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Suture versus tacker closure of the peritoneum in transabdominal preperitoneal repair of inguinal hernia: A prospective comparative cohort study

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Abstract

BACKGROUND: Laparoscopic transabdominal preperitoneal repair of inguinal hernia (TAPP) is routinely done by general surgeons. (1) One crucial step is peritoneal closure post-mesh placement to prevent contact with the bowel. (2) There are various techniques available for peritoneal closure. (3) This prospective comparative cohort study compares the effectiveness of sutures versus tackers in terms of time efficiency, cost, postoperative patient comfort, and complications.

MATERIALS AND METHODS: This prospective comparative cohort study included patients undergoing unilateral TAPP at a tertiary care hospital in South India from December 2022 to April 2024. A total of 80 patients were included in the study, of which 50 underwent peritoneal closure by tackers and 30 underwent peritoneal closure by sutures based on the standard of care of the operating surgeon. These patients were observed intra-operatively, post-operatively, and during the first follow-up visit at 10–14 days and at 3 months.

RESULTS: Peritoneal closure time was significantly lower for the tacker group (2.78 min vs. 11.17 min, $P < 0.001$). The tacker group had a higher cost (₹5313 vs. ₹1855, $P < 0.001$) and experienced increased postoperative pain at both 10–14 days (36% vs. 10%, $P = 0.011$) and 3 months (24% vs. 6.7%, $P = 0.048$).

CONCLUSION: This study shows that although suturing for peritoneal closure is more time-consuming and technically challenging, it can significantly reduce the material cost and reduce both early and late postoperative pain. Using barbed suture materials can help reduce operative times.

TRIAL REGISTRATION: Study registered under the Clinical Trial Registry of India. CTRI Number: CTRI/2022/11/047211.

Keywords:

Hernia, inguinal, laparoscopy, sutures, tackers

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Introduction

Background

Globally, over 20 million patients undergo elective repair for inguinal hernias each year. Hernia repair is the most frequently performed procedure by general surgeons.[1] An ideal hernia treatment technique should be associated with high patient comfort, a short time to return to work, low cost, and low recurrence rate.[2] Lichtenstein tension-free repair is the most commonly performed hernia repair procedure because of its simplicity, low recurrence, and associated complications.[3] Since the early 90s with the advent of innovative

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minimally invasive surgical platforms, laparoscopic transabdominal preperitoneal (TAPP) repair and totally extraperitoneal repair (TEP) have emerged.[3,4] The advent of laparoscopic techniques for inguinal hernia repair as an alternative to conventional open surgery has led to improved surgical outcomes, including fewer wound-related complications, less postoperative pain, shorter hospital stays, faster recovery, and reduced chronic pain.[2] For primary unilateral inguinal hernia in both sexes, International Hernia-Surge guidelines recommend laparoscopic repair because of lesser postoperative and chronic pain, provided surgeons with adequate expertise and resources are available.[5] Now, the TAPP technique can be performed robotically with similar trocar configuration and similar dissection steps with better three-dimensional optics and wristed instrumentation, allowing for better visualization of the anatomy and improved mobility.[6,7] Laparoscopic TAPP inguinal hernia repair is regularly performed. It involves gaining access to the abdominal cavity, obtaining the pneumoperitoneum, incising the peritoneum to create a preperitoneal space, reducing the inguinal hernia, and placement of mesh in this pocket.[8] Peritoneal closure during TAPP inguinal hernia repair has been the standard of care to reduce the risk of mesh adhesion to intestines, erosion, fistula formation, and small bowel obstruction.[9,10] Many methods for closure of the peritoneal flap to partition the mesh from intra-abdominal contents exist, which include sutures, tacks, staples, and non-penetrating fixation devices.[8,11,12] The barrier-coated mesh has been designed with an internally facing resorbable hydrogel barrier or other layer to minimize adhesion formation, and not requiring secured coverage of the peritoneal flap is also being practised.[13] Tackers are very commonly used in laparoscopic inguinal hernia surgery owing to their ease of use and time efficiency. However, they are associated with increased pain in the postoperative period and higher cost.[2,9] Sutures are associated with lesser post-operative pain and lesser cost than tackers; however, they are technically more demanding and more time-consuming.[2,8] Much of the literature on hernia for fixation devices in laparoscopic inguinal and ventral hernia repairs has evaluated mesh fixation, with few data directly comparing these techniques for peritoneal closure.[8]

Objectives

The study aims to compare suture and tacker techniques for peritoneal closure during TAPP repair in terms of operative time, postoperative pain, costs, and complications. We hypothesized that tacker closure would reduce operative time but may increase postoperative pain and costs compared to sutures.

