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Research Article A

COMPARATIVE STUDY OF CONVENTIONAL POLYPROPYLENE MESH WITH ANATOMICAL 3D POLYPROPYLENE MESH IN TAPP IN ADULTS

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ABSTRACT

Background: Laparoscopic transabdominal preperitoneal (TAPP) repair is widely performed for inguinal hernia. Conventional flat polypropylene mesh requires mechanical fixation using tackers, which may increase operative time and postoperative discomfort. Anatomically contoured three-dimensional (3D) polypropylene mesh is designed to conform to inguinal anatomy and may eliminate the need for fixation.

Objectives: To compare conventional polypropylene mesh and anatomical 3D polypropylene mesh in TAPP repair with respect to operative time, postoperative pain, chronic groin pain, seroma formation, fixation requirement, and early recurrence.

Methods: This prospective comparative study included 30 patients undergoing elective TAPP repair for uncomplicated inguinal hernia. Patients were divided into two groups: Group I (n = 15) received conventional polypropylene mesh with tacker fixation, and Group II (n = 15) received anatomical 3D polypropylene mesh without routine fixation. Operative time, 24-hour Visual Analogue Scale (VAS) pain score, chronic groin pain, seroma formation, and early recurrence were analyzed. Statistical analysis was performed using SPSS version 24, and $p < 0.05$ was considered statistically significant.

Results: Mean operative time was significantly higher in the conventional mesh group compared to the 3D mesh group (74.2 ± 9.1 minutes vs 59.8 ± 8.4 minutes; $p < 0.001$). Mean VAS score at 24 hours was also significantly higher in Group I (6.1 ± 1.2) compared to Group II (3.8 ± 1.0; $p < 0.001$). Chronic groin pain was observed in 3 patients (20.0%) in the conventional mesh group and 1 patient (6.7%) in the 3D mesh group ($p = 0.724$). Seroma formation occurred in 4 patients (26.7%) in Group I and 2 patients

(13.3%) in Group II ($p = 0.625$). Fixation was required in all patients in Group I and none in Group II ($p < 0.001$). No early recurrence was observed in either group.

Conclusion: Anatomical 3D polypropylene mesh significantly reduces operative time and immediate postoperative pain compared to conventional polypropylene mesh requiring fixation in TAPP repair. Although lower rates of chronic groin pain and seroma formation were observed in the 3D mesh group, these differences were not statistically significant. Larger studies with long-term follow-up are required to confirm these findings.

Keywords: Inguinal hernia; TAPP repair; Polypropylene mesh; 3D anatomical mesh; Chronic groin pain; Mesh fixation.

INTRODUCTION

Inguinal hernia accounts for nearly 75% of all abdominal wall hernias and remains one of the most commonly performed procedures in general surgical practice worldwide[1]. Epidemiological data indicate a lifetime risk of inguinal hernia development of approximately 27% in men and 3% in women[2]. In India, inguinal hernia repair constitutes a significant proportion of elective surgical workload in tertiary care centres, with thousands of procedures performed annually[3].

Over the past two decades, laparoscopic transabdominal preperitoneal (TAPP) repair has gained widespread acceptance due to advantages such as reduced postoperative wound complications, earlier ambulation, shorter hospital stay, and faster return to work when compared with open repair[4]. However, the durability and success of TAPP repair are critically dependent on adequate mesh placement and stabilization within the preperitoneal space.

Conventional flat polypropylene mesh has been the standard prosthetic material used for reinforcement of the myopectineal orifice. Owing to its planar design, mechanical fixation using tackers is commonly employed to prevent mesh displacement and recurrence. Although effective in ensuring stability, fixation devices have been implicated in several postoperative complications. Reports from Indian laparoscopic hernia series indicate that immediate postoperative groin pain may occur in 25–40% of patients undergoing fixation-based repair, with chronic groin pain persisting in approximately 5–15% at 3–6 months follow-up.

