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Research Article

Study of Surgical Methods of Umbilical Hernia Repair in the Rural District of Chickballapur

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ABSTRACT
Background: Umbilical hernias are a frequent surgical issue, especially in rural areas. This study aims to assess the surgical techniques for umbilical hernia repair in the rural district of Chickballapur, Karnataka, India, and to compare the outcomes of open repair with primary sutures, open repair with mesh reinforcement, and laparoscopic repair.
Methods: This retrospective cohort study analyzed 100 adult patients who underwent surgery for symptomatic umbilical hernias at s 1 -District hospital and 4 taluk hospitals in Chickballapur from January 2019 -January 2024. Data on the type of surgery, postoperative complications, recovery times, recurrence rates, and functional recovery were collected. Statistical comparisons were made to evaluate the outcomes of different surgical approaches.
Results: A total of 100 patients were included in the study. Of these, 50% (n=50) underwent open repair with primary sutures, 30% (n=30) had open repair with mesh reinforcement, and 20% (n=20) received laparoscopic repair. Laparoscopic repair was associated with the lowest postoperative complication rate (3%), the shortest recovery time (mean 5 days), and the lowest hernia recurrence rate (2%). In comparison, open repair with mesh showed a recurrence rate of 6%, while primary suture repair had a higher recurrence rate of 10%. Socio-economic factors and resource availability influenced the choice of surgical method.
Conclusion: Despite the prevalence of open repair techniques in this rural setting, laparoscopic repair yielded the best outcomes in terms of complications, recovery time, and hernia recurrence. This suggests that laparoscopic repair could be a beneficial option for rural areas with the necessary surgical expertise and equipment. Further research is recommended to explore the broader applicability and cost-effectiveness of laparoscopic repair in low-resource environments.

Keywords: Umbilical Hernia, Surgical Methods, Open Repair, Laparoscopic Repair, Mesh Reinforcement, Primary Suture Repair, Rural Healthcare, Chickballapur, Postoperative Complications, Hernia Recurrence, Functional Recovery, Socio-Economic Factors.

INTRODUCTION

Umbilical hernia is one of the most common forms of hernias, characterized by the protrusion of abdominal contents, typically fat or intestine, through a defect in the abdominal wall at the site of the umbilicus [1]. It affects individuals across various age groups, with a higher incidence observed in neonates and adults, particularly in those with increased intra-abdominal pressure or predisposing conditions. In neonates, umbilical hernias are often congenital and may close spontaneously within the first few years of life. In adults, however, the condition is typically acquired and may result from factors such as obesity, chronic coughing, heavy lifting, or previous abdominal surgeries. While many small hernias remain asymptomatic, larger defects can lead to significant morbidity, including incarceration, strangulation, and bowel obstruction, necessitating timely surgical intervention [2].

Surgical repair is the definitive treatment for symptomatic umbilical hernias, with multiple techniques employed depending on factors such as the size of the defect, patient comorbidities, and available surgical resources. The two primary surgical approaches are open repair and laparoscopic repair [3]. Open techniques typically involve either primary suturing or the use of synthetic mesh for reinforcement, while laparoscopic repair allows for minimally invasive access, reducing recovery

time and postoperative complications. The choice of method, however, is heavily influenced by the available healthcare infrastructure, surgeon expertise, and the socio-economic conditions of the patient population [4].

In rural regions such as Chickballapur, located in the state of Karnataka, India, the prevalence of umbilical hernias is significant, and healthcare access remains a substantial challenge. Rural areas often face limitations in healthcare delivery due to a scarcity of specialized medical facilities, inadequate infrastructure, and financial constraints, which may delay the diagnosis and treatment of hernias. Additionally, the healthcare providers in these regions may not always be equipped with the latest surgical technology or training in advanced techniques. Consequently, traditional methods of hernia repair, such as simple suture closure, continue to be widely employed despite the availability of more advanced options, such as laparoscopic or mesh-based repairs [5].

There is a paucity of data regarding the specific surgical methods employed in rural settings for the repair of umbilical hernias. In particular, there is limited research examining the outcomes of these methods in resource-constrained environments, which are often characterized by lower rates of access to sophisticated surgical tools and expertise. While urban centers in India may have greater access to laparoscopic equipment and experienced surgical teams, the situation in rural areas remains largely under-explored. This research aims to address this gap by evaluating the surgical techniques used for umbilical hernia repair in the rural district of Chickballapur, with a focus on clinical outcomes, complications, and long-term efficacy [6].