Methods

This is a prospective comparative cohort study conducted from December 2022 to April 2024 in the Department of General Surgery at a tertiary care center in Southern India. Patients over the age of 18 years undergoing unilateral laparoscopic inguinal hernia repair (TAPP) are enrolled into the study after obtaining ethical clearance and informed consent.

Inclusion criteria

Patients over 18 years of age undergoing unilateral TAPP in the Department of General Surgery at our hospital were included.

Exclusion criteria

Patients undergoing bilateral TAPP, laparoscopy converted to open hernia surgery, any other surgery performed along with laparoscopic inguinal hernia repair, and recurrent inguinal hernia repairs were excluded.

The outcome variables include material cost (suture/tacker), peritoneal closure time, postoperative pain, postoperative complications, postoperative hospital stay, pain at first follow-up (10–14 days), pain at 3 months, and hernia recurrence. The exposures include the method of peritoneal closure (suture or tacker) and the type of the suture material used. The potential confounders include the age and sex of the participant, comorbidities, surgeon experience, size of the hernia defect, and content of the hernia. Postoperative pain is measured using the Visual Analog Scale, which is a subjective measurement tool where the patient rates their pain on a scale of 0 (no pain) to 10 (worst possible pain).

The patients were enrolled as per the inclusion criteria 1 day prior to the study; they were explained in detail about the study with a Participant Information sheet, and written informed consent was obtained. Patients are divided into two groups (tacker or suture) based on the standard of care of the operating surgeon intraoperatively. All the patients in both groups were operated by surgeons with > 10 years of experience. A 15 cm × 15 cm lightweight polypropylene mesh was used and was fixed with two tackers in all participants. The intraoperative time required for peritoneal closure is noted in minutes. Intraoperative complications such as injury to surrounding structures and bleeding due to vascular injury are noted. Postoperative pain was measured on post-operative days 0, 1, and 2 using the VAS. Post-operative clinical bedside complications such as urinary retention, port site infection, groin seroma, and scrotal edema are noted. Duration of hospital stay (days after surgery) is noted to compare the post-op recovery. Any complications and pain on

the first follow-up (post-operative days 10–14) are noted. Follow-up was conducted at the end of 3 months via telephonic interview to look for recurrence or any complaints. The participant and individual assessing the post-operative pain are blinded to the type of peritoneal closure used to avoid observer bias. Based on the standard formula for comparing two means, the study sample size was calculated between 70 and 100. Data were collected based on Proforma.

Statistical analysis

Categorical data were summarized by frequency and percentages. Quantitative data were summarized by mean and standard deviation. Comparison of categorical data between the groups was performed by the chi-square test and Fisher's exact test. The quantitative data were compared using the *t* test. For missing data, data imputation was performed by the last observation carried forward method. Statistical Package for Social Sciences version 23 software (IBM Corp., Armonk, NY, USA) was used to analyze the data. The level of significance was 5%.