Chronic groin pain following laparoscopic hernia repair is multifactorial and may arise from nerve entrapment, periosteal injury to the pubic tubercle, or inflammatory response to fixation devices. Such pain significantly impacts patient quality of life and may delay return to normal activity[7]. Additionally, fixation increases operative time and contributes to higher procedural cost, which is particularly relevant in resource-limited healthcare settings.

To address these concerns, anatomically contoured three-dimensional (3D) polypropylene meshes have been developed. These meshes are preformed to conform to the inguinal anatomy and are designed to remain stable within the preperitoneal space without routine mechanical fixation. Early comparative data suggest that 3D mesh may reduce

operative time, postoperative pain, and fixation-related morbidity without increasing recurrence rates. However, prospective comparative evidence from Indian tertiary care settings remains limited.

In view of the ongoing debate regarding fixation necessity and the potential advantages of anatomical 3D mesh, the present study was undertaken to compare conventional flat polypropylene mesh with anatomical 3D polypropylene mesh in TAPP repair with respect to operative time, postoperative pain, chronic groin pain, seroma formation, fixation requirement, and early recurrence.

MATERIALS AND METHODS

Study Design and Setting

This prospective comparative study was conducted in the Department of General Surgery at a tertiary care teaching hospital over a period of one year from December 2023 to November 2024.

Institutional Ethics Committee approval was obtained prior to commencement of the study. Written informed consent was secured from all participants.

Study Population

The sample size of 30 patients (15 in each group) was determined based on feasibility during the study period and patient availability at the study center. As this was a prospective comparative study conducted within a fixed time frame, all eligible patients meeting inclusion criteria were enrolled consecutively.

Patients were allocated into two equal groups:

- Group I (n = 15): Conventional flat polypropylene mesh with tacker fixation
- Group II (n = 15): Lightweight anatomical 3D polypropylene mesh without routine fixation

Allocation was performed based on operative planning and surgeon discretion.

Inclusion Criteria

- Age between 15 and 65 years
- Primary unilateral or bilateral uncomplicated inguinal hernia
- ASA grade I–III
- Fit for laparoscopic under general anesthesia
- Provided informed consent

Exclusion Criteria

- Complicated (obstructed or strangulated) inguinal hernia
- Recurrent inguinal hernia
- Previous lower abdominal surgery
- Severe cardiopulmonary comorbidity
- Coagulopathy
- Patients unwilling to participate

These criteria were applied to ensure homogeneity and eliminate confounding factors influencing postoperative pain and complication rates.

Preoperative Evaluation

All patients underwent:

- Detailed clinical examination
- Routine hematological and biochemical investigations
- Ultrasonography where indicated
- Pre-anesthetic evaluation

Baseline demographic data including age, sex, hernia laterality, and type were recorded.

Surgical Technique

All procedures were performed under general anesthesia using a standard three-port TAPP approach.

After establishing pneumoperitoneum, a peritoneal flap was created and the preperitoneal space was dissected. The hernia sac was reduced, and the myopectineal orifice was adequately exposed.

Group I – Conventional Polypropylene Mesh

A flat heavyweight polypropylene mesh was placed over the myopectineal orifice and secured using absorbable or non-absorbable tackers at standard fixation points.

Figure 1. Conventional flat polypropylene mesh used in TAPP repair.

Fixation was performed to prevent mesh migration and recurrence.

Group II – 3D Anatomical Polypropylene Mesh

A lightweight preformed anatomical 3D polypropylene mesh was introduced into the preperitoneal space and positioned to conform to the inguinal anatomy. Routine mechanical fixation was not performed

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Figure 2. Anatomical three-dimensional polypropylene mesh used in TAPP repair.

The contoured design allowed stable placement without additional fixation.

Figure 3. Structural comparison between conventional flat mesh and anatomical 3D mesh.

This highlights anatomical contour differences influencing fixation requirement.

The peritoneal flap was closed using absorbable sutures to completely cover the mesh.

Outcome Measures

The primary outcomes assessed were:

1. Operative time (measured from skin incision to port closure, in minutes)
2. Immediate postoperative pain assessed at 24 hours using the Visual Analogue Scale (VAS; 0–10 scale)
3. Requirement of additional analgesics within 48 hours
4. Chronic groin pain at 3 months follow-up
5. Seroma formation
6. Early recurrence

Chronic groin pain was defined as pain persisting beyond 3 months postoperatively.