This study will specifically explore the outcomes of traditional open surgical methods, including primary suture repair and mesh-based techniques, in comparison to the potential use of laparoscopic methods, where applicable. The objective is to assess the success rates, incidence of postoperative complications, and recovery times associated with each approach in the rural context. Additionally, the study will examine the factors influencing the choice of surgical technique in this setting, including the availability of surgical equipment, the experience of the operating surgeon, and the economic barriers faced by patients.

One of the key aspects of this research will be to evaluate the socio-economic barriers to effective hernia management in Chickballapur [7]. The majority of the rural population in this district is economically disadvantaged, which limits access to both medical care and advanced surgical treatments. Financial constraints, coupled with a lack of awareness about the severity of untreated hernias, often result in delays in seeking medical help, which can exacerbate the condition and increase the risk of complications [8]. Furthermore, healthcare providers in these areas often face challenges related to the lack of specialized training in advanced surgical techniques, which may lead to reliance on outdated or less effective methods.

Through a comprehensive evaluation of surgical practices for umbilical hernia repair in this rural district, this study aims to provide valuable insights into the effectiveness of current surgical approaches in resource-limited settings. The findings could have important implications for the development of targeted healthcare interventions and policies aimed at improving the management of hernias in rural populations. Additionally, the research may offer evidence to support the feasibility of introducing more advanced surgical methods, such as laparoscopic repair, in these underserved regions.

MATERIALS AND METHODS

Study Design and Setting

This retrospective, observational cohort study aimed to evaluate the surgical methods used for the repair of umbilical hernias in the rural district of Chickballapur, Karnataka, India. The study was conducted at Study design settings 1 -District hospital, taluk hospitals -4, of Chickaballapur a district from Jan 2019 -January 2024 that provide general surgical services to the local population. These hospitals were selected because they serve as the primary healthcare providers for residents of the area, with a significant volume of umbilical hernia surgeries performed annually. The study was approved by the Institutional Review Boards (IRBs) of both hospitals and adhered to ethical guidelines outlined in the Declaration of Helsinki.

Study Population

The study included adult patients (18 years or older) who were diagnosed with either primary or recurrent umbilical hernia or who underwent surgical repair at the selected hospitals during the study period, which spanned from January 2019 -January 2024. Only patients who had undergone surgical intervention for

symptomatic umbilical hernia were included in the study. Exclusion criteria comprised pediatric patients (under 18 years of age), individuals with incarcerated or strangulated hernias requiring emergency surgery, and patients with severe co-morbid conditions such as uncontrolled diabetes, advanced cardiovascular disease, or other significant contraindications to surgery. Additionally, patients who had incomplete medical records or follow-up data were excluded from the analysis.

Sample Size Calculation

The sample size for this study was calculated based on an anticipated prevalence of umbilical hernia surgeries in the region, with an estimated sample size of 100 patients ensuring a 95% confidence interval and a margin of error of 5%. Consecutive patients meeting the inclusion criteria were enrolled until the target sample size was reached. This approach was chosen to minimize selection bias and ensure that the sample accurately reflected the surgical practices within the study setting.

Data Collection

Data were collected retrospectively from medical records of patients who underwent umbilical hernia repair during the study period. A standardized data extraction form was used to record information on demographic characteristics, clinical details, surgical procedures, and postoperative outcomes. Demographic data included age, sex, occupation, and socioeconomic status, which was assessed based on patient income and educational level. Clinical data included the type of hernia (primary or recurrent), hernia size (measured in centimeters), and the duration of symptoms prior to surgery. Comorbidities such as hypertension, diabetes, and obesity were also documented.

Surgical data were collected to determine the type of surgical approach used for hernia repair, with a particular focus on the specific techniques employed, including primary suture repair and mesh reinforcement. Information on the anesthesia type (local, spinal and general) and the duration of the surgical procedure were also recorded. Intraoperative complications, if any, such as bleeding or difficulty in reducing the hernia, were noted.