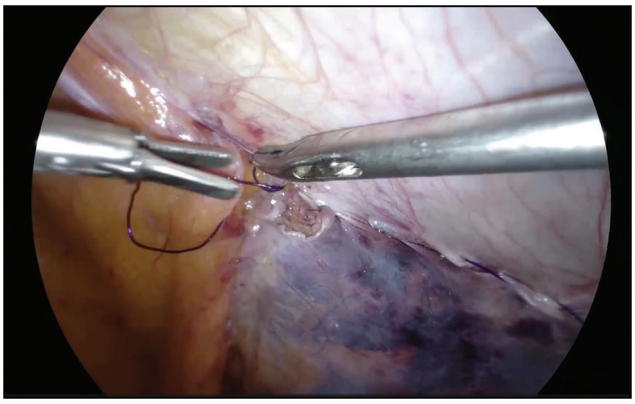

Figure 1: Intraoperative photograph showing peritoneal closure with suture

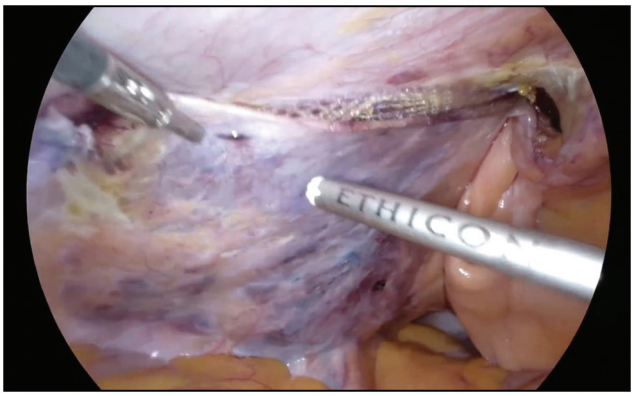

Figure 2: Intraoperative photograph showing peritoneal closure with tacker

Results

Demographic details

A total of 80 participants who underwent unilateral TAPP repair were recruited, out of which 30 participants underwent peritoneal closure by suture [Figure 1] and 50 participants underwent peritoneal closure by tacker [Figure 2]. The majority of the participants were in the age group of 50–70 years (46%), followed by 30–50 years (32.5%). Among the 80 participants, 77 (96.25%) were male and three (3.75%) were female. A total of 43 participants underwent right TAPP, and 37 participants underwent left TAPP. The mean defect size of the hernia in the suture group was 1.88 cm, and the mean defect size in the tacker group was 1.7 cm. As per EHS groin hernia classification in the tacker group (M2-28%, L2-28%, L1-22%, M1-10%, L3-10%, and M3-2%) and suture group (M2-33.3%, L2-20%, M1-13.3%, L3-10%, L1-10%, and M3-6.6%).

Ten participants were discharged on postoperative day 1, so for the VAS pain score on postoperative day 2, data imputation was performed using the last observation carried forward method. All participants completed the follow-up at 10–14 days and 3 months. The average follow-up time was 3 months. For the confounders, multivariable regression was done.

Outcomes

(1) The mean cost for peritoneal closure was compared between the suture and tacker groups. The mean cost for the suture group was ₹1855 ($20.09), and the mean cost for the tacker group was ₹5313 ($63.28). The tacker was associated with a higher cost $P < 0.001$ [Table 1, Figure 3].

(2) The mean time for peritoneal closure in the suture group was 11.17 min. The mean time for peritoneal closure in the tacker group was 2.78 min. Sutures take a longer time for peritoneal closure than tackers $P < 0.001$. The time for peritoneal closure was compared among different suture materials, and V LOCK™ (Barbed VICRYL) had the shortest time, 9.83 min, and PDS 2-0™ had the longest time, 13.20 min. [Table 2, Figure

Table 1: Mean material cost for peritoneal closure suture versus tacker

Group	*N*	Mean	Std. deviation	Median	IQR		Mann–Whitney test *P* value
					Lower	Upper	
Suture	30	1855.00	1145.78	965.00	965.00	3118.00	< 0.001
Tacker	50	5313.00	1741.42	4950.00	3300.00	6600.00	

4]. None of the 80 participants had any intraoperative complications such as injury to surrounding structures or bleeding due to vascular injury noted during the study.

(3) The postoperative pain on postoperative days (POD) 0, 1 and 2 was compared. It was found that the mean visual analogue pain score in the suture group was 4.39, and in the tacker group, it was 5.29. However, the *P* value was 0.180, hence not statistically significant [Table 3].

(4) In the postoperative period, one patient from the suture group (3.3%) and one from the tacker group (2%) had urinary retention. One patient from the tacker group (2%) had port site infection.

The post-operative hospital stay duration was compared, and the suture group (2.17 days) had a slightly longer postoperative hospital stay than the tacker group (1.88 days). $P = 0.05$ (not significant).

