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Comparing Fixation Vs Non-Fixation of Mesh in Laparoscopic Totally Extra Peritoneal (TEP) Repair of Inguinal Hernia - A Prospective Study

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KEYWORDS

Laparoscopy, Hernia, Minimally invasive surgery

ABSTRACT:

Introduction: Inguinal hernioplasty is one of the most common surgeries encountered in the field of general surgery. As Sir Astley Cooper said in the preface to his work on the anatomy and surgical treatment of abdominal hernia, "No disease of the human body belonging to the province of the surgeon requires in its treatment a greater combination of accurate anatomical knowledge with surgical skill, than hernia in all of its varieties" [1]. In this era of minimally invasive surgery, and with the advancement of technology, laparoscopic hernioplasty is now accepted as the preferred modality over open hernioplasty. However, with this procedure becoming more widely performed, various techniques for the laparoscopic repair of inguinal hernias have emerged, with proponents for both fixation and non-fixation of the mesh, and both are supported by evidence. This study aims to prove that non-fixation is comparable to fixation, with the additional advantage of decreased postoperative pain, cost and reduced duration of surgery.

Objectives: This study aims to compare mesh fixation vs non-fixation in laparoscopic totally extraperitoneal (TEP) inguinal hernioplasty. The primary objectives were to measure the distance of mesh migration post-operatively between the two groups, to determine the duration of surgery, and to compare the post-operative pain between the two groups using the visual analogue scale.

Methods: This single-center, prospective interventional study was conducted in the Department of General Surgery at SRIHER to compare laparoscopic totally extraperitoneal (TEP) hernioplasty with and without mesh fixation. Forty patients aged 18 years and older, diagnosed with direct hernias (<3 cm defect) or indirect hernias (unilateral or bilateral), were included. Patients with complicated or large hernias, those unfit for general anesthesia, or who did not consent were excluded. Intraoperatively, the mesh was marked with ligaclips at the superomedial edge. Case Group A (20 patients) underwent mesh fixation using tackers, while Control Group B (20 patients) had non-fixed mesh placement. Outcomes, including mesh migration (assessed via serial X-rays), postoperative pain (measured using the Visual Analogue Scale), and operative

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time, were evaluated on postoperative days 1, 7, and 30. This study aimed to determine the impact of mesh fixation on clinical outcomes and surgical efficiency in TEP hernioplasty.

Results: Both groups were matched for age, comorbidities, defect size, and type of hernia. The mean duration of surgery was significantly longer in the fixed group (84.5 minutes) compared to the non-fixed group (70 minutes) ($p < 0.0005$). Mesh migration was observed in both groups at postoperative day (POD) 7 and POD 30, with values of 0.603 and 1.355 in the fixed group and 0.823 and 1.509 in the non-fixed group, respectively. However, there was no significant difference in mesh migration between the two groups. Postoperative pain scores were higher in the fixed group on POD 1, but by POD 7, the pain levels were comparable between the groups.

Conclusions: In comparing mesh fixation and non-fixation techniques in Totally Extraperitoneal (TEP) inguinal hernia repair, non-fixation has been shown to be more advantageous. Specifically, non-fixation reduces both surgery duration and immediate postoperative pain, facilitating earlier resumption of normal activities. Furthermore, there was no significant difference in mesh migration between the fixation groups and non-fixation, suggesting that non-fixation is a potentially superior technique for patients undergoing inguinal hernia repair, providing both clinical and logistical benefits.

1. Introduction

Inguinal hernia repair is one of the most frequently performed surgical procedures globally, with a significant number of cases reported annually. The introduction of synthetic mesh has revolutionized hernia repair by substantially reducing recurrence rates, and it is now considered the gold standard approach in hernia surgery. Furthermore, the transition from open to laparoscopic techniques has marked a significant advancement in the field, offering advantages such as reduced postoperative pain, shorter hospital stays, faster recovery times, and improved cosmetic results [2,3].

Laparoscopic inguinal hernia repair is primarily conducted using two approaches: Transabdominal Preperitoneal (TAPP) and Totally Extraperitoneal (TEP) hernioplasty. The TEP approach, first described by McKernon and Laws in 1993, avoids breaching the peritoneal cavity, thereby minimizing the risk of intra-abdominal complications [4]. Despite advancements, debate continues regarding the necessity of mesh fixation in TEP repairs. While non-fixation is a common practice during laparoscopic surgery, mesh can also be secured using sutures, staples, absorbable tackers, or tissue adhesives. However, mesh fixation, particularly with staples, has been associated with increased postoperative pain and the potential for scarring at fixation sites [5,6]. This study aims to assess the outcomes of mesh fixation versus non-fixation in TEP hernioplasty, focusing on variables such as mesh migration, operative time, and postoperative pain.

