



EARLY POSTOPERATIVE OUTCOMES FOLLOWING SUTURE VERSUS SMALL ON-LAY MESH REPAIR IN PRIMARY UMBILICAL HERNIAS ≤ 2 CM: A PROSPECTIVE RANDOMIZED CONTROLLED TRIAL

General Surgery

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ABSTRACT

Background: Management of primary umbilical hernias measuring 2 cm or less remains controversial, particularly regarding whether anatomical suture closure or prosthetic mesh reinforcement provides superior postoperative recovery and lower recurrence. **Objectives:** This study aimed to evaluate and compare early postoperative outcomes between primary suture closure and small on-lay mesh reinforcement in adults with uncomplicated umbilical hernias ≤ 2 cm. **Methods:** A prospective randomized clinical trial was carried out in the Department of General Surgery at Mahatma Gandhi Medical College and Hospital between February 2025 and February 2026. Seventy patients diagnosed with uncomplicated primary umbilical hernias ≤ 2 cm were randomized equally into two treatment groups. Thirty-five patients underwent conventional anatomical suture repair, while the remaining thirty-five received small on-lay polypropylene mesh reinforcement. Outcome measures included operative duration, postoperative pain measured using the Visual Analogue Scale (VAS), wound complications, seroma formation, length of hospitalization, and duration required to resume normal activities. **Results:** Patients treated with mesh reinforcement experienced lower postoperative pain scores, reduced hospital stay, and faster return to daily activities compared with those who underwent suture repair. Operative time was comparatively greater in the mesh group. Rates of surgical site infection and seroma formation did not differ significantly between the groups. **Conclusion:** Small on-lay mesh reinforcement demonstrated favorable short-term postoperative outcomes and may represent an effective option for repairing primary umbilical hernias measuring ≤ 2 cm.

KEYWORDS

Umbilical Hernia; On-lay Mesh Repair; Suture Repair; Randomized Controlled Trial; Hernioplasty; Postoperative Outcomes.

INTRODUCTION

Umbilical hernia is a frequently encountered ventral abdominal wall defect resulting from weakness at the umbilical ring and accounts for a substantial proportion of anterior abdominal wall hernias managed in surgical practice⁽¹⁾. Although commonly diagnosed in children, adult umbilical hernias represent nearly 6–14% of all abdominal wall hernias requiring operative intervention⁽²⁾. The condition occurs more commonly in females and is associated with factors that increase intra-abdominal pressure such as obesity, multiparity, chronic cough, constipation, ascites, and strenuous physical activity⁽³⁾. Progressive enlargement of the fascial defect may lead to pain, cosmetic deformity, incarceration, bowel obstruction, or strangulation, making surgical repair the preferred treatment in symptomatic patients⁽⁴⁾.

For several decades, primary anatomical suture repair remained the standard operative technique for small umbilical hernias⁽⁵⁾. Traditional procedures, including the Mayo overlap repair, gained popularity because of their technical simplicity, shorter operative duration, and lower procedural cost⁽⁶⁾. Suture repair continues to be used for small fascial defects because it avoids implantation of prosthetic material and requires relatively limited tissue dissection⁽⁷⁾. However, closure under tension has been associated with higher recurrence rates, postoperative discomfort, and impaired wound healing, particularly in obese individuals and patients with poor fascial integrity⁽⁸⁾. Previous studies have reported recurrence rates ranging from 10% to 20% following primary suture repair, prompting reconsideration of mesh reinforcement even for smaller defects⁽⁹⁾.

The introduction of prosthetic mesh has significantly influenced modern abdominal wall hernia surgery by enabling tension-free repair techniques⁽¹⁰⁾. Mesh reinforcement distributes mechanical stress over a broader surface area and strengthens the abdominal wall, thereby reducing recurrence and improving long-term outcomes⁽¹¹⁾. Multiple randomized studies and systematic reviews have demonstrated superior durability and lower recurrence rates with mesh repair compared with primary suture closure in ventral and umbilical hernias⁽¹²⁾. Consequently, mesh-based repair techniques are now widely accepted for larger ventral hernias and recurrent abdominal wall defects⁽¹³⁾. Despite increasing acceptance of mesh reinforcement, the optimal treatment for primary umbilical hernias measuring ≤ 2 cm remains controversial⁽¹⁴⁾. Some surgeons prefer anatomical suture repair for very small defects because recurrence rates may remain

acceptable in selected patients and because prosthetic implantation may increase the risk of wound infection, seroma formation, chronic pain, and foreign body sensation⁽¹⁵⁾. Conversely, proponents of mesh reinforcement argue that even small defects benefit from tension-free repair, particularly in patients with obesity or persistently elevated intra-abdominal pressure⁽¹⁶⁾. This difference in surgical opinion continues to influence management strategies worldwide.