(5) On the first follow-up (10–14 days), three participants from the suture group (10%) and 18 participants from the tacker group (36%) experienced pain. The tacker group had higher pain on the first follow-up $P = 0.011$(significant) [Table 4, Figure 5].

(6) At the end of 3 months, two participants from the suture group (6.7%) and 12 participants from the tacker group (24%) experienced pain. The tacker group had higher pain at 3 months than the suture group. $P = 0.048$ (significant) [Table 5, Figure 6]. No recurrence was noted in either of the groups.

Discussion

In our study, effort has been made to compare suture and tacker techniques for peritoneal closure and highlight their advantages and disadvantages. The comparable parameters include material cost, time for peritoneal closure, early postoperative pain, postoperative complications, duration of hospital stay, complications and pain at first follow-up, and long-term pain and recurrence at 3 months [Table 6].

In our present study, the mean material cost for peritoneal closure among the suture and tacker groups was compared. The cost was significantly less in the suture group compared to the tacker group. None of the other studies have compared the material cost for peritoneal closure as such. However, in the study by Ross *et al.* (2015, 2017), the total procedural cost was compared, and it was found that the cost was higher in the suture group than in the tacker group. This was because a larger mesh was used in the suture group, adding to the cost.

In our study, the mean time for peritoneal closure was significantly less in the tacker group than in the suture group. Similar results were observed in other studies. However, a study by Ross *et al.* in 2015 and 2017 compared the total operative times and showed that the operative time was higher in the tacker group. This was,

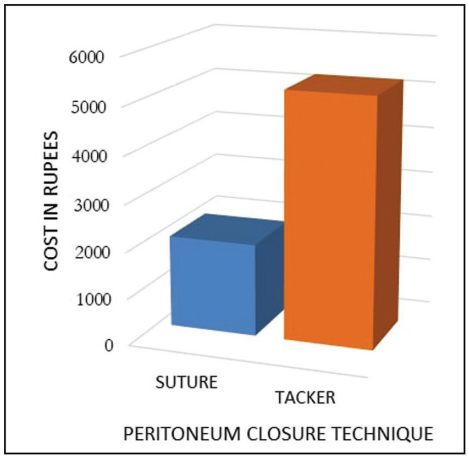

Figure 3: Graph showing that tacker has higher cost

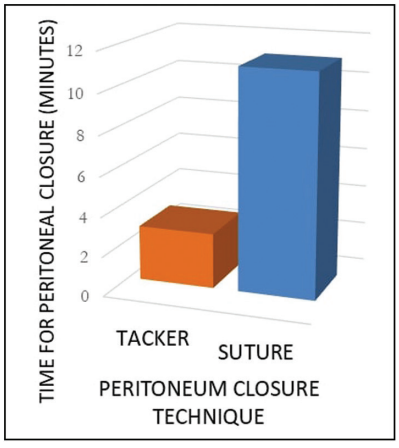

Figure 4: Graph showing time for peritoneal closure suture versus tacker

Table 2: Time for peritoneal closure suture versus tacker

Group		*N*	Mean	Std. deviation	*t* test *P* value	
Time for peritoneal closure (min)	Suture	30	11.17	2.13	< 0.001	HS
	Tacker	50	2.78	1.42		

however, attributed to the larger hernia defect sizes in the tacker group.

None of the other studies have compared the time for peritoneal closure among different suture materials. However, we have compared the time for peritoneal closure among different suture materials and found that the use of barbed sutures takes significantly less time than use of conventional suturing.

As per our study, the tacker group experienced more pain than the suture group according to visual analog scale score on POD 0, 1, and 2. However, the results were not statistically significant. Other similar studies have also shown that the postoperative pain in the early postoperative period was higher in the tacker group.

The postoperative complications during the hospital stay that were observed in our study include urinary retention and port site infection, which were slightly higher in the tacker group. However, the results are not statistically significant. Other related studies also had similar results, with the most common complications being urinary retention, groin seroma, and scrotal edema. However, their incidence could not be attributed to the peritoneal closure technique.

