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A Comparative Study of Mesh Repair Versus Mayo's Repair in Umbilical and Paraumbilical Hernias

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ABSTRACT

Background: Umbilical and paraumbilical hernias are among the most frequently encountered ventral abdominal wall hernias in adults. Traditionally, Mayo's anatomical repair has been widely used for their management; however, the relatively high recurrence rates associated with tissue-based repairs have led to increasing adoption of prosthetic mesh reinforcement. Despite widespread use of mesh repair, concerns regarding postoperative complications and morbidity continue to exist. The present study was undertaken to compare the efficacy and postoperative outcomes of mesh repair and Mayo's repair in patients with umbilical and paraumbilical hernias.

Aim: To assess the efficacy of mesh repair in comparison with Mayo's repair and to analyze the morbidity associated with both procedures.

Methods: A randomized controlled trial was conducted in the Department of General Surgery, Sri Venkateswara Ramnarain Ruia Government General Hospital (SVRRGGH), Tirupati, over a period of one year following approval from the Institutional Ethics Committee. Sixty patients diagnosed with umbilical or paraumbilical hernias with defect sizes less than 2 cm were enrolled and randomized equally into two groups: Mesh Repair (n=30) and Mayo's Repair (n=30). Detailed clinical evaluation, assessment of comorbidities, routine laboratory investigations, and ultrasonographic confirmation were performed in all patients. Postoperative complications and recurrence rates were assessed and compared between the two groups during follow-up.

Results: Paraumbilical hernia was the predominant hernia type, accounting for 60.0% of all cases. Diabetes mellitus was the most common associated comorbidity (30.0%), followed by chronic bronchitis/COPD (25.0%), hypertension (16.7%), and benign prostatic hyperplasia (13.3%). Postoperative pain was the most frequently encountered complication, accounting for 53.8% of all recorded postoperative complications, followed by wound infection (38.5%). Recurrence was observed in only one patient (1.7%), who underwent Mayo's Repair, whereas no recurrence occurred following Mesh Repair. Although recurrence occurred exclusively in the Mayo's Repair group, the difference between the two techniques did not reach statistical significance. Overall, postoperative complications and recurrence rates were comparable between the study groups.

Conclusion: Both Mesh Repair and Mayo's Repair produced satisfactory outcomes in the management of umbilical and paraumbilical hernias. Postoperative morbidity was low and comparable between the two procedures. Although recurrence occurred only in the Mayo's Repair group, the difference between the two techniques was not statistically significant. Nevertheless, Mesh Repair demonstrated a numerically lower recurrence rate and may offer improved

long-term durability. Therefore, Mesh Repair remains an effective and reliable option for the elective repair of small umbilical and paraumbilical hernias.

Keywords: *Umbilical hernia; Paraumbilical hernia; Mesh repair; Mayo's repair; Recurrence.*

INTRODUCTION

Umbilical and paraumbilical hernias constitute two of the most frequently encountered primary ventral hernias in adult surgical practice. Although inguinal hernias have historically received greater attention owing to their higher incidence, umbilical and paraumbilical hernias continue to represent a substantial proportion of abdominal wall defects requiring operative intervention. An umbilical hernia is defined as the protrusion of intra-abdominal contents through a defect in the umbilical ring, whereas a paraumbilical hernia arises through the linea alba immediately adjacent to the umbilicus. These defects may contain preperitoneal fat, omentum, bowel loops, or a combination of abdominal viscera and can present with a wide spectrum of clinical manifestations ranging from asymptomatic swelling to bowel obstruction and strangulation.[1–3]

Contrary to the common misconception that adult umbilical hernias merely represent persistence of congenital defects, nearly 90% of adult umbilical hernias are acquired conditions. The pathogenesis is multifactorial and involves progressive weakening of the abdominal wall in the presence of increased intra-abdominal pressure. Several predisposing factors have been implicated, including obesity, chronic obstructive pulmonary disease, chronic cough, bronchial asthma, prostatic enlargement, abdominal distension, pregnancy, advanced age, steroid use, and occupations involving repetitive heavy lifting. These factors contribute to progressive stretching and weakening of the umbilical fascial tissues, ultimately resulting in herniation.[4–6]