2. Objectives

This study aims to evaluate and compare the outcomes of mesh fixation versus non-fixation techniques in laparoscopic totally extraperitoneal (TEP) inguinal hernioplasty. The analysis focuses on three key parameters, critical to assessing the effectiveness and patient-centered outcomes of these approaches:

1. Mesh Migration: Assessing the extent of mesh displacement post-surgery between the two groups. Mesh migration can influence the recurrence rate and overall success of the procedure.

2. Mesh Placement Time: Comparing the operative time required to secure the mesh in place with and without fixation techniques. This measurement reflects the technical ease and efficiency of each method.

3. Postoperative Pain: Using the Visual Analogue Scale (VAS), the study measures pain levels in patients following surgery. Fixation techniques, such as stapling or tacking, may contribute to increased postoperative discomfort due to tissue irritation or nerve involvement.

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3. Methods

This prospective, single-center, comparative study was conducted in the Department of General Surgery, SRIHER. Ethical approval was obtained from the institutional ethics committee prior to the commencement of the study, ensuring compliance with all ethical standards for human research. Informed consent was secured from all participants before their inclusion in the study.

The study included patients aged 18 years and older who were diagnosed with primary inguinal hernias and opted for laparoscopic hernioplasty. Participants were selected based on predefined inclusion and exclusion criteria. Inclusion criteria encompassed patients with indirect and direct hernias with defect sizes less than 3 cm, presenting either unilaterally or bilaterally. Exclusion criteria ruled out patients with recurrent hernias, complicated hernias such as strangulated or obstructed hernias, or those with direct hernias exceeding a defect size of 3 cm. Additionally, patients who did not consent to participate or were deemed unfit for general anesthesia were excluded from the study.

A total of 40 patients meeting the eligibility criteria underwent laparoscopic TEP hernioplasty. These patients were divided into two groups of 20 each. In the case group (Group A), the mesh was fixed using tackers, while in the control group (Group B), the mesh was placed without fixation. To ensure precise tracking of mesh placement, the superomedial edge of the mesh was marked intraoperatively with ligaclips in all patients.

The postoperative outcomes were systematically assessed during follow-up visits on postoperative days (POD) 1, 7, and 30. The primary variables compared between the two groups included:

1. Mesh Migration: Mesh migration was evaluated using serial X-rays taken during the follow-up period. This provided a quantifiable measure of any displacement from the original placement site, offering insights into the stability provided by fixation methods.

2. Postoperative Pain: Pain levels were assessed using the Visual Analogue Scale (VAS) at each follow-up visit. This allowed for a comparative analysis of the patient comfort levels between the fixation and non-fixation groups.

3. Surgical Duration: The mean operative time was recorded for each group to evaluate the efficiency of the procedure. Fixation methods, which involve additional procedural steps, were hypothesized to increase the duration compared to non-fixation.

This study aimed to generate data to address the ongoing debate regarding the necessity and efficacy of mesh fixation in laparoscopic TEP hernioplasty.

Surgical Technique

The pre-peritoneal space was developed using an open technique with blunt dissection facilitated by the use of a telescope and insufflation. This approach was chosen for its cost-effectiveness and reduced complexity, as the creation of the space was straightforward without any significant technical challenges. Once the space was established, the hernial sac was meticulously dissected down to the area where the vas deferens turned medially, ensuring complete exposure regardless of whether the hernia was direct or indirect.

To maintain consistency across all cases, a 12x15 cm monofilament, non-absorbable polypropylene mesh was utilized. In the fixation group (Group A), the mesh was secured using tackers to ensure stability. In contrast, the non-fixation group (Group B) had the mesh placed without fixation, allowing it to remain in place through natural tissue adherence. To facilitate precise postoperative radiological evaluation and assessment of mesh migration, Ligaclips were applied to mark the mesh's superomedial border. This marking technique enabled consistent tracking of mesh position during follow-up with radiological imaging.

Postoperative Follow-Up:

Serial X-rays of the erect abdomen with pelvis (AP view) were conducted on postoperative day (POD) 1, POD 7, and one month postoperatively to assess mesh migration. To minimize errors and ensure consistency, the same radiographer performed all imaging. The distance between the ligaclips and the pubic symphysis was measured using a radiographic scale to evaluate mesh migration (Figure 1).