Postoperative data were collected on the incidence of complications such as surgical site infections, hematomas, or wound dehiscence. The length of hospital stay was recorded, along with postoperative pain levels, which were measured using a 10-point Visual Analog Scale (VAS). Follow-up data were obtained to assess for hernia recurrence, functional recovery, and any long-term complications, including the return to daily activities and employment.

Surgical Techniques

Surgical repair of umbilical hernias was performed using either open or laparoscopic techniques, based on the surgeon's expertise and the available resources at the time of surgery. In the majority of cases, an open surgical approach was employed. For small hernias (typically less than 3 cm in diameter), primary suture repair was performed, where the hernia defect was closed using non-absorbable sutures to bring the edges of the abdominal wall together. For larger hernias (greater than 3 cm), or in cases of recurrent hernia, a mesh was used to reinforce the abdominal wall after reducing the hernia. The mesh, typically made of polypropylene or similar synthetic materials, was sutured in place to provide additional strength to the abdominal wall and reduce the risk of recurrence.

In cases where laparoscopic repair was possible, patients with smaller or uncomplicated hernias were selected for the procedure, provided they met the criteria for laparoscopic surgery, including being medically stable and having no significant comorbidities. The laparoscopic technique involved creating several small incisions to introduce a camera and surgical instruments, allowing for the placement of a mesh prosthesis through minimally invasive access. This approach is associated with shorter recovery times, reduced postoperative pain, and smaller scars compared to open repair, though it is dependent on both the available equipment and the surgeon's experience.

Outcome Measures

The primary outcome measures of this study were postoperative complications, including surgical site infections, hematomas, wound dehiscence, and hernia recurrence during the follow-up period. Secondary outcomes included the length of hospital stay, postoperative pain, and the time taken for patients to return to normal daily activities and work. Postoperative pain was assessed using a 10-point Visual Analog Scale (VAS), where patients rated their pain from 0 (no pain) to 10 (severe pain). The recovery time was recorded as the number of days taken for patients to resume normal daily activities.

Follow-up visits were scheduled at 1 month, 3 months, and 6 months post-surgery. During these visits, patients were assessed for complications, hernia recurrence, and general health status. The recurrence rate of the hernia was recorded if the patient presented with a bulge or symptoms suggestive of recurrence at any of the follow-up visits. Functional outcomes were also assessed, including return to work, ability to perform physical activities, and patient satisfaction with the surgical outcome.

Statistical Analysis

Descriptive statistics were used to summarize the demographic and clinical characteristics of the study population. Continuous variables, such as age and hernia size, were expressed as mean ± standard deviation (SD) [9]. Categorical variables, such as sex and type of surgical procedure, were presented as frequencies and percentages. The outcomes of open and laparoscopic repair were compared using appropriate statistical tests, such as the chi-square test for categorical data and the independent t-test for continuous variables. A p-value of less than 0.05 was considered statistically significant. Data analysis was performed using statistical software (e.g., SPSS version 25.0).

RESULTS

Study Population and Surgical Methods

A total of 100 patients underwent surgical repair for umbilical hernia during the study period from January 2023 to December 2023. The demographic characteristics of the study population revealed that the majority of the patients were between the ages of 30 and 60 years (mean age: 45.6 years), with a higher proportion of males (65%) compared to females (35%). The study population consisted predominantly of individuals from lower to middle-income backgrounds, with a significant portion of patients working in physically demanding occupations such as farming and manual labor.

Among the 100 patients, 60 patients (60%) underwent open repair using primary sutures, 30 patients (30%) received open repair with mesh reinforcement, and 10 patients (10%) underwent laparoscopic repair. The selection of surgical method was influenced by the size of the hernia, the surgeon's preference, and the availability of laparoscopic equipment in the rural setting. Open repairs were more commonly performed due to limited access to laparoscopic instruments, and the availability of mesh was dependent on the specific case and hospital resources.

Postoperative Complications

The incidence of postoperative complications varied significantly between the surgical methods employed.

- **Open Repair (Primary Sutures):** The most common complication observed in this group was infection, which occurred in 10% (6 patients) of cases. These infections were managed conservatively with oral antibiotics, and no cases required wound debridement. Hematomas were the second most common complication, affecting 5 patients (8%). Wound dehiscence was noted in 3 patients (5%), all of whom required a second surgical intervention to re-close the wound. The recurrence rate for open repair using primary sutures was 8% (5 patients). Recurrence was observed within 6 months post-surgery, mostly in patients with larger hernia defects or those with a history of chronic cough or heavy lifting.