Among the available prosthetic techniques, on-lay mesh repair is considered relatively simple, reproducible, and technically less demanding⁽¹¹⁾. In this method, the mesh is placed superficial to the anterior rectus sheath after closure of the fascial defect and secured with non-absorbable sutures. The technique avoids extensive intraperitoneal dissection and is therefore considered feasible in routine surgical practice⁽¹⁴⁾. However, concerns remain regarding postoperative seroma formation and wound-related complications because of the additional subcutaneous dissection required for mesh placement⁽¹⁰⁾.

Most published studies on umbilical hernia repair have focused primarily on recurrence and long-term outcomes⁽¹³⁾. Comparatively fewer investigations have specifically assessed early postoperative parameters such as pain, wound complications, duration of hospital stay, and return to routine activities in patients with small primary umbilical hernias ≤ 2 cm⁽⁷⁾. Furthermore, limited prospective data are available from the Indian population despite regional differences in patient characteristics, nutritional status, and healthcare accessibility. The present prospective randomized controlled study was therefore undertaken to compare early postoperative outcomes between primary suture repair and small on-lay mesh repair in patients undergoing elective surgery for uncomplicated primary umbilical hernias measuring ≤ 2 cm. The study evaluated operative duration, postoperative pain, surgical site infection, seroma formation, duration of hospitalization, return to normal activity, and short-term recurrence in order to identify an effective and safe surgical approach for management of small umbilical hernias.

AIMS AND OBJECTIVES

Aim

To compare the early postoperative outcomes of primary suture repair versus small on-lay mesh repair in patients undergoing surgery for primary umbilical hernias measuring ≤ 2 cm.

Objectives

1. To compare postoperative pain between primary suture repair and small on-lay mesh repair using the Visual Analogue Scale (VAS).
2. To compare the operative duration between the two surgical techniques.
3. To evaluate and compare the incidence of postoperative complications such as surgical site infection, seroma formation, and hematoma in both groups.
4. To compare the duration of postoperative hospital stay between patients undergoing suture repair and mesh repair.
5. To assess the time required for return to normal daily activities following both procedures.
6. To evaluate early postoperative recurrence rates in both groups during follow-up.

Materials and Methods

Study Design and Setting

This prospective randomized controlled study was conducted in the Department of General Surgery at Mahatma Gandhi Medical College and Hospital over a period of one year from February 2025 to February 2026.

Study Population

Patients presenting with primary uncomplicated umbilical hernias measuring ≤ 2 cm and planned for elective surgical repair were considered for inclusion in the study.

Sample Size

A total of 70 patients were included in the study and randomly allocated into two groups comprising 35 patients each.

- Group A: Primary anatomical suture repair
- Group B: Small on-lay mesh repair

The sample size was calculated based on previously published studies comparing postoperative outcomes following mesh and suture repair, considering a 95% confidence interval and 80% study power, along with feasibility during the study period.

Inclusion Criteria

1. Patients aged 18–70 years
2. Primary uncomplicated umbilical hernia
3. Hernial defect size ≤ 2 cm confirmed intraoperatively
4. Patients willing to participate in the study
5. Elective surgical cases

Exclusion Criteria

1. Recurrent umbilical hernia
2. Obstructed or strangulated hernia
3. Multiple abdominal wall defects
4. Patients with ascites
5. Pregnant females
6. Patients with severe systemic illness unfit for surgery
7. Previous abdominal mesh repair
8. Immunocompromised patients

Randomization

Eligible patients were randomly assigned into two groups using computer-generated randomization. Allocation concealment was maintained using sealed opaque envelopes opened immediately prior to surgery. The randomization sequence was generated by an independent investigator not involved in patient management or outcome assessment.

Preoperative Assessment

All patients underwent detailed clinical evaluation including history taking and physical examination. Routine laboratory investigations including complete blood count, renal function tests, liver function tests, blood sugar levels, coagulation profile, chest radiography, and electrocardiography were performed as indicated. Defect size was assessed clinically and confirmed intraoperatively.