Postoperative pain was assessed using the Visual Analogue Scale (VAS) on POD 1, POD 7, and one month postoperatively. To eliminate potential bias, a

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standardized postoperative rehabilitation protocol was adhered to for all patients.

The standardized postoperative rehabilitation protocol was designed to ensure consistent care and minimize variability in patient recovery. Patients were encouraged to begin gradual ambulation as soon as possible after surgery, typically within the first 24 hours postoperatively.

A multimodal pain management approach was implemented. Upon completion of the surgery, patients were administered an initial dose of analgesics to minimize postoperative pain. This often included intravenous (IV) analgesics, such as opioids (e.g., morphine or fentanyl), to provide rapid relief in the early recovery phase. As patients began to recover, the administration of analgesics was shifted to oral medications, such as NSAIDs (e.g., ibuprofen or diclofenac) and acetaminophen, to manage pain more comfortably and allow for mobility. These medications were given at regular intervals, with dosages adjusted based on pain levels and patient response. The goal was to keep pain at a manageable level to support early mobilization and recovery. Pain scores were systematically documented during each assessment, allowing the surgical team to track the patient's pain trends over time. This information was used to modify analgesic regimens and ensure the patient's pain management was both effective and safe. Any significant changes in pain intensity or new pain patterns were evaluated to rule out complications like infection or hematoma.

Scheduled follow-up visits were conducted to monitor healing progress, assess for any complications, and provide further guidance. During these visits, the surgical site was evaluated, and the patient's pain levels and activity tolerance were reviewed. This standardized protocol aimed to support optimal recovery, reduce variability in postoperative outcomes, and ensure patient safety during the rehabilitation period.

By using a consistent and evidence-based approach, the research ensured that pain levels were assessed accurately, allowing for more reliable comparisons of postoperative outcomes across the study groups.

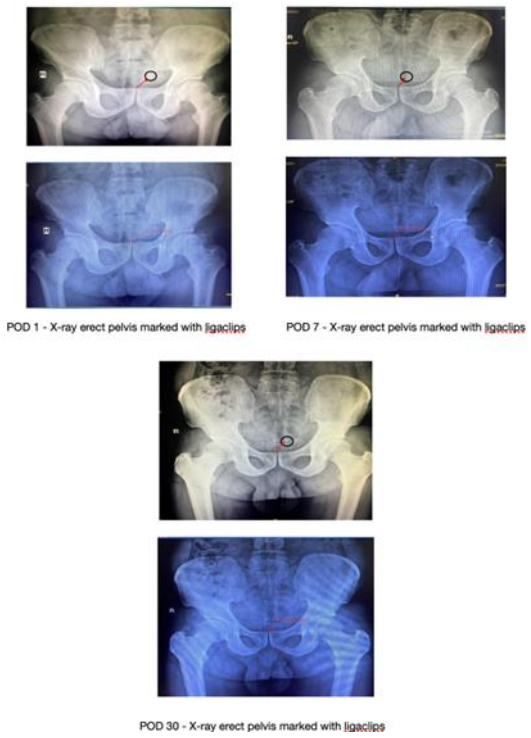

Figure 1: Post-operative serial X-rays on POD 1, POD 7, and POD 30

4. Results

The study enrolled 40 patients, evenly distributed into two groups of 20 each. The mean age was 54.8 years for the fixation group and 56.1 years for the non-fixation group. No significant differences were found between the groups regarding age, hernial defect size, comorbidities, or type of inguinal hernia, ensuring a well-matched comparison. The hernial defect sizes were comparable across groups, with no statistical significance observed. In the fixation group, 50% of the patients had direct hernias, while the remaining 50% had indirect hernias. In the non-fixation group, 55% had indirect hernias (Table 1).

Table 1: Number of cases in each group

			Mesh placement		Total
			Fixed	Not Fixed	
Diagnosis	DIRECT	Count	10	9	19
		%	50.0%	45.0%	47.5%
	INDIRECT	Count	10	11	21
		%	50.0%	55.0%	52.5%
Total		Count	20	20	40
		%	100.0%	100.0%	100.0%

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Patients were classified according to the European Hernia Society (EHS) classification system, with the majority falling into the L2 or M2 categories. No significant differences were observed between the fixed and non-fixed groups regarding the distribution of cases according to the EHS classification (Table 2).