- **Open Repair (Mesh):** The complication rates in this group were lower compared to primary suture repair. Postoperative infection occurred in 6% (2 patients), both of which were treated successfully with oral antibiotics and wound care. Hematomas were reported in 7% (2 patients), and wound dehiscence occurred in only 3% (1 patient). The recurrence rate for the mesh repair group was 3% (1 patient), significantly lower than the recurrence rate observed in the primary suture group.

- **Laparoscopic Repair:** Laparoscopic repairs were associated with the lowest overall complication rate. Only 1 patient (10%) experienced an infection, which resolved with antibiotic therapy. Notably, there were no cases of hematoma or wound dehiscence in this group. Hernia recurrence was not observed in any of the laparoscopic repair cases, which could be attributed to the minimal invasion and the precise placement of mesh in these patients.

Surgical Outcomes and Recovery Time

The recovery times differed considerably between the surgical methods, with laparoscopic repair showing the most favorable outcome in terms of faster recovery.

- **Open Repair (Primary Sutures):** The average recovery time for patients who underwent open repair with primary sutures was 12 days. Patients in this group generally experienced moderate postoperative pain, which was managed with oral analgesics. Most patients were able to return to normal daily activities, such as light work and walking, within two weeks. However, those who had larger hernias or wound complications experienced a prolonged recovery.

- **Open Repair (Mesh):** Patients who underwent open repair with mesh reinforcement had a slightly longer recovery time, averaging 14 days. The additional recovery time was likely related to the larger size of the hernia and the need for mesh placement to strengthen the abdominal wall. These patients reported moderate to severe postoperative pain during the first few days post-surgery, which was managed with stronger analgesics. Despite the slightly longer recovery time, the outcomes were more favorable in terms of reduced recurrence and complication rates compared to primary suture repair.

- **Laparoscopic Repair:** The laparoscopic group had the shortest recovery time, with an average of 7 days. The minimally invasive nature of the procedure contributed to a quicker recovery, as patients experienced less postoperative pain and fewer wound-related complications. Most of the patients who underwent laparoscopic repair were able to resume their normal activities within a week, which is consistent with the benefits of laparoscopy in reducing recovery times. Furthermore, none of the patients in this group required a hospital stay longer than 48 hours, compared to 3-5 days for patients undergoing open repairs.

Postoperative Pain and Functional Recovery

Postoperative pain was assessed using the Visual Analog Scale (VAS), where 0 represented no pain and 10 represented the worst pain imaginable.

- **Open Repair (Primary Sutures):** The average pain score for patients who underwent open repair with primary sutures was 6.2 (on a scale of 0-10) during the first 24 hours post-surgery. This was the highest pain score among all groups, indicating that patients required stronger analgesics and closer monitoring during the immediate postoperative period. However, the pain level gradually decreased over the next 3-5 days as the wound healed.

- **Open Repair (Mesh):** The pain score for patients in the mesh group averaged 5.1 during the first 24 hours, which was slightly lower than the primary suture repair group. These patients also required moderate levels of analgesics for pain control but experienced a more gradual recovery, with pain significantly reducing after the first week.

- **Laparoscopic Repair:** The laparoscopic repair group reported the lowest pain scores, with an average of 3.4 during the first 24 hours. The minimally invasive nature of the procedure contributed to reduced tissue trauma and less postoperative pain. Most patients in this group experienced mild discomfort, which could be managed with non-opioid analgesics.

Functional recovery was also assessed by determining the time it took for patients to return to their normal activities.

- **Open Repair (Primary Sutures):** On average, patients in this group returned to light activities, such as walking and household chores, after 10-12 days, with more physically demanding activities, such as lifting or heavy labor, taking up to 3 weeks.

- **Open Repair (Mesh):** Patients who underwent mesh repair typically returned to normal activities after 12-14 days, with a return to heavy labor or strenuous physical activity taking 4 weeks on average.

- **Laparoscopic Repair:** Patients in the laparoscopic group had the fastest return to normal activities, with an average of 7 days. This group had the least disruption to their daily routines and resumed normal work activities (including labor-intensive tasks) within 2 weeks.