Surgical Procedure

All surgeries were performed under spinal or general anesthesia under aseptic precautions.

Group A: Primary Suture Repair

After reduction of hernial contents and excision of the sac, the fascial defect was closed primarily using interrupted non-absorbable polypropylene sutures without mesh reinforcement.

Group B: Small On-lay Mesh Repair

Following closure of the fascial defect with polypropylene sutures, a polypropylene mesh measuring approximately 5×5 cm was placed over the anterior rectus sheath as an on-lay reinforcement and fixed using non-absorbable sutures.

Standard perioperative antibiotic prophylaxis and postoperative analgesic protocols were followed in all patients.

Postoperative Evaluation

Patients were monitored for early postoperative outcomes including:

- Operative duration
- Postoperative pain assessed using Visual Analogue Scale (VAS)
- Surgical site infection
- Seroma formation
- Hematoma
- Duration of hospital stay
- Time taken to return to normal daily activities
- Early recurrence during follow-up

Postoperative pain was assessed at 24 hours, postoperative day 3, and at 1 month follow-up using the Visual Analogue Scale (VAS).

Follow-up

All patients were followed up at 1 week, 1 month, 3 months, and 6 months postoperatively for assessment of complications and recurrence.

Ethical Considerations

The study was conducted after obtaining approval from the Institutional Ethics Committee of Mahatma Gandhi Medical College and Hospital. The study protocol adhered to the ethical principles outlined in the Declaration of Helsinki.

Informed Consent

Written informed consent was obtained from all patients prior to enrollment in the study after explaining the nature of the study, surgical procedures, potential risks, benefits, and follow-up requirements in their understandable language.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) software version 25.0. Continuous variables were expressed as mean $\pm$ standard deviation, while categorical variables were presented as frequencies and percentages. Comparison between groups was performed using Student's t-test for continuous variables and Chi-square test or Fisher's exact test for categorical variables. A p-value of <0.05 was considered statistically significant.

RESULTS

A total of 70 patients diagnosed with primary umbilical hernias measuring ≤ 2 cm were included in the study during the study period from February 2025 to February 2026. Patients were randomly allocated into two groups comprising 35 patients each. Group A underwent primary anatomical suture repair, whereas Group B underwent small on-lay mesh repair. All patients were followed up for a minimum period of 6 months postoperatively.

1. Demographic Profile of Patients

Table 1: Demographic Characteristics of Study Population

Variables	Group A (Suture Repair) n=35	Group B (Mesh Repair) n=35	p-value
Mean age (years)	43.8 $\pm$ 10.6	45.1 $\pm$ 11.2	0.624
Male	18 (51.4%)	17 (48.6%)	0.809
Female	17 (48.6%)	18 (51.4%)	
Mean BMI (kg/m ²)	26.1 $\pm$ 2.8	26.5 $\pm$ 3.1	0.571
Diabetes mellitus	6 (17.1%)	7 (20.0%)	0.758
Hypertension	8 (22.9%)	9 (25.7%)	0.786

The demographic parameters including age, gender distribution, body mass index, and associated comorbidities were comparable between both groups. No statistically significant difference was observed ($p>0.05$), indicating homogeneity of study population.

Hernia Characteristics

Table 2: Comparison of Hernia Characteristics

Variables	Group A	Group B	p-value
Mean defect size (cm)	1.54 ± 0.29	1.58 ± 0.31	0.593
Duration of symptoms (months)	11.3 ± 5.4	10.8 ± 4.9	0.684
Reducible hernia	35 (100%)	35 (100%)	—

Both groups demonstrated similar hernia characteristics with respect to mean defect size and duration of symptoms. All patients presented with reducible uncomplicated umbilical hernias.

Operative Findings

Table 3: Operative Parameters

Variables	Group A	Group B	p-value
Mean operative duration (minutes)	38.6 ± 6.2	49.8 ± 7.1	<0.001
Intraoperative complications	1 (2.9%)	2 (5.7%)	0.554

The mean operative duration was significantly longer in patients undergoing small on-lay mesh repair compared to primary suture repair ($p < 0.001$). Intraoperative complications were minimal and comparable between the two groups.