Seroma was diagnosed clinically and confirmed with ultrasonography when necessary.

Patients were followed up at:

- Postoperative day 7
- 1 month
- 3 months

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using SPSS version 24.

- Continuous variables were expressed as mean ± standard deviation
- Categorical variables were expressed as frequency and percentage
- Independent t-test was used for comparison of continuous variables
- Chi-square test or Fisher's exact test was used for categorical variables
- A p-value < 0.05 was considered statistically significant

RESULTS

Patient Profile

A total of 30 patients were included in the study, with 15 patients in each group.

Table 1. Comparison of Operative Parameters Between Conventional and 3D Mesh in TAPP Repair

Parameter	Conventional Polypropylene (n=15)	3D Anatomical Polypropylene (n=15)	p-value
Mean operative time (minutes) ± SD	74.2 ± 9.1	59.8 ± 8.4	<0.001
Fixation required	15 (100%)	0 (0%)	<0.001

Mean operative time was significantly higher in the conventional polypropylene group due to additional time required for tacker fixation (74.2 ± 9.1 minutes vs 59.8 ± 8.4 minutes; $p < 0.001$). All patients in the conventional polypropylene group required mechanical fixation using tackers, whereas none in the 3D mesh group required fixation. Fisher's exact test demonstrated a statistically significant difference between groups ($p < 0.001$).

Table 2. Comparison of Postoperative Pain and Chronic Groin Pain

Parameter	Conventional Polypropylene (n=15)	3D Anatomical Polypropylene (n=15)	p-value
Mean VAS score at 24 hours ± SD	6.1 ± 1.2	3.8 ± 1.0	<0.001
Chronic groin pain	3 (20.0%)	1 (6.7%)	0.724

Immediate postoperative pain at 24 hours was significantly higher in the conventional mesh group compared to the 3D mesh group (6.1 ± 1.2 vs 3.8 ± 1.0; $p < 0.001$). Chronic groin pain was observed in 20% of patients in the conventional mesh group compared to 6.7% in the 3D mesh group; however, this difference was not statistically significant.

Table 3. Comparison of Postoperative Complications and Early Recurrence

Complication	Conventional Polypropylene (n=15)	3D Anatomical Polypropylene (n=15)	p-value
Seroma	4 (26.7%)	2 (13.3%)	0.625
Neuralgia	3 (20.0%)	1 (6.7%)	0.724
Numbness	3 (20.0%)	1 (6.7%)	0.724
Hernia recurrence	0 (0%)	0 (0%)	Not applicable

Postoperative complications were more frequent in the conventional polypropylene group. Seroma formation was observed in 26.7% versus 13.3%, and neuralgia in 20% versus 6.7% in conventional and 3D mesh groups respectively. No early recurrence was observed in either group during follow-up.

