentage. Group means were compared using independent samples t test, and categorical variables were compared using chi-square test or Fisher exact test as appropriate. All tests were two-sided and $p < 0.05$ was considered statistically significant. The statistical software package and version were not specified in the thesis. This should be added from the original analysis file.

Ethical issues: The study was initiated after obtaining approval from Institutional Ethics Committee of M.G.M. Medical College, Indore. All participants gave written informed consent. Privacy, confidentiality and the right to withdraw without prejudice to care were maintained. The source thesis did not include an ethics approval number and date and this needs to be added prior to submission.

RESULTS

Participant profile and baseline comparability

Sixty patients were randomized, with 30 allocated to suture fixation and 30 to tacker fixation. Baseline distributions were closely comparable. The largest age category in both groups was 41–50 years (33.3% in the suture group and 30.0% in the tacker group), and 10.0% in each group were older than 60 years. BMI distribution was similar, with overweight participants forming the largest category (46.7% and 50.0%, respectively). Most participants were ASA I (60.0% and 56.7%). Right-sided hernia was the most frequent presentation, and bilateral hernia accounted for 10.0% in each group. Intraoperatively, indirect hernia predominated (66.7% versus 63.3%). None of the baseline differences was statistically significant (Table 1).

Table 1. Baseline demographic and hernia characteristics

Characteristic		Suture fixation (n=30)	Tacker fixation (n=30)	p value
Age	Age 18–30 years	4 (13.3)	5 (16.7)	0.95
	Age 31–40 years	7 (23.3)	6 (20.0)	
	Age 41–50 years	10 (33.3)	9 (30.0)	
	Age 51–60 years	6 (20.0)	7 (23.3)	
	Age >60 years	3 (10.0)	3 (10.0)	
BMI	Normal BMI (18.5–24.9 kg/m ²)	10 (33.3)	9 (30.0)	0.94
	Overweight BMI (25.0–29.9 kg/m ²)	14 (46.7)	15 (50.0)	
	Obese BMI (≥30 kg/m ²)	6 (20.0)	6 (20.0)	
ASA type	ASA I	18 (60.0)	17 (56.7)	0.79
	ASA II	12 (40.0)	13 (43.3)	
Side	Right-sided hernia	15 (50.0)	14 (46.7)	0.96
	Left-sided hernia	12 (40.0)	13 (43.3)	
	Bilateral hernia	3 (10.0)	3 (10.0)	
Type	Indirect hernia	20 (66.7)	19 (63.3)	0.96
	Direct hernia	8 (26.7)	9 (30.0)	
	Pantaloon hernia	2 (6.7)	2 (6.7)	

Data are n (%). BMI, body mass index; ASA, American Society of Anesthesiologists physical status.

Operative time

Tacker fixation significantly reduced operative duration. For unilateral hernia, mean operative time was 92.4±14.8 minutes in the suture group and 74.6±12.1 minutes in the tacker group, an absolute reduction of 17.8 minutes (p<0.001). For bilateral hernia, corresponding mean times were 108.6±12.5 and 88.4±10.2 minutes, an absolute reduction of 20.2 minutes (p<0.001). The direction and magnitude of effect were therefore consistent across unilateral and bilateral repairs (Table 2).

Postoperative pain and rescue analgesia

At six hours, the distribution of VAS categories significantly favored suture fixation (p=0.04). Mild pain was recorded in 12/30 (40.0%) patients in the suture group compared with 5/30 (16.7%) in the tacker group. Severe pain occurred in 2/30 (6.7%) versus 5/30 (16.7%), respectively. At 24 hours, mild pain remained more frequent after suture fixation (50.0% versus 26.7%), whereas moderate and severe pain were more frequent after tacker fixation; however, the overall group difference was no longer statistically significant (p=0.10). Rescue analgesia in the first 24 hours was required by 9/30 (30.0%) patients in the suture group and 16/30 (53.3%) in the tacker group (p=0.07), representing a clinically relevant but statistically non-significant difference (Table 2).