Table 3: Postoperative pain on postoperative days (POD) 0, 1, and 2 visual analogue scale (VAS) suture versus tacker

	N	Mean VAS score	Std. deviation
Pain-POD 0			
Suture	30	7.33	0.61
Tacker	50	8.50	0.51
Pain-POD 1			
Suture	30	3.80	0.66
Tacker	50	4.78	0.86
Pain-POD 2			
Suture	26	2.04	0.34
Tacker	40	2.60	0.55

The mean duration of postoperative hospital stay was slightly higher in the suture group than in the tacker group. However, it was not statistically significant. Other similar studies also have observed no significant differences between the lengths of hospital stay between the two groups.

The patients were observed during the first follow-up visit at 7–14 days, and it was found that the tacker group had significantly more pain during the first follow-up than the suture group. Other related studies also show the same results. Hence, peritoneal closure by closure by suture is associated with lesser pain in the first follow-up.

Similarly, complications such as groin seroma and scrotal edema were compared during the first follow-up visit (7–14 days), and it was found that both complications were higher in the tacker group than in the suture group. However, it was not statistically significant. Other related studies showed similar results.

The patients were followed-up at 3 months to look for long-term pain or any recurrence of hernia. As per our study, a higher number of participants in the tacker group had pain at the end of 3 months compared to the suture group. Studies by Oguz *et al.* and Ross *et al.* 2017 showed similar results.

Our study was conducted on a South Indian population in a single tertiary care center with a 3-month follow-up. There may be regional variations in healthcare systems, standards of care, and cost and level of surgical expertise. However, the results of our study were comparable to the results obtained from various national and international studies. Hence, our study can be considered generalizable to the population. Multi-center studies with varied hospital settings could strengthen the generalizability.

Limitations

A single-center study with moderate sample size. Lack of long-term follow-up beyond 3 months. A smaller

Table 4: First follow-up (10–14) days complications groin seroma, scrotal edema, and pain in the suture versus tacker group

	Suture		Tacker		Total	
	Count	Column N %	Count	Column N %	Count	Column N %
Groin seroma						
N	27	90.0	40	80.0	67	83.8
Y	3	10.0	10	20.0	13	16.3
Scrotal edema						
N	30	100.0	47	94.0	77	96.3
Y	0	0.0	3	6.0	3	3.8
Pain						
N	27	90.0	32	64.0	59	73.8
Y	3	10.0	18	36.0	21	26.3