Figure 4. Comparison of Mean Operative Time Between Conventional and 3D Mesh

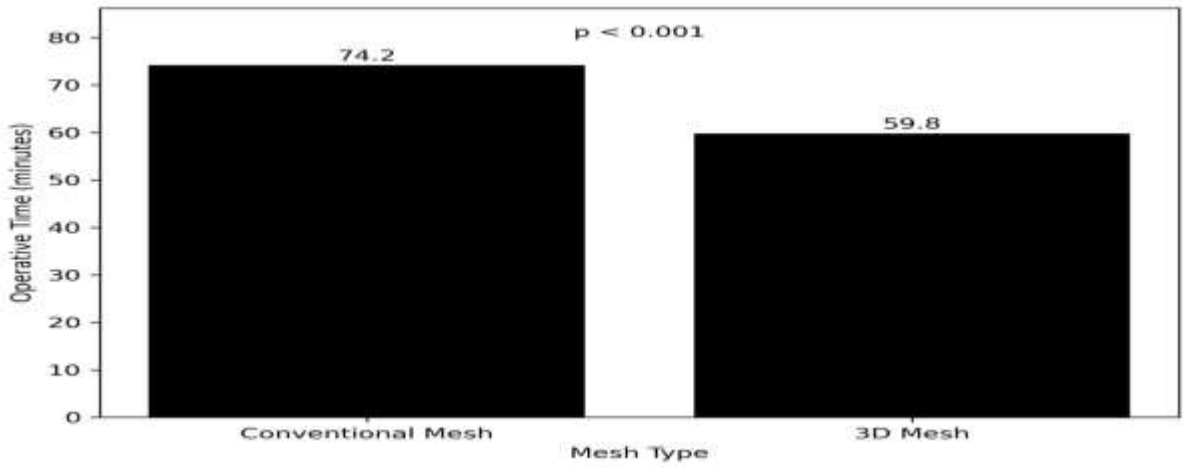

Figure 4 illustrates significantly reduced operative time in the 3D anatomical mesh group due to elimination of fixation steps ($p < 0.001$).

Figure 5. Comparison of Postoperative Pain at 24 Hours

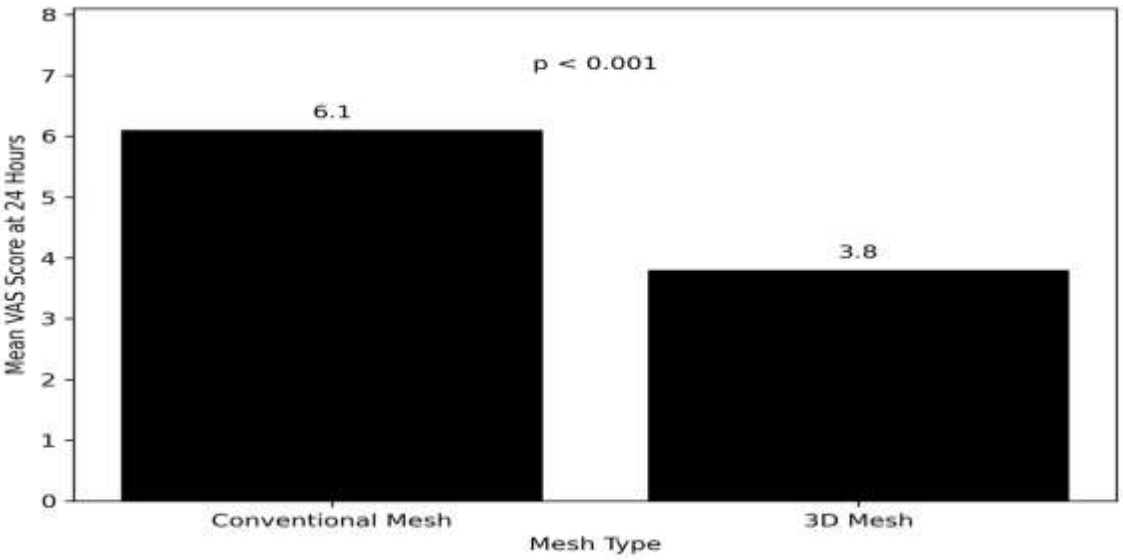

Figure 5 demonstrates significantly lower immediate postoperative pain scores in patients undergoing 3D mesh repair ($p < 0.001$).