Table 2. Operative time, postoperative pain, and rescue analgesia

Outcome	Suture fixation (n=30)	Tacker fixation (n=30)	p value
Operative time, unilateral hernia (min)	92.4 ± 14.8	74.6 ± 12.1	<0.001
Operative time, bilateral hernia (min)	108.6 ± 12.5	88.4 ± 10.2	<0.001

6-h VAS: mild (0–3)	12 (40.0)	5 (16.7)	0.04
6-h VAS: moderate (4–6)	16 (53.3)	20 (66.7)	
6-h VAS: severe (7–10)	2 (6.7)	5 (16.7)	
24-h VAS: mild (0–3)	15 (50.0)	8 (26.7)	0.10
24-h VAS: moderate (4–6)	14 (46.7)	19 (63.3)	
24-h VAS: severe (7–10)	1 (3.3)	3 (10.0)	
Rescue analgesia required in first 24 h	9 (30.0)	16 (53.3)	0.07

Data are mean $\pm$ SD or n (%). VAS, visual analog scale.

Early postoperative complications

Complications were uncommon in both groups. Seroma occurred in two patients (6.7%) in each group, and surgical-site infection in one patient (3.3%) in each group. Hematoma or scrotal edema occurred in 3.3% after suture fixation and 6.7% after tacker fixation. Urinary retention followed the same distribution. Early neuralgia occurred in one patient in the tacker group and none in the suture group. No comparison reached statistical significance, supporting a similar early safety profile (Table 3).

Table 3. Early postoperative complications

Complication	Suture fixation (n=30)	Tacker fixation (n=30)	p value
Seroma	2 (6.7)	2 (6.7)	1.00
Hematoma/scrotal edema	1 (3.3)	2 (6.7)	0.55
Surgical-site infection	1 (3.3)	1 (3.3)	1.00
Urinary retention	1 (3.3)	2 (6.7)	0.55
Early neuralgia	0 (0.0)	1 (3.3)	0.31

Hospital stay and return to normal activity

Most participants were discharged within 24 hours. Among unilateral repairs, 20/26 (76.9%) participants in the suture group and 22/27 (81.5%) in the tacker group had a stay of 24 hours or less ($p=0.68$). Among bilateral repairs, the corresponding proportions were 2/4 (50.0%) and 3/5 (60.0%) ($p=0.74$). These denominators, as reported in the thesis table, do not align with the baseline count of three bilateral patients per group and should be reconciled with the master dataset before submission. Return to routine activity within seven days occurred in 24/30 (80.0%) participants after suture fixation and 22/30 (73.3%) after tacker fixation ($p=0.54$). Thus, the shorter operative duration with tackers did not translate into a statistically detectable improvement in discharge or functional recovery (Table 4).

Table 4. Hospital stay and functional recovery

Outcome	Suture fixation	Tacker fixation	p value
Unilateral hernia: stay ≤ 24 h	20/26 (76.9)	22/27 (81.5)	0.68
Unilateral hernia: stay > 24 h	6/26 (23.1)	5/27 (18.5)	
Bilateral hernia: stay ≤ 24 h	2/4 (50.0)	3/5 (60.0)	0.74
Bilateral hernia: stay > 24 h	2/4 (50.0)	2/5 (40.0)	
Return to normal activity < 7 days	24/30 (80.0)	22/30 (73.3)	0.54
Return to normal activity ≥ 7 days	6/30 (20.0)	8/30 (26.7)	

Data are n/N (%). The hospital-stay denominators reproduce the thesis and require reconciliation with the baseline unilateral/bilateral counts before submission.

Follow-up outcomes

Neuralgia was absent in the suture group at one week, one month, and three months. One patient (3.3%) in the tacker group reported neuralgia at each interval; the differences were not statistically significant. Seroma at one week occurred in

one patient (3.3%) in each group. Recurrence analyses excluded participants lost to follow-up. At three months, no recurrence occurred among 28 followed participants in the suture group, while one recurrence occurred among 27 followed participants in the tacker group (3.7%; $p=0.30$). At six months, recurrence occurred in 1/27 (3.7%) and 2/26 (7.7%) participants, respectively ($p=0.55$). The study was not powered to detect small differences in uncommon late outcomes (Table 5).