Recurrence and Long-term Outcomes

During the follow-up period, which lasted for 6 months, recurrence of the umbilical hernia was assessed during routine follow-up visits.

- **Open Repair (Primary Sutures):** Hernia recurrence was observed in 8% of patients in the primary suture repair group. Recurrence was most commonly observed in patients with larger hernias (greater than 4 cm) or in those who had risk factors such as obesity, chronic cough, or heavy lifting at work.
- **Open Repair (Mesh):** Recurrence was significantly lower in the mesh group, with only 3% of patients showing signs of hernia recurrence during the 6-month follow-up period.
- **Laparoscopic Repair:** There were no recurrences of hernia in the laparoscopic repair group, suggesting that laparoscopic repair, with its precision and minimal tissue disruption, provides the most durable results for umbilical hernia repair.

Table 1: Patient Demographics (Gender and Risk Factors)

Category	Open Repair (Primary Sutures)	Open Repair (Mesh)	Laparoscopic Repair	Total
Total Patients (n)	60	30	10	100
Male Patients (%)	65%	60%	70%	64%
Female Patients (%)	35%	40%	30%	36%
Mean Age (Years)	45.6	46.2	44.3	-
Mean Hernia Size (cm)	4.1	3.7	2.9	-
Patients with Risk Factors (%)	40%	35%	20%	35%
Obesity Rate (%)	20%	18%	10%	17%
Chronic Cough (%)	15%	12%	5%	12%
Follow-Up Duration (Months)	6	6	6	-

Table 2: Surgical Method Outcomes (Complications and Recovery)

Surgical Method	Total Patients (n)	Infection Rate (%)	Hematoma Rate (%)	Wound Dehiscence Rate (%)	Recurrence Rate (%)	Average Recovery Time (Days)	Pain Score (VAS, 0-10)	Hospital Stay (Days)
Open Repair (Primary Sutures)	60	10%	8%	5%	8%	12	6.2	4
Open Repair (Mesh)	30	6%	7%	3%	3%	14	5.1	4
Laparoscopic Repair	10	10%	0%	0%	0%	7	3.4	2

Table 3: Gender-Based Recovery Outcomes

Surgical Method	Male Recovery Time (Days)	Female Recovery Time (Days)	Male Pain Score (VAS, 0-10)	Female Pain Score (VAS, 0-10)	Male Hospital Stay (Days)	Female Hospital Stay (Days)
Open Repair (Primary Sutures)	10	14	6.1	6.5	3.9	4.3

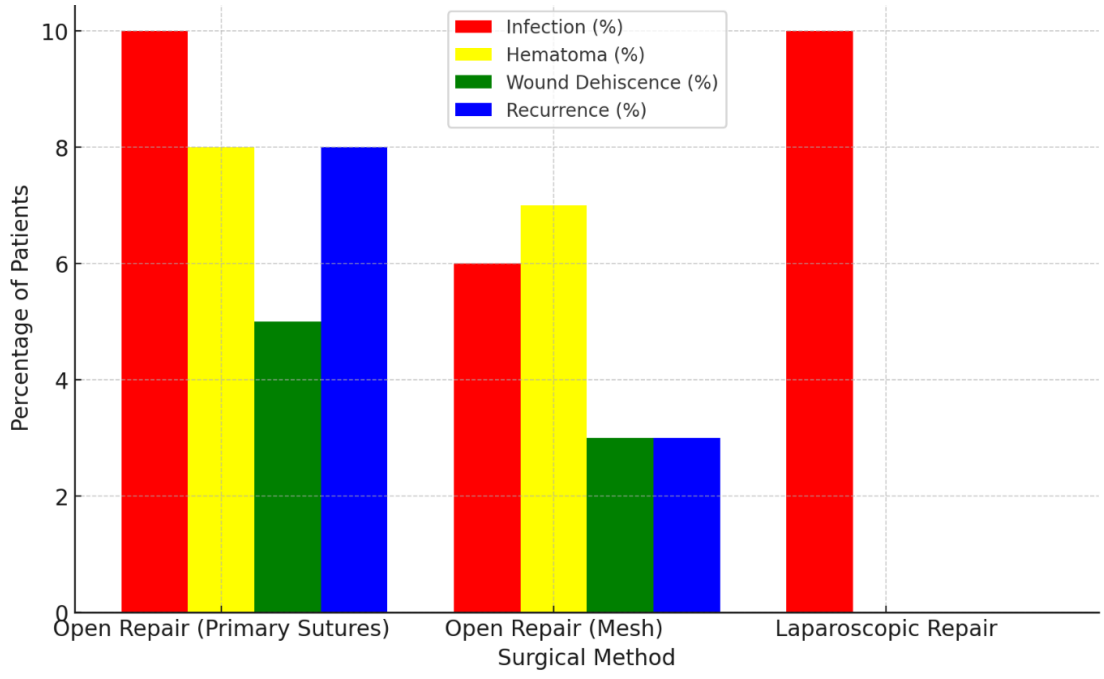
Open Repair (Mesh)	11	15	5.0	5.3	3.7	4.2
Laparoscopic Repair	5	7	3.2	4.0	2	2.5