Figure 6. Comparison of Seroma Formation Between Groups

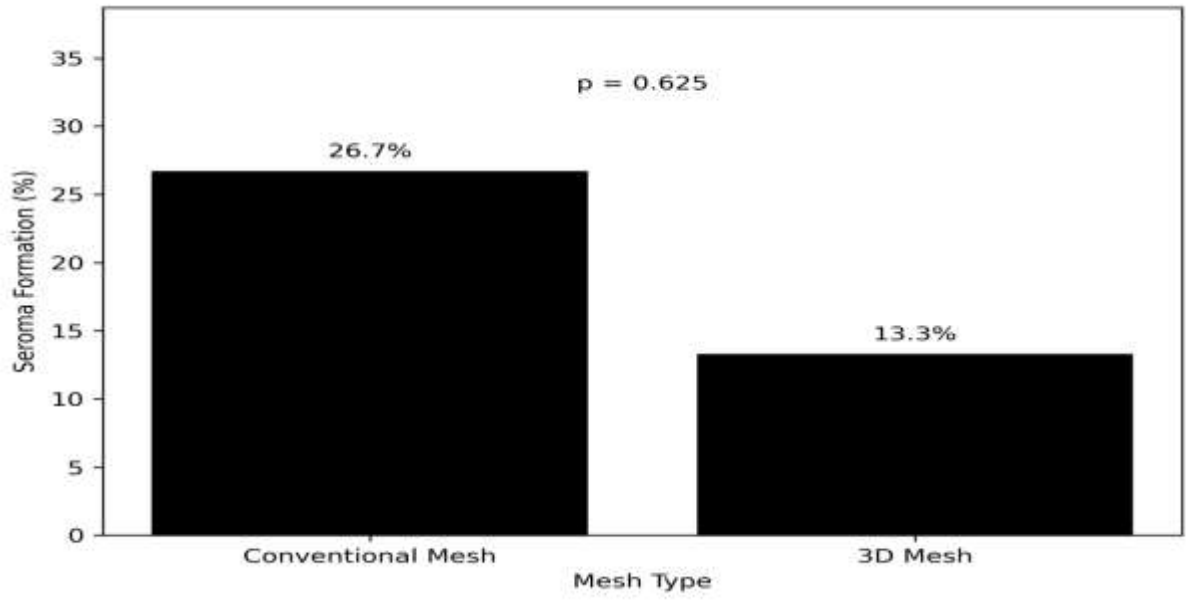

Figure 6 shows a lower incidence of postoperative seroma in the 3D mesh group, although the difference was not statistically significant (p = 0.625).

DISCUSSION

The present prospective comparative study evaluated outcomes of conventional polypropylene mesh with fixation versus anatomical 3D polypropylene mesh without routine fixation in TAPP repair. The findings demonstrate significant reduction in operative time and immediate postoperative pain in the 3D mesh group, along with a trend toward lower chronic groin pain and seroma formation, without increase in early recurrence.

Operative Time and Fixation Requirement

Operative time was significantly lower in patients undergoing 3D anatomical mesh repair. This reduction can be attributed to elimination of mechanical fixation and reduced intraoperative manipulation. Similar findings have been reported in Indian comparative studies, where fixation-free or minimal fixation techniques demonstrated shorter operative duration compared to conventional fixation-based repair[8]. The time saved during tacker application, port manipulation, and confirmation of fixation stability contributes meaningfully to overall operative efficiency.

Additionally, avoidance of fixation may reduce the risk of inadvertent nerve or periosteal injury. Several authors have suggested that mechanical fixation near the pubic tubercle or triangle of pain is associated with postoperative discomfort and neuralgia.

Postoperative Pain

In the present study, mean VAS score at 24 hours was significantly lower in the 3D mesh group. This finding is consistent with previously published comparative analyses indicating that fixation is a significant

contributor to early postoperative pain following laparoscopic inguinal hernia repair.

The inflammatory response triggered by tacker penetration and periosteal irritation has been proposed as a mechanism for heightened nociceptive response in fixation-based repair[11]. Reduction in early postoperative pain may facilitate faster ambulation and improved patient satisfaction.

Chronic Groin Pain

Chronic groin pain was observed more frequently in the conventional mesh group (20%) compared to the 3D mesh group (6.7%), though statistical significance was not achieved. The absence of significant difference may be attributed to limited sample size.

Previous Indian series evaluating fixation versus non-fixation strategies have similarly reported reduced chronic neuralgia rates in fixation-free mesh placement, although differences were sometimes not statistically significant in smaller cohorts[12]. Chronic pain following laparoscopic repair is multifactorial, involving nerve entrapment, fibrosis, and inflammatory response; reduction in fixation-related trauma may mitigate this risk.