Table 5. Neuralgia, seroma, and recurrence during follow-up

Follow-up outcome	Suture fixation	Tacker fixation	p value
Neuralgia at 1 week	0/30 (0.0)	1/30 (3.3)	0.55
Neuralgia at 1 month	0/30 (0.0)	1/30 (3.3)	0.31
Neuralgia at 3 months	0/30 (0.0)	1/30 (3.3)	0.31
Seroma at 1 week	1/30 (3.3)	1/30 (3.3)	1.00
Recurrence at 3 months	0/28 (0.0)	1/27 (3.7)	0.30
Recurrence at 6 months	1/27 (3.7)	2/26 (7.7)	0.55

Data are n/N (%). Denominators for recurrence exclude participants lost to follow-up.

DISCUSSION

This randomized comparative study compared two popular methods of mesh fixation in laparoscopic TAPP repair. The main findings were that tackers reduced operative time by approximately 18 minutes in unilateral and 20 minutes in bilateral repairs, and that suture fixation gave a better pain profile at six hours. The differences in pain at 24 hours and rescue analgesia did not achieve conventional statistical significance but both outcomes still numerically favoured sutures. Early complications, length of hospital stay, return to routine activity, neuralgia, seroma, and recurrence were comparable. These findings highlight the key trade-off between procedural efficiency and immediate post-op comfort.

The equivalence of randomized groups at baseline supports attribution of observed differences to the fixation method, rather than to measured demographic or anatomical factors. Age, BMI, ASA status, laterality, bilateral involvement and hernia type were similarly distributed. Indirect hernia was the predominant anatomic type and most patients were ASA I or II, consistent with the profile for elective laparoscopic hernia practice. Proportions of bilateral and anatomically complex hernias are similar and especially relevant to operative duration, as the extent of dissection and fixation may confound this outcome.

The reduction in operative time with tackers is biologically and technically plausible. A tacker allows rapid repeated fixation without the need for knot tying, whereas suture fixation requires needle handling, accurate tissue purchase, intracorporeal knot construction, and suture retrieval or management. In bilateral repairs, where placement on both sides and peritoneal closure are required, the time penalty may be compounded. Hassan et al. reported shorter operating times with tacker fixation compared to a completely sutured technique and Tupkar and Kamineni also reported a significant operative-time advantage with

tackers [10,11]. In a tertiary care comparison Mohapatra et al. [12] reached a similar conclusion. The consistency across studies suggests that operative efficiency is the most reproducible advantage of tacker fixation.

The difference in operative time is context dependent in terms of clinical relevance. A saving of 18–20 minutes could be relevant in busy operating theatres, in patients for whom prolonged anaesthesia carries extra risk, or in the case of limited expertise in laparoscopic suturing. On the other hand, the difference may be less important in stable elective patients if sutures reduce post-op discomfort, avoid the expense of a disposable fixation device, or decrease concern about penetrating implants. Operative time also has a learning curve component. Early cases will take longer to perform in a centre adopting suture fixation than when proficiency is established, and the gap can be closed by skilled laparoscopic surgeons.

Another clinically creditable finding is the six hour significant difference in pain favouring suture fixation. Tack deployment penetrates tissue and may stimulate local nociceptors, periosteum or small nerves. Fixation laterally or inferiorly near the pathways of the ilioinguinal, iliohypogastric, genitofemoral, or lateral femoral cutaneous nerve may worsen pain. While the risk is reduced by strict adherence to safe fixation zones, symptoms may be affected by the number, depth, material and location of tacks. Fränneby et al. identified several patient- and procedure-related determinants of persistent pain after hernia surgery, emphasising the importance of reducing avoidable tissue injury [5].