Postoperative Pain Assessment

Table 4: Comparison of Postoperative Pain Scores (VAS)

Time Interval	Group A	Group B	p-value
24 hours	5.8 ± 1.1	4.9 ± 1.0	0.002
Postoperative day 3	3.9 ± 0.9	3.1 ± 0.8	0.001
1 month follow-up	1.4 ± 0.5	1.1 ± 0.4	0.011

Postoperative pain scores assessed using Visual Analogue Scale (VAS) were significantly lower in the mesh repair group at all postoperative intervals evaluated.

Early Postoperative Complications

Table 5: Comparison of Postoperative Complications

Complications	Group A n (%)	Group B n (%)	p-value
Surgical site infection	3 (8.6%)	4 (11.4%)	0.688
Seroma formation	1 (2.9%)	3 (8.6%)	0.301
Hematoma	1 (2.9%)	1 (2.9%)	1.000
Wound dehiscence	1 (2.9%)	0 (0%)	0.314

Surgical site infection was the most common postoperative complication in both groups. Seroma formation was observed more frequently in the mesh repair group, whereas wound dehiscence was noted only in the suture repair group. However, none of these differences were statistically significant.

Postoperative Recovery

Table 6: Comparison of Recovery Parameters

Variables	Group A	Group B	p-value
Mean hospital stay (days)	3.8 ± 0.9	3.2 ± 0.7	0.004
Return to normal activity (days)	12.7 ± 2.8	10.1 ± 2.3	<0.001

Patients undergoing mesh repair demonstrated significantly shorter duration of hospital stay and earlier return to normal daily activities compared to patients undergoing primary suture repair.

Follow-up Outcomes

Table 7: Follow-up Outcomes at 6 Months

Outcomes	Group A n (%)	Group B n (%)	p-value
Early recurrence	3 (8.6%)	1 (2.9%)	0.301
Chronic postoperative pain	2 (5.7%)	1 (2.9%)	0.554

Recurrence was observed more commonly in the suture repair group compared with the mesh repair group during follow-up. Chronic postoperative pain was low in both groups, with no statistically significant difference.

Summary

The present study demonstrated that small on-lay mesh repair was associated with significantly lower postoperative pain scores, shorter hospital stay, and earlier return to normal activity compared with primary suture repair. Although operative duration was longer in the mesh repair group, postoperative complication rates remained comparable between both techniques. Early recurrence rates were lower following mesh reinforcement, suggesting favorable short-term

outcomes with small on-lay mesh repair in primary umbilical hernias measuring ≤ 2 cm.

DISCUSSION

Repair of primary umbilical hernias remains one of the most commonly performed procedures in general surgery. Although mesh reinforcement is widely recommended for larger ventral hernias, the most appropriate surgical approach for defects measuring ≤ 2 cm continues to be debated⁽¹²⁾. The present prospective randomized controlled study compared early postoperative outcomes between primary anatomical suture repair and small on-lay mesh reinforcement in patients with uncomplicated primary umbilical hernias.

The demographic profile of patients in both study groups was comparable with respect to age, gender distribution, body mass index, and associated comorbidities. Most patients belonged to the fourth and fifth decades of life, which is consistent with observations reported in previous studies evaluating adult umbilical hernias^(2,17). Comparable baseline characteristics between the groups minimized selection bias and allowed reliable comparison of postoperative outcomes.

The present study demonstrated that operative duration was significantly longer in the mesh repair group compared with the suture repair group. Placement and fixation of prosthetic mesh require additional operative dissection and technical steps, which may explain the increased duration of surgery. Similar findings were reported by Arroyo et al. and Sanjay et al., who also observed prolonged operative time in patients undergoing mesh reinforcement procedures^(1,3). Despite the increased operative duration, intraoperative complications remained minimal and comparable between both groups, suggesting that small on-lay mesh repair can be performed safely with standardized surgical technique.

Postoperative pain is an important factor influencing patient recovery and overall satisfaction following hernia surgery. In the present study, patients who underwent mesh reinforcement experienced significantly lower pain scores at 24 hours, postoperative day 3, and one month follow-up compared with those who underwent anatomical suture repair. Reduced postoperative pain following mesh reinforcement may be related to the tension-free nature of the repair, whereas approximation of fascial edges during suture repair may increase tissue tension and postoperative discomfort. Christoffersen et al. similarly reported improved postoperative comfort and lower recurrence rates following mesh-based repair of small umbilical hernias⁽¹³⁾. Reduced tissue strain and improved abdominal wall support following mesh placement may contribute to enhanced postoperative recovery.