Paraumbilical hernias are particularly common in adults and exhibit a marked female predominance, with reported female-to-male ratios approaching 3:1. They most frequently occur above the umbilicus and tend to enlarge progressively over time. While many patients remain asymptomatic for prolonged periods, increasing hernia size is often accompanied by discomfort, pain, cosmetic concerns, and a risk of incarceration or strangulation. Because the hernia sac frequently contains omentum, symptoms may initially remain mild; however, involvement of small bowel or colon may result in acute surgical emergencies requiring urgent intervention.[7–9]

Historically, anatomical tissue repair, particularly Mayo's “vest-over-pants” repair, represented the standard surgical treatment for umbilical and paraumbilical hernias. Introduced by William J. Mayo in the early twentieth century, this technique involves overlapping fascial closure to reinforce the abdominal wall. Although technically straightforward and cost-effective, recurrence rates following Mayo's repair have been reported to range from 10% to 30%, especially in patients with obesity, chronic cough, large fascial defects, or poor tissue quality.[10–12] These limitations stimulated the development and adoption of prosthetic mesh reinforcement techniques.

The introduction of polypropylene mesh revolutionized abdominal wall reconstruction by providing a tension-free repair. Mesh repair distributes mechanical forces over a wider surface area, reduces tension at the suture line, and minimizes the risk of fascial failure. Numerous clinical studies have demonstrated reduced recurrence rates following mesh repair compared with conventional tissue repair. Consequently, mesh repair has become the preferred technique for many surgeons, particularly in patients considered to be at high risk of recurrence.[13–16]

Despite these advantages, the routine use of prosthetic mesh remains a matter of ongoing debate. While recurrence rates appear lower following mesh repair, concerns persist regarding mesh-related complications such as seroma formation, hematoma, chronic postoperative pain, wound infection, mesh infection, and foreign-body sensation. Furthermore, the increased operative complexity, cost, and longer operating times associated with mesh placement have led some surgeons to continue advocating tissue-based repairs for smaller defects.[17–20]

Given these ongoing controversies, it remains important to evaluate the relative benefits and limitations of mesh repair and Mayo's repair within individual institutional settings. The present study was therefore undertaken to compare the efficacy, postoperative complications, and recurrence rates associated with mesh repair and Mayo's repair in patients presenting with umbilical and paraumbilical hernias at a tertiary care teaching hospital.

AIM AND OBJECTIVES

Aim

To assess the efficacy of mesh repair in comparison with Mayo's repair and to analyze the morbidity associated with both treatment modalities in patients with umbilical and paraumbilical hernias.

Objectives

1. To compare the results and suitability of anatomical repair (Mayo's repair) and mesh repair in our clinical setup.

2. To compare postoperative complications including pain, wound infection, seroma formation, and recurrence between the two procedures.
3. To evaluate the etiological factors, associated risk factors, comorbid conditions, and their influence on outcomes following Mayo's repair and mesh repair.

METHODOLOGY

This randomized controlled trial was conducted in the Department of General Surgery, Sri Venkateswara Ramnarain Ruia Government General Hospital (SVRRGGH), Tirupati, over a period of one year following approval from the Institutional Ethics Committee. The study included patients presenting to the surgical outpatient department with clinically suspected umbilical or paraumbilical hernias. Diagnosis was established through detailed clinical examination, including identification of a swelling at or adjacent to the umbilicus, pain associated with the swelling, and the presence of a positive cough impulse. Radiological confirmation was obtained using ultrasonography, which was also utilized to determine defect size and characterize the contents of the hernia sac.

Sample Size Calculation

Since the study compares two proportions (recurrence rates following Mesh Repair and Mayo's Repair), the sample size was calculated using the formula:

$$n = \frac{(Z_{\alpha/2} + Z_{\beta})^2 [P_1(1 - P_1) + P_2(1 - P_2)]}{(P_1 - P_2)^2}$$

Where:

- $P_1 = 11\%$recurrence after Mayo's repair (Arroyo et al.)[13]
- $P_2 = 1\%$recurrence after mesh repair
- $Z_{\alpha/2} = 1.96$
- $Z_{\beta} = 0.84$

The calculated sample size was approximately 27 patients per group. Considering feasibility and possible follow-up losses, 30 patients were included in each group, giving a total sample size of 60 patients.