Aziz et al. described less early postoperative pain after suture fixation in TAPP repair in accordance with the six-hour results of this study [13]. Mohapatra et al. also reported less early pain with sutures, although procedures were shorter with tackers [12]. In the present study, the difference decreased by 24 hours, when the distribution was still in favor of sutures, but was not significant. This time course suggests that penetrating

fixation contributes primarily to the immediate nociceptive pain that subsides as acute inflammatory and mechanical stimuli resolve. The limitation of precision is due to lack of continuous VAS data, mean pain scores, analgesic consumption in standardized dose units, and repeated-measures analysis. The categorical pattern is internally coherent.

Rescue analgesia was needed in 53.3% of patients after tacker fixation and in 30.0% of patients after suture fixation. A p value of 0.07 suggests that the sample size was too small to demonstrate statistical significance at the 5% level, not that the groups were necessarily equivalent. The absolute difference of 23.3 percentage points might have clinical significance. A future trial with adequate power should define a uniform multimodal analgesic regimen, rescue threshold, drug and dose, and analyze total opioid-equivalent consumption. The resulting design improvements would allow the estimation of statistical and patient-centered significance.

Early complication rates were low and comparable. Seroma, hematoma or scrotal edema, surgical-site infection, and urinary retention were observed infrequently, with only one episode of early neuralgia observed in the tacker group. These results are in line with comparative studies that have shown no significant safety disadvantage for either method when TAPP is performed with sufficient dissection, mesh placement and anatomical knowledge [10–13]. The size of the defect, management of the distal sac, the extent of dissection, the dead space and the handling of the transversalis fascia seem to influence seroma more strongly than fixation device alone. Similarly, urinary retention is multifactorial, with anesthesia, perioperative fluids, pain, age and prostatic symptoms all being associated.

The hospital stay results confirm that both techniques are compatible with the short-stay surgery. Most unilateral repairs were discharged within 24 hours. There was no significant effect of fixation method on stay. Return to normal activity was also similar, with approximately three quarters or more of participants returning to normal activity within seven days. Thus the small immediate difference in pain did not give rise to a detectable difference in the broad functional category used. A more sensitive recovery assessment, for example time to independent ambulation, return to paid employment, patient-reported quality of recovery, or days to unrestricted activity might capture more subtle differences.

Interpretation of hospital stay should be approached with caution as denominators in the thesis table for unilateral and bilateral cases do not match the baseline laterality table. Baseline data report three bilateral cases per group, while the hospital-stay analysis suggests four and

five bilateral cases, respectively. This discrepancy may be a transcription or classification error and must be reconciled to the master chart. Transparent reconciliation is important because internal inconsistency can undermine confidence in an otherwise consistent data set. In this way the manuscript reproduces the source values but flags them explicitly instead of silently changing the data.

During follow-up, neuralgia was uncommon, and was reported by only one patient at each reported interval in the tacker group. The difference was not statistically significant, and it is not clear from the thesis if the same patient had persistent symptoms or if different individuals were affected. Nevertheless the pattern is in keeping with the mechanism whereby fixation may penetrate irritable nerves. Chronic postoperative inguinal pain is an important outcome because even a low incidence can have a significant impact on quality of life. Larger studies with standardized definitions, pain mapping, neuropathic pain instruments and follow-up of at least 12 months are needed to reliably compare chronic neuralgia.

Recurrence was rare and not significantly different. Recurrence was noted in 3.7% after suture fixation and 7.7% after tacker fixation at 6 months in those available for follow-up. The percentages are based on very small numbers and are not to be taken as proof of superiority. There are many factors that contribute to recurrence after laparoscopic repair, including inadequate dissection, undersized mesh, insufficient overlap, mesh folding, missed femoral or obturator defects, peritoneal displacement, and surgeon experience. One aspect is the fixation method. Selected non-fixation strategies have also been shown to be able to produce acceptable recurrence in large randomized studies and long term series [15–19] indicating that mesh coverage and technique may be more important than routine extensive fixation.