Table 2: Number of cases according to EHS classification

			Mesh placement		Total
			Fixed	Not Fixed	
EHS Classification	L1	Count	3	2	5
		%	15.0%	10.0%	12.5%
	L2	Count	5	7	12
		%	25.0%	35.0%	30.0%
	L3	Count	2	2	4
		%	10.0%	10.0%	10.0%
	M1	Count	3	3	6
		%	15.0%	15.0%	15.0%
	M2	Count	7	5	12
		%	35.0%	25.0%	30.0%
Total		Count	20	20	40
		%	100.0%	100.0%	100.0%

Surgery Duration:

The mean duration of surgery was notably longer in the fixation group (84.5 minutes) compared to the non-fixation group (70 minutes). This difference was statistically significant, indicating that the fixation procedure may involve additional time due to the need for mesh placement and securing with tackers. (Figure 2)

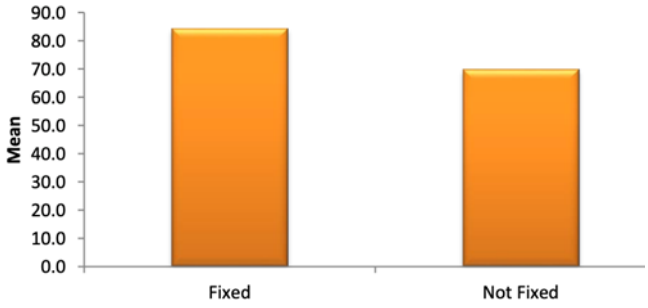

Fig 2: Surgery duration in fixed and non fixed groups

Mesh Migration:

Mesh migration was evaluated by measuring the displacement of the ligaclips relative to the pubic symphysis on serial X-rays taken on POD 7 and POD 30. In the fixation group, mesh migration was observed, with a mean displacement of 0.603 cm at POD 7 and 1.355 cm at POD 30. Similarly, the non-fixation group showed migration, with a mean displacement of 0.823 cm at POD 7 and 1.509 cm at POD 30, with a p-value of 0.0005. Despite these observed changes in both groups, no significant difference in mesh migration was found when comparing the two groups at POD 7 (p-value 0.596) and POD 30 (p-value 0.733), suggesting that the fixation method did not have a meaningful impact on reducing mesh migration compared to non-fixation (Table 3 and 4).

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
POD 7 Mesh Migration	Equal variances assumed	.286	.596	-1.399	38	.170	-.22050	.15761	-.53956	.09856
POD 30 Mesh Migration	Equal variances assumed	.118	.733	-.934	38	.356	-.15350	.16433	-.48616	.17916

Table 3: Comparison of mesh migration between fixation and non-fixation groups on POD 7, and POD 30

Mesh placement		N	Mean	SD
POD 7 Mesh Migration	Fixed	20	.60	.42
	Not Fixed	20	.82	.57
POD 30 Mesh Migration	Fixed	20	1.36	.52
	Not Fixed	20	1.51	.52

Table 4: Independent samples test comparing mesh migration between the two groups.

Postoperative Pain:

Postoperative pain was assessed using the Visual Analogue Scale (VAS) on POD 1, POD 7, and POD 30. On POD 1, the mean VAS score in the fixation group was 2.75, significantly higher than the mean score of 2.0 in the non-fixation group (p-value 0.0005). This indicates that patients in the fixation group experienced greater pain immediately after surgery compared to those in the non-fixation group. However, by POD 7 and POD 30, the VAS scores between the groups had equalized, with no significant differences observed (Fig 3). This suggests that while the fixation group had higher initial postoperative pain, the pain levels became comparable over time, implying that pain associated with the fixation process was transient. This analysis provides insight into the implications of mesh fixation on surgery duration, mesh stability, and postoperative pain management.

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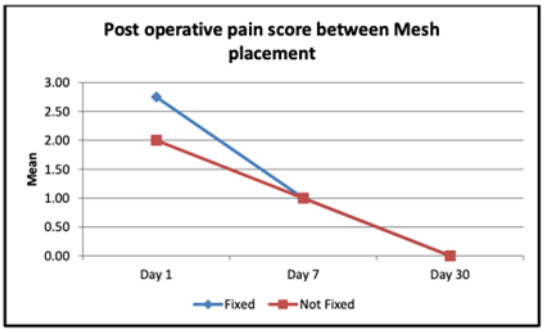

	Day 1	Day 7	Day 30
Fixed	2.75	1	0
Not Fixed	2.00	1	0

Fig 3: Post operative pain score comparison between both groups

5. Discussion

The fixation of mesh in Totally Extraperitoneal (TEP) repair of inguinal hernias remains a contentious topic in the surgical community. Surgeons employ various techniques, balancing the perceived security of mesh fixation against the potential drawbacks, such as increased postoperative pain and longer operative times. While some surgeons advocate for fixation to prevent mesh migration and recurrence, others question its necessity, citing additional complications and costs associated with fixation.