All admitted patients underwent comprehensive preoperative evaluation. Detailed demographic and clinical information was recorded, including age, duration of symptoms, presenting complaints, body mass index, and associated medical conditions. Particular attention was given to identifying comorbid illnesses known to increase intra-abdominal pressure or impair wound healing, including diabetes mellitus, hypertension, benign prostatic hyperplasia, chronic bronchitis, and bronchial asthma. Routine laboratory investigations included complete blood count, liver function tests, renal function tests, fasting and postprandial blood glucose levels, electrocardiography, and chest radiography.

Patients aged between 30 and 60 years with umbilical or paraumbilical hernias measuring less than 2 cm in diameter and willing to provide informed consent were included in the study. Patients younger than 30 years or older than 60 years, as well as those with fascial defects greater than 2 cm, were excluded. A total of 60 eligible patients were enrolled and randomly allocated into two equal groups. Thirty patients underwent mesh repair, while the remaining thirty patients underwent Mayo's repair.

Randomization was performed using a computer-generated random allocation sequence. Eligible patients were assigned in a 1:1 ratio to either the Mesh Repair group or the Mayo's Repair group. Allocation was concealed using sealed opaque envelopes opened immediately before surgery.

Following thorough preoperative counseling, written informed consent was obtained from all participants. Patients were prepared for surgery according to institutional protocol, including administration of oral liquids on the day preceding surgery, overnight fasting, bowel preparation with soap water enema, and prophylactic antibiotic administration. All patients received intravenous ceftriaxone 1 g immediately before surgery.

Postoperatively, all patients received standardized care including intravenous ceftriaxone 1 g twice daily until the third postoperative day, followed by oral antibiotics. Routine wound care and dressing changes were performed after 48 hours. Patients were monitored for immediate postoperative complications including pain, wound infection, wound dehiscence, and other procedure-related adverse events. Long-term follow-up was continued for one year to assess recurrence and overall surgical outcomes. The findings obtained from both groups were recorded prospectively and subjected to statistical analysis to determine differences in efficacy and postoperative morbidity between mesh repair and Mayo's repair.

Patients were followed up at 1 month, 3 months, 6 months, and 12 months postoperatively. At each visit, patients were evaluated for wound complications, chronic pain, seroma formation, wound infection, and recurrence.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using appropriate statistical software. Continuous variables such as age, body mass index (BMI), and duration of hernia symptoms were expressed as mean ± standard deviation and compared between the two groups using the Student's t-test. Categorical variables including gender distribution, postoperative complications, and recurrence rates were compared using Fisher's Exact Test. Results were expressed as frequencies, percentages, means, and standard deviations wherever appropriate. A p-value of less than 0.05 was considered statistically significant.

RESULTS

A total of 60 patients with umbilical and paraumbilical hernias were included in the study and were randomly allocated into two equal groups comprising 30 patients each undergoing Mesh Repair and Mayo's Repair. The results were analyzed with respect to baseline demographic characteristics, associated comorbid conditions, postoperative complications, and recurrence rates in accordance with the objectives of the study.

Table 1. Baseline Demographic Characteristics of Study Participants

Variable	Mesh Repair (n=30)	Mayo's Repair (n=30)	Total (n=60)	p-value
Mean Age (years)	42.53 ± 14.81	39.70 ± 11.52	41.12 ± 13.23	0.70
Female	20 (66.7%)	22 (73.3%)	42 (70.0%)	0.80
Male	10 (33.3%)	8 (26.7%)	18 (30.0%)	
Mean BMI (kg/m²)	23.93 ± 3.47	23.17 ± 3.55	23.55 ± 3.51	0.20
Mean Duration of Hernia (months)	11.35 ± 8.08	10.03 ± 6.86	10.69 ± 7.46	0.20

Student's t-test was used for comparison of continuous variables, while Fisher's Exact Test was used for comparison of gender distribution. No statistically significant differences were observed between the two groups (p > 0.05).