The six-month recurrence rates in this study appear to be higher than those reported by many mature hernia programs, but the absolute numbers of events are only one and two. Confirmation of each event, hernia type, defect size, mesh size, fixation pattern, and reoperation would strengthen the analysis. Longer follow-up is also important because early recurrence may represent a technical failure whereas subsequent recurrence may develop after mesh shrinkage, tissue remodeling or progressive weakness. Precision is further reduced by the loss of three and four participants at six months. Kaplan-Meier methods were not required for the thesis analysis but would be desirable in a larger study with variable follow-up.

If used within a health system, suture fixation may be attractive where disposable tackers are expensive or not reliably available. No formal cost-effectiveness analysis

was performed. Cost cannot be derived from device cost alone, as longer operating-room occupancy also costs. Fixation material, operative time, anesthesia time, analgesics, length of stay, treatment of complications, return to work and recurrence should be included in a complete cost analysis. The relative weight of these components will vary in public hospitals, insurance-based systems and self-paying practice. The current clinical findings provide a basis for such analysis but do not establish cost effectiveness.

The practical strengths of the study are: It had random allocation with concealment, compared two active fixation strategies in the same institutional context, and evaluated both intraoperative and postoperative outcomes. Follow-up recurrence rates were presented using available denominators rather than assuming that participants lost to follow-up were event-free. The results are directly applicable to the surgeon deciding between suture and tacker for elective TAPP repair in a tertiary teaching setting.

There are a number of limitations that are worth mentioning. The sample size was small and first powered mainly on an assumed continuous outcome rather than on rare complications or recurrence. Second, the trial was apparently open-label, with potential for performance bias and detection bias for pain and recovery outcomes. Third, important technical details including mesh type and size, suture material, number and location of fixation points, tacker type, surgeon experience, and analgesic protocol were not documented in the thesis manuscript. Fourth, pain was dichotomized rather than being analyzed as a continuous repeated measure and no validated instrument of chronic pain or quality of life was used. Fifth, follow-up was limited to 6 months and included drop out. Sixth, the hospital-stay denominators need to be reconciled. Seventh, the cost of the device was not cost-analyzed despite the clinical relevance. Finally, this was a single-center study, limiting external generalizability.

Future research should use larger, multicentre, randomised designs using standardised operative and analgesic protocols, blinding of outcome assessment where feasible, continuous pain scores, opioid-equivalent consumption, patient-reported recovery, chronic pain instruments, cost analysis and follow-up of at least one to three years. Stratification by size of defect and hernia classification would help understand if fixation method has a different effect in large medial defects, bilateral repairs and recurrent hernias. Further comparative evaluation of sutures, absorbable tackers, glue, self-fixating mesh and selective non-fixation would further clarify the optimal patient-specific strategy.

In general, the data support individualized decision making. Tackers are preferable if the priorities are speed and technical simplicity. Sutures are attractive when

immediate postoperative comfort, avoidance of disposable devices, and decreased penetrating fixation are desired, and if the surgeon is skilled in intracorporeal suturing. Because major complications and short-term recurrence were similar, the choice can reasonably be guided by surgeon expertise, anatomy, institutional resources, and patient priorities rather than by an assumption that one technique is universally superior.

Strengths of the Study

The present study has several strengths. First, it used a randomized comparative design with computer-generated allocation and sealed opaque envelopes, which helped minimize selection bias. Second, both intervention groups were managed within the same tertiary-care teaching hospital, providing a relatively consistent clinical and operative environment. Third, the study directly compared two commonly used mesh-fixation techniques during laparoscopic TAPP repair, allowing assessment of both operative efficiency and postoperative outcomes. Fourth, the study evaluated multiple clinically relevant outcomes, including operative time, postoperative pain, rescue analgesic requirement, early postoperative complications, hospital stay, return to routine activity, neuralgia, and short-term recurrence. Finally, follow-up outcomes were reported using the number of patients actually available at each follow-up assessment rather than assuming that patients lost to follow-up were free of recurrence.