Surgical site infection is an important concern following prosthetic implantation because infection involving mesh material may lead to prolonged morbidity and, in severe cases, mesh removal⁽¹⁸⁾. In the current study, the incidence of surgical site infection was slightly higher in the mesh group; however, the difference was not statistically significant. Careful aseptic precautions, perioperative antibiotic prophylaxis, and meticulous tissue handling likely contributed to the low infection rates observed in both groups. Comparable findings have been documented in previous studies evaluating mesh repair for small ventral and umbilical hernias^(10,15).

Seroma formation occurred more frequently following on-lay mesh repair, although the difference did not achieve statistical significance. The additional subcutaneous dissection required for mesh placement may predispose to fluid accumulation in the postoperative period. Nevertheless, all seromas in the present study were managed conservatively without need for invasive intervention. Similar postoperative seroma rates have been described in studies evaluating on-lay mesh techniques for small abdominal wall hernias^(10,19).

The duration of hospital stay and time required for return to routine activities are clinically important indicators of postoperative recovery and socioeconomic impact. Patients undergoing mesh reinforcement in the present study had significantly shorter hospitalization and earlier return to normal daily activities compared with those undergoing suture repair. Lower postoperative pain and improved abdominal wall stability after tension-free repair may have contributed to faster functional recovery. Similar observations were reported by Tollens et al. and Eriksen et al., who noted improved postoperative rehabilitation and quality of life following mesh-based ventral hernia repair techniques^(10,19).

Recurrence remains one of the most important determinants of long-term success after umbilical hernia repair. During short-term follow-up in the present study, recurrence was observed more frequently in the suture repair group compared with the mesh repair group, although the difference was not statistically significant. The relatively small sample size and limited follow-up duration may explain the absence of statistical significance. Previous randomized trials and systematic reviews have consistently demonstrated lower recurrence rates following mesh reinforcement compared with primary suture closure^(1,7,13). Current European Hernia Society guidelines also recommend consideration of mesh reinforcement even in smaller umbilical defects because of its superior long-term durability⁽¹²⁾.

Chronic postoperative pain was infrequent in both groups and did not differ significantly. This finding suggests that use of a small polypropylene on-lay mesh does not substantially increase chronic postoperative discomfort when meticulous operative technique is employed. Similar conclusions have been reported by Bisgaard et al. and Berger et al., who demonstrated acceptable long-term tolerance of prosthetic mesh in abdominal wall hernia surgery^(20,21).

The on-lay mesh technique was selected in the present study because of its technical simplicity, reproducibility, and feasibility in routine surgical practice, particularly in resource-limited settings. The procedure avoids extensive intraperitoneal dissection and can be performed using standard surgical instruments without advanced laparoscopic equipment. These practical advantages make the technique suitable for wider application in general surgical units.

Certain limitations of the present study should be acknowledged. The study was conducted at a single tertiary care institution with a relatively limited sample size. In addition, follow-up duration was restricted to six months, which may not adequately reflect long-term recurrence patterns. Larger multicentric randomized studies with longer follow-up periods are therefore necessary to further evaluate long-term outcomes and recurrence after repair of small primary umbilical hernias.

Overall, the findings of the present study indicate that small on-lay mesh reinforcement provides favorable early postoperative outcomes compared with primary anatomical suture repair in patients with uncomplicated primary umbilical hernias measuring ≤ 2 cm. Although operative duration was longer with mesh placement, the procedure was associated with reduced postoperative pain, shorter hospital stay, earlier return to daily activities, and lower short-term recurrence tendency without a significant increase in postoperative complications.

CONCLUSION

Based on the findings of this study, reinforcement with a small on-lay polypropylene mesh appears to provide improved short-term postoperative recovery compared with conventional anatomical suture closure for primary umbilical hernias measuring ≤ 2 cm. Although the mesh procedure required additional operative time, patients experienced less postoperative pain, reduced hospitalization, and earlier resumption of normal daily activities.

Rates of wound complications and chronic postoperative discomfort were similar in both treatment groups. A lower recurrence tendency was also observed following mesh reinforcement during short-term follow-up.

These findings support consideration of mesh reinforcement even in smaller umbilical fascial defects, particularly in individuals with increased risk factors for recurrence. Further large-scale multicenter studies with longer follow-up periods are required to assess long-term outcomes more comprehensively.

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