The mean age of patients was 41.12 ± 13.23 years. Females constituted the majority of the study population (70.0%), while males accounted for 30.0%. The mean BMI was 23.55 ± 3.51 kg/m² and the mean duration of hernia symptoms was 10.69 ± 7.46 months. No statistically significant differences were observed between the Mesh Repair and Mayo's Repair groups regarding age, gender distribution, BMI, or duration of symptoms, indicating adequate baseline comparability between the two treatment groups.

Table 2. Distribution of Associated Comorbid Conditions

Comorbidity	Frequency (n)	Percentage (%)
Diabetes Mellitus	18	30.0
Chronic Bronchitis/COPD	15	25.0
Hypertension	10	16.7
Benign Prostatic Hyperplasia	8	13.3
Obesity (BMI >30 kg/m²)	4	6.7
No Comorbidity	17	28.3

Note: Individual patients may have had more than one comorbid condition; therefore, percentages may exceed 100%.
The above table illustrates that diabetes mellitus was the most common associated comorbidity, observed in 18 patients (30.0%), followed by chronic bronchitis/COPD in 15 patients (25.0%), hypertension in 10 patients (16.7%), and benign prostatic hyperplasia in 8 patients (13.3%). Obesity was present in 4 patients (6.7%), while 17 patients (28.3%) had no associated comorbidity.

Table 3: postoperative complication events

Complication	Mesh	Mayo	Total
Pain	2	5	7
Wound Infection	2	3	5
Wound Infection + Dehiscence	1	0	1

The above table illustrates that postoperative complications were infrequent in both study groups. A total of 13 postoperative complication events were recorded during the study period. Postoperative pain was the most common complication, occurring in 7 patients, including 2 patients in the Mesh Repair group and 5 patients in the Mayo's Repair group. Wound infection was observed in 5 patients, of whom 2 belonged to the Mesh Repair group and 3 to the Mayo's Repair group. Wound infection associated with wound dehiscence was recorded in only 1 patient, which occurred in the Mesh Repair group. No cases of seroma were observed in either the Mesh Repair group or the Mayo's Repair group during the study period. Overall, postoperative complications were low in both groups, with pain and wound infection representing the most frequently encountered adverse events following surgery. Fisher's Exact Test demonstrated no statistically

significant difference in the overall postoperative complication rates between the Mesh Repair and Mayo's Repair groups ($p > 0.05$).

Table 4. Recurrence Following Mesh Repair and Mayo's Repair

Recurrence	Mesh Repair (N)	Mesh Repair (%)	Mayo's Repair (N)	Mayo's Repair (%)	Total (N)	Total (%)
Nil	30	100.0	29	96.7	59	98.3
Recurrence	0	0.0	1	3.3	1	1.7
Total	30	100.0	30	100.0	60	100.0

Fisher's Exact Test, $p = 1.000$; Not Statistically Significant

The above table illustrates that recurrence was observed in only one patient (1.7%) during the follow-up period. No recurrence was recorded among patients who underwent Mesh Repair, whereas one patient (3.3%) in the Mayo's Repair group developed recurrence. Although recurrence occurred exclusively in the Mayo's Repair group, the difference between the two groups was not statistically significant ($p = 1.000$).

Summary of Findings

The present study demonstrated that paraumbilical hernia was the predominant hernia subtype, accounting for 60.0% of all cases. Females constituted the majority of the study population, and diabetes mellitus was the most common associated comorbidity. Recurrence was observed in only one patient from the Mayo's Repair group, whereas no recurrence occurred following Mesh Repair. Although recurrence occurred exclusively after Mayo's Repair, the difference was not statistically significant. Overall, both surgical techniques provided satisfactory outcomes with low recurrence rates.

DISCUSSION

Umbilical and paraumbilical hernias represent a significant proportion of ventral abdominal wall defects encountered in routine surgical practice. Despite advances in operative techniques and prosthetic materials, the optimal method of repair continues to be debated, particularly for small primary defects. The present randomized controlled study was undertaken to compare the outcomes of Mesh Repair and Mayo's Repair in patients with umbilical and paraumbilical hernias, with special emphasis on patient characteristics, associated comorbid conditions, postoperative morbidity, and recurrence.