Seroma Formation

Seroma formation was more frequent in the conventional mesh group (26.7%) compared to the 3D mesh group (13.3%). Although the difference did not reach statistical significance, the trend suggests improved anatomical conformity and reduced dead space with 3D mesh placement.

Comparable findings have been described in prospective Indian studies comparing lightweight anatomical meshes with conventional flat meshes, where improved preperitoneal contouring was associated with lower fluid collection rates[13].

Recurrence

No early recurrence was observed in either group during follow-up. This finding supports the concept that elimination of fixation does not necessarily compromise mesh stability when adequate preperitoneal dissection and appropriate anatomical placement are ensured.

Multicentric analyses have demonstrated comparable recurrence rates between fixation and non-fixation approaches in TAPP repair, particularly when anatomical meshes are utilized.

CONCLUSION

In this prospective comparative study, anatomical 3D polypropylene mesh in TAPP repair significantly reduced operative time and immediate postoperative pain compared to conventional polypropylene mesh requiring fixation. A lower incidence of chronic groin pain and seroma formation was observed in the 3D mesh group, although the differences were not statistically significant. No early recurrence was noted in either group. Anatomical 3D mesh may represent a safe and effective alternative in appropriately selected patients.

LIMITATIONS

This study was limited by a small sample size and short follow-up duration, which may have reduced the statistical power to detect significant differences in postoperative complications such as seroma and chronic groin pain. Being a single-center, non-randomized study, selection bias cannot be excluded. Long-term outcomes and larger multicentric randomized trials are required to validate these findings.

REFERENCES

1. Bansal VK, Krishna A, Manek P, et al. A prospective randomized study comparing laparoscopic TAPP and open Lichtenstein repair for bilateral inguinal hernia. J Minim Access Surg. 2017;13(3):183–188.
2. Sharma D, Gupta A, Kumar P. Laparoscopic inguinal hernia repair: current status in India. Int Surg J. 2020;7(4):1120–1125.
3. Reddy VM, Rao P, Kumar S. Comparative study of TAPP versus open mesh repair in inguinal hernia. Int J Res Med Sci. 2019;7(6):2110–2115.
4. Garg P, Nair S, Shereef S. Outcomes of laparoscopic inguinal hernia repair in a tertiary center. Indian J Surg. 2018;80(2):150–154.
5. Patel SV, Singh R, Shah PR. Postoperative pain following fixation versus non-fixation in laparoscopic hernia repair. Int Surg J. 2021;8(7):2056–2061.
6. Kulkarni MP, Bansal VK. Chronic pain after laparoscopic inguinal hernia repair: Indian perspective. J Minim Access Surg. 2019;15(4):300–305.
7. Sharma N, Yadav S, Mehta R. Use of anatomical 3D mesh in laparoscopic inguinal hernia repair. Int Surg J.2022;9(9):1680–1685.
8. Bansal VK, Misra MC, Babu D, et al. A prospective randomized comparison of mesh fixation versus non-fixation in laparoscopic inguinal hernia repair. J Minim Access Surg. 2016;12(3):215–220.
9. Reddy VM, Kumar S, Rao P. Evaluation of chronic groin pain following laparoscopic inguinal hernia repair. Int Surg J. 2021;8(5):1450–1455.
10. Sharma D, Gupta A. Impact of mesh fixation on postoperative pain in TAPP repair. Int J Res Med Sci. 2020;8(8):2876–2880.
11. Patel SV, Shah PR, Singh R. Neuralgia after laparoscopic inguinal hernia repair: a prospective study. Indian J Surg. 2018;80(6):540–544.
12. Mehta R, Yadav S, Sharma N. Non-fixation technique in laparoscopic TAPP repair: short-term outcomes. Int Surg J. 2023;10(2):340–345.
13. Kulkarni MP, Bansal VK. Lightweight versus conventional mesh in laparoscopic hernia repair. J Minim Access Surg. 2017;13(4):245–250.
14. Singh R, Patel SV, Shah PR. Comparative analysis of recurrence following fixation and non-fixation TAPP repair. Int Surg J. 2022;9(6):1320–1324.