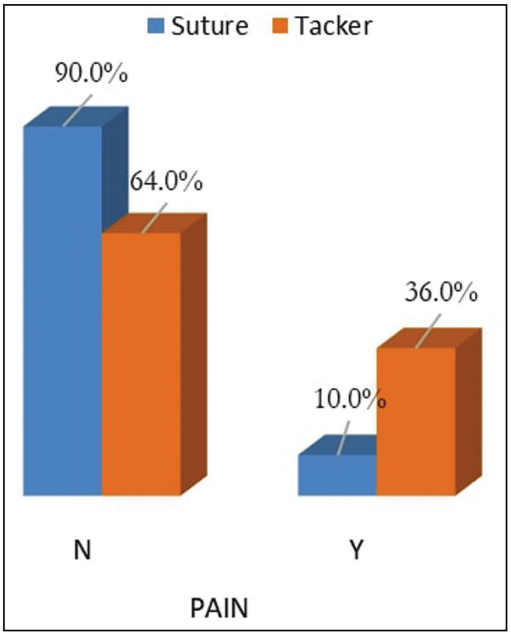

Figure 5: Graph showing higher pain in the tacker group on first follow-up

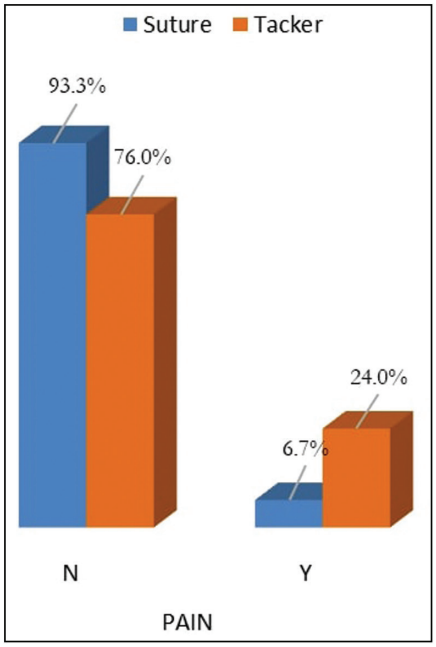

Figure 6: Graph showing higher pain in the tacker group at the end of 3 months

Table 5: Showing pain and recurrence at end of 3 months

	Group					
	Suture		Tacker		Total	
	Count	Column N %	Count	Column N %	Count	Column N %
Recurrence						
N	30	100.0	49	98.0	79	98.8
Y	0	0.0	1	2.0	1	1.3
Pain						
N	28	93.3	38	76.0	66	82.5
Y	2	6.7	12	24.0	14	17.5

number of cases in the suture group resulted in unequal groups. The study did not account for the mesh fixation method, which can independently affect the pain scores in both groups.

Conclusion

This study shows that although suturing for peritoneal closure is more time-consuming and technically challenging, it can significantly reduce the material cost and reduce both early and late postoperative pain. Based on these findings, surgeons should consider cost-effectiveness and patient comfort when choosing a peritoneal closure technique. Using barbed suture materials can help reduce the operative time.

Future studies should consider multi-centric designs with extended follow-up periods to assess recurrence rates.

Author contributions

First author Dr. Rajagopal C is the principal investigator, and the data collection for the study has been done by him. The second and corresponding author Dr. Sunil Krishna is one of the chief operating surgeons in the department of General Surgery. Most of the participants/patients in the study have been operated by him and his colleagues in the department of General Surgery. The study was guided by him and provided significant contributions in the manuscript preparation. The third author Dr. Pavan M Bhat helped in the manuscript preparation.

Ethical policy and institutional review board statement

The study was approved by the Kasturba Medical College and Kasturba Hospital Institutional Ethics Committee (No. IEC2/280, dated on Oct 26, 2022). The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki (2022) (*WMA - The World Medical Association-WMA Declaration of Helsinki – Ethical Principles for Medical Research Involving Human Subjects*, n.d.).

Declaration of patient consent

The participants/patients have been recruited after obtaining written informed consent from them and the

Table 6: Comparing the results of similar studies

Author	Cost	Time for peritoneal closure (min)	Postoperative pain on postoperative days 0, 1, and 2	Pain on first follow-up (10–14) days	Complications on first follow-up	Pain after 3 months
Ross *et al.* 2015[8]		(Operative time) tacker (108.6 ± 42.8) vs. suture (97.4 ± 30.9)		Tackers 55.9% suture 30.4% had significant postop pain as per Carolinas QOL scale		
Oguz *et al.* 2015[2]		Tacker (4.2 ± 2.4) suture (14.5 ± 6.5)	Visual analogue scale (VAS) tacker (2.9 ± 0.4) suture (1.8 ± 0.5) $P = 0.027$	VAS tacker (1 ± 0.3) suture (0.3 ± 0.4) $P = 0.064$		
Ross *et al.* 2017[9]	Mean procedure cost tacker ($13,378$ ± $3037) vs. suture ($13,957 ± $4189)	(Operative time) tacker (105.4 ± 42.5) vs. suture (100.9 ± 33.0)		Tacker 53.5% vs. suture 50.6% had pain as per Carolinas QOL scale		
Singhal *et al.* 2023[14]		Tacker (3.24 ± 0.3) vs. suture (7.13 ± 0.41)	VAS tacker (5.82 ± 0.63) vs. suture (3.91 ± 0.63)	VAS tacker (2.09 ± 0.31) vs. suture (0.91 ± 0.16)		
Our study	Suture rupees (1855 ± 1145.7) tacker rupees (5313 ± 1741)	Tacker (2.78 ± 1.42) suture (11.17 ± 2.13)		Suture 10%, tacker 36%		Suture 6.7%, tacker 24%

relatives and handing over a participant information sheet explaining about the research, the purpose, outcomes and confidentiality of information.

Data availability statement

The datasets generated during and/or analyzed during the current study are not publicly available but are available from the corresponding author on reasonable request.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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