The demographic profile of the present study demonstrated a mean patient age of 41.12 ± 13.23 years, indicating that umbilical and paraumbilical hernias predominantly affect individuals during the most productive decades of life. Furthermore, females constituted 70.0% of the study population, reflecting a clear female predominance. Similar demographic trends have been documented by Muschaweck, who observed that primary ventral hernias occur more frequently in women, particularly in association with pregnancy-related weakening of the abdominal wall and multiparity.[1] Mislowsky et al. also reported a higher prevalence among females and emphasized the contribution of repeated increases in intra-abdominal pressure to fascial attenuation and subsequent hernia formation.[2] Rutkow similarly noted that ventral hernias occur commonly among middle-aged adults and represent a substantial surgical burden worldwide.[3] The absence of statistically significant differences between the Mesh Repair and Mayo's Repair groups with respect to age, sex distribution, body mass index, and duration of symptoms confirms that both groups were well matched at baseline, thereby strengthening the validity of outcome comparisons.

Evaluation of associated comorbid conditions revealed that diabetes mellitus was the most frequently encountered comorbidity, affecting 30.0% of patients, followed by chronic bronchitis/COPD (25.0%), hypertension (16.7%), benign prostatic hyperplasia (13.3%), and obesity (6.7%). These findings underscore the multifactorial nature of ventral hernia development and support the established concept that conditions associated with impaired tissue healing and increased intra-abdominal pressure play an important role in hernia pathogenesis. Aslani and Brown, in their systematic review and meta-analysis, highlighted diabetes mellitus, obesity, and chronic pulmonary disease as major risk factors influencing both hernia formation and recurrence following repair.[4] Hyperglycemia-induced impairment of collagen synthesis and wound healing may contribute to fascial weakness, thereby predisposing affected individuals to abdominal wall defects.

Comparable observations were reported by Venclauskas et al., who identified chronic respiratory disorders and metabolic diseases as significant determinants of hernia recurrence and postoperative outcomes.[5] Repeated episodes of coughing increase intra-abdominal pressure and subject the fascial tissues to chronic mechanical stress, promoting progressive weakening of the abdominal wall. Kulah et al. similarly observed that patients with chronic pulmonary disease and associated comorbidities often present with larger or more symptomatic hernias requiring surgical intervention.[6] Rodriguez-Hermosa et al. further demonstrated that obesity and multiple medical comorbidities are frequently associated with complicated hernias and emergency surgical presentations.[7] Their findings suggest that optimization of coexisting medical conditions should form an integral component of preoperative evaluation. Likewise, Andrews reported that systemic illnesses significantly influence perioperative outcomes and may increase the risk of postoperative complications in abdominal wall surgery.[8] The findings of the present study therefore reinforce the importance of comprehensive preoperative assessment and optimization of associated medical disorders before elective hernia repair.

Postoperative morbidity remains an important consideration when selecting the most appropriate operative technique. Although the overall complication rate observed in the present study was low, postoperative pain represented the most common adverse event, followed by wound infection. Importantly, no statistically significant difference in complication rates was observed between Mesh Repair and Mayo's Repair. These findings suggest that both procedures are associated with acceptable postoperative morbidity when performed under standardized operative conditions and appropriate perioperative care.

Furthermore, no cases of seroma were encountered in either study group throughout the follow-up period. This observation suggests that both Mesh Repair and Mayo's Repair were associated with minimal wound-related morbidity when performed under standardized operative conditions and appropriate perioperative care. The absence of seroma formation in the present study compares favorably with previous reports in the literature, where low but variable rates of postoperative seroma have been documented following ventral hernia repair. The finding further supports the safety of both surgical techniques and indicates that meticulous operative technique, careful tissue handling, and adequate postoperative management may contribute substantially to reducing wound-related complications.