Our findings align with those of Jakob Burcharth *et al.*[7] and Cody A. Koch [8], who observed that non-fixation of the mesh in TEP hernia repair significantly reduces postoperative pain, shortens hospital stays, and minimizes the requirement for narcotic analgesics. This trend is further substantiated by studies conducted by Beattie *et al.* [9], and Poobalan *et al.* [10], which link mesh fixation with higher incidences of chronic pain and increased healthcare costs. Additionally, Choy *et al.* [11] demonstrated that non-fixation does not lead to significant differences in mesh migration or recurrence rates, conclusions mirrored by our data.

The use of fixation devices, such as staples or tacks, has been associated with chronic pain and higher expenses, as reported by Beattie *et al.* [9] and Poobalan *et al.* [10].

In contrast, George S. Ferzli's [12] research found no significant difference in pain or discomfort between fixation and non-fixation groups during a 12-month follow-up, suggesting that long-term outcomes might not favor one approach over the other.

Interestingly, Claus et al.[13] conducted a similar investigation using ligaclips and radiographic examination to compare mesh fixation to non-fixation in unilateral, uncomplicated hernias. Their findings revealed no significant difference in mesh migration between the two groups, echoing/reflecting the results of our study.

Similarly, a clinical trial by Pankaj Garg *et al.* [14] indicated that non-fixation is both safe and effective, particularly in resource-limited settings, providing comparable recurrence rates alongside reduced postoperative pain and costs.

Choy *et al.* [8] further investigated mesh displacement during TEP repairs and found no intraoperative movement of the mesh in either fixation or non-fixation groups. These findings underscore that the mesh remains stable during surgery, irrespective of the fixation technique employed.

Similar to our study over the years multiple meta-analyses have indicated that non-fixation of the mesh showed no significant mesh migration and had no effect on recurrence rates. Additionally, there was no risk of injury to vessels and nerves as no tackers were deployed. Mesh stability in TEP repair is enhanced by biological processes, including mesenchymal proliferation and collagen deposition. Within two weeks of surgery, tissue begins incorporating into the mesh, and collagen growth over the subsequent months reinforces its stability in the preperitoneal space. This natural adherence reduces the need for fixation while maintaining low recurrence rates, as supported by International Endohernia Society standards.

In our study, we took serial X-rays on POD 0, POD 7 and 1 month following surgery, to assess mesh migration, taking into account the distance between the superiormedial clip and the pubic symphysis. Within each group, limited mesh migration was observed over time. However, intergroup comparisons revealed no statistically significant differences, indicating that fixation does not provide additional benefits in preventing mesh migration.

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Postoperative pain was higher in the fixation group on POD 1 but became comparable by POD 7 and POD 30. Operative times were also significantly longer in the fixation group. These findings suggest that fixation adds complexity and discomfort without improving outcomes in terms of migration or recurrence.

Clinical Implications & Societal Impact

The results of our study suggest that non-fixation of mesh in TEP hernia repair is a viable option that does not compromise patient outcomes. The non-fixation technique reduces operative time, postoperative pain, and healthcare costs, without increasing the risk of mesh migration or recurrence. This finding is particularly relevant in resource-limited settings, where minimizing surgical costs and optimising patient recovery is critical.

Furthermore, our study highlights the importance of surgical expertise in achieving optimal outcomes with non-fixation techniques. With the growing body of evidence supporting non-fixation, it may be time to reconsider the routine use of fixation devices in TEP hernia repairs, especially in cases where the risk of migration is low.

6. Conclusion

This study demonstrates that non-fixation of the mesh in laparoscopic Totally Extraperitoneal (TEP) inguinal hernia repair offers several advantages over fixation techniques. Non-fixation significantly reduces surgery duration and immediate postoperative pain, enabling patients to resume normal activities more quickly. Importantly, no significant differences were observed in mesh migration or recurrence rates between the two approaches, affirming the clinical efficacy of non-fixation.

In addition to clinical benefits, non-fixation is associated with lower overall healthcare costs, making it a particularly attractive option in resource-limited settings. These findings support non-fixation as a viable and potentially preferable technique for TEP inguinal hernioplasty. Further research and long-term follow-up are recommended to validate these outcomes and encourage widespread adoption of this approach.

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