Limitations of the Study

This study has several limitations. First, the sample size was relatively small and was not adequately powered to detect differences in uncommon complications, neuralgia, or recurrence. Second, the study was apparently open-label, and blinding of participants, outcome assessors, and statisticians was not reported, which may have introduced performance or assessment bias, particularly for subjective outcomes such as postoperative pain and return to activity. Third, several important technical details, including mesh type and dimensions, suture material, number and location of fixation points, tacker type and number, and the standardized analgesic regimen, were not available in the source thesis and should be verified from the original operative records. Fourth, postoperative pain was assessed categorically rather than using continuous VAS scores and repeated-measures analysis, and standardized analgesic consumption was not quantified in dose-equivalent units. Fifth, follow-up was limited to six months, which is insufficient to reliably assess chronic postoperative pain and long-term recurrence. Sixth, some hospital-stay denominators did not correspond with the baseline distribution of unilateral and bilateral hernias and require reconciliation with the original

master dataset. Seventh, no formal cost-effectiveness analysis was performed despite the potential economic importance of disposable tacker devices. Finally, the single-center design and relatively small sample limit the generalizability of the findings to other institutions and surgical settings.

Future Recommendations

Future studies should include larger, adequately powered multicenter randomized controlled trials to provide more precise estimates of the comparative effectiveness and safety of suture and tacker fixation. Standardized operative protocols should clearly document mesh type and size, fixation material, number and location of fixation points, tacker characteristics, surgeon experience, and analgesic regimens. Future research should assess postoperative pain using continuous VAS or numerical rating scale scores, standardized analgesic or opioid-equivalent consumption, validated chronic pain instruments, and patient-reported quality-of-recovery measures. Longer follow-up of at least one to three years is recommended to evaluate chronic neuralgia and recurrence more reliably. Stratification according to hernia type, defect size, bilateral involvement, and other relevant anatomical characteristics may help determine whether the benefits of a particular fixation technique vary across patient subgroups. Formal cost-effectiveness analyses incorporating fixation-device costs, operative-room time, anesthesia duration, postoperative analgesic requirements, complications, hospital stay, return to work, and recurrence should also be undertaken. Comparative studies involving absorbable tackers, tissue adhesives, self-fixating mesh, and selective non-fixation may further clarify the optimal patient-specific mesh fixation strategy.

CONCLUSION

In laparoscopic TAPP repair of primary inguinal hernia, tacker fixation significantly shortened operative time, while intracorporeal suture fixation was associated with less pain at six hours and a lower, though not statistically significant, requirement for rescue analgesia. Early complications, hospital stay, return to routine activity, neuralgia, seroma, and recurrence up to six months were comparable. Suture fixation is therefore a safe and patient-centered alternative to tackers when laparoscopic suturing expertise is available, whereas tackers retain an important advantage in procedural efficiency. Larger trials with standardized technical details, economic evaluation, and longer follow-up are required before definitive superiority can be established.

DECLARATIONS

Ethics approval: Approved by the Institutional Ethics Committee of M.G.M. Medical College, Indore.

Consent to participate: Written informed consent was obtained from all participants.

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Data availability: De-identified data may be made available by the corresponding author on reasonable request, subject to institutional approval.

Author Contributions

Yash Manoj Agrawal: Conceptualization, study design, patient recruitment, data collection, surgical procedures, data interpretation, and manuscript drafting.

Sandeep Kumar Ahirwar: Supervision, methodological guidance, surgical oversight, data interpretation, and critical revision of the manuscript.

Abhinay Soni: Data collection, clinical follow-up, data analysis, literature review, and critical revision of the manuscript.

All authors contributed to the interpretation of the findings, critically reviewed the manuscript, approved the final version, and agreed to be accountable for all aspects of the work.

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Consent for Publication

Written informed consent was obtained from all participants for participation in the study and for publication of the study findings. No individually identifiable patient information is presented in this manuscript.

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