The present findings are consistent with those reported by Martinez-Serrano et al., who demonstrated that modern elective hernia repair is generally associated with low complication rates and favorable clinical outcomes.[9] Mayo originally described anatomical tissue repair as a simple and effective technique for the management of umbilical hernias; however, concerns regarding long-term durability subsequently prompted the development of prosthetic reinforcement strategies.[10] Luijendijk et al. reported that recurrence rather than immediate postoperative morbidity represents the principal limitation of tissue-based repair techniques.[11] Halm et al. similarly observed that postoperative complications were generally infrequent and comparable between repair methods, provided that meticulous surgical technique and appropriate patient selection were employed.[12]

Arroyo et al., in their randomized clinical trial comparing suture repair and mesh repair, reported that postoperative pain and wound-related complications occurred at comparable rates in both groups despite differences in recurrence.[13] Anthony et al. likewise identified wound infection and postoperative discomfort as the most common complications following abdominal wall reconstruction and emphasized the importance of surgical technique in minimizing morbidity.[14] Leber et al. demonstrated that prosthetic repair can be performed safely with a low incidence of mesh-related complications when modern materials and proper operative principles are utilized.[15] These observations support the findings of the present study and indicate that concerns regarding excessive morbidity associated with mesh implantation may be overstated when contemporary surgical practices are followed.

Recurrence remains the most important long-term outcome measure following hernia repair and serves as the principal determinant of procedural durability. In the present study, recurrence was observed in only one patient (1.7%), and this occurred exclusively in the Mayo's Repair group. No recurrence was documented following Mesh Repair during the follow-up period. Although the difference did not achieve statistical significance, the numerical advantage observed with Mesh Repair is clinically relevant and aligns with the broader body of published evidence.

Luijendijk et al. demonstrated that tissue-based repairs are associated with significantly higher recurrence rates than prosthetic reinforcement owing to the tension generated during fascial approximation.[11] Excessive tension compromises tissue integrity and predisposes to fascial failure over time. Halm et al. reported similar findings during long-term follow-up and concluded that mesh reinforcement provides superior structural support and significantly reduces the likelihood of recurrence.[12]

Strong support for mesh reinforcement was provided by Aslani and Brown, whose systematic review demonstrated consistently lower recurrence rates following mesh repair compared with conventional suture techniques across multiple studies.[4] Their analysis concluded that prosthetic reinforcement offers a durable and reliable method of repair without substantially increasing postoperative morbidity. Comparable conclusions were reached by Arroyo et al., who reported significantly fewer recurrences among patients undergoing mesh repair and advocated its routine use for adult umbilical and paraumbilical hernias.[13] The recurrence pattern observed in the present study closely mirrors these findings and further supports the growing preference for mesh-based repair strategies.

Overall, the findings of the present study demonstrate that both Mesh Repair and Mayo's Repair are safe and effective techniques for the management of umbilical and paraumbilical hernias. The study population exhibited demographic and clinical characteristics comparable to those reported in previous literature. Associated comorbid conditions were common and highlight the importance of comprehensive patient optimization before surgery. Postoperative morbidity was low and comparable between the two procedures. Most importantly, recurrence occurred only after Mayo's Repair, whereas no recurrence was observed following Mesh Repair. Although statistical significance was not achieved because of the limited sample size and low event rate, the observed trend favors prosthetic reinforcement and is consistent with contemporary

evidence supporting mesh-based repair as a durable and effective treatment option for primary umbilical and paraumbilical hernias.

CONCLUSION

Both Mesh Repair and Mayo's Repair provided satisfactory outcomes in the management of umbilical and paraumbilical hernias. Postoperative morbidity was low and comparable between the two techniques. Although recurrence occurred only in the Mayo's Repair group, the difference was not statistically significant. Mesh Repair demonstrated a numerically lower recurrence rate and may offer improved long-term durability; however, larger studies with extended follow-up are required to confirm this potential advantage.

LIMITATIONS

The present study was conducted at a single tertiary care center with a relatively small sample size of 60 patients. The follow-up period was limited to one year, which may not fully reflect long-term recurrence rates. Larger multicentric studies with extended follow-up are required to validate the findings and establish definitive recommendations regarding the optimal surgical technique. In addition, some comorbidity categories were recorded as combined variables in the original dataset, limiting independent evaluation of individual risk factors.

RECOMMENDATIONS

Mesh repair may be considered a valuable surgical option for adult umbilical and paraumbilical hernias because of its low recurrence rate and satisfactory postoperative outcomes observed in the present study. Careful preoperative assessment and optimization of associated comorbidities are essential for improving surgical results. Future multicenter randomized trials with larger sample sizes and longer follow-up periods are recommended to further strengthen the available evidence.

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