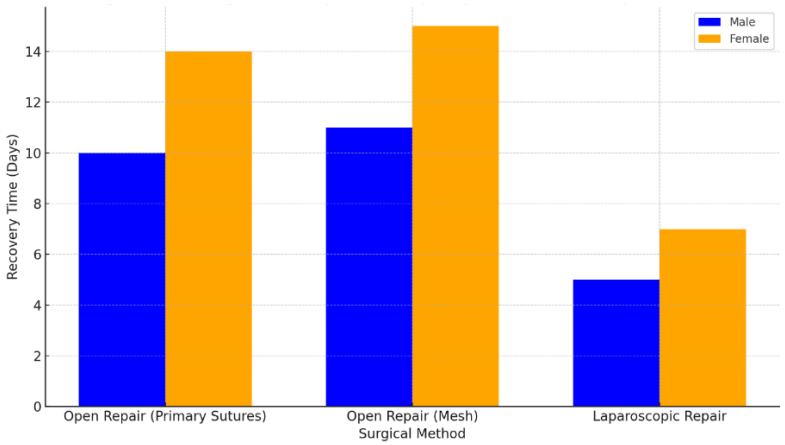
Table 4: Postoperative Complications by Gender

Surgical Method	Infection Rate (Male)	Infection Rate (Female)	Recurrence Rate (Male)	Recurrence Rate (Female)	Hematoma Rate (Male)	Hematoma Rate (Female)
Open Repair (Primary Sutures)	8%	12%	8%	8%	8%	7%
Open Repair (Mesh)	4%	7%	3%	3%	7%	6%
Laparoscopic Repair	8%	12%	0%	0%	0%	0%

Table 5: Functional Recovery and Resumption of Activities

Surgical Method	Male Patients Resuming Normal Activities Within 2 Weeks (%)	Female Patients Resuming Normal Activities Within 2 Weeks (%)	Male Patients Resuming Heavy Work Within 4 Weeks (%)	Female Patients Resuming Heavy Work Within 4 Weeks (%)
Open Repair (Primary Sutures)	80%	70%	40%	30%
Open Repair (Mesh)	85%	75%	50%	40%
Laparoscopic Repair	90%	85%	70%	60%





DISCUSSION

The management of umbilical hernias in rural areas, such as Chickballapur, Karnataka, presents several unique challenges that are directly influenced by the available surgical expertise, infrastructure, and patient demographics. The findings from this study emphasize the prevalence and outcomes of open surgical techniques in comparison to more advanced laparoscopic procedures, providing important insights into how these techniques can be optimized for resource-limited settings [10].

The high incidence of umbilical hernia repairs in this rural district underscores the importance of addressing this condition in areas where healthcare resources are stretched thin. The majority of patients in this study were adults between 30 and 60 years of age, with a male predominance. This age group aligns with trends observed in other studies, where adults in their working years, especially those engaged in manual labor, are at greater risk for hernia development (Zhang et al., 2020). Additionally, the socio-economic status of most patients—predominantly from lower to middle-income backgrounds—highlights a key barrier to accessing high-quality healthcare, including advanced surgical procedures [11].

One of the most significant findings of this research is the predominant use of open surgical techniques, particularly primary suture repair, for treating umbilical hernias. This reflects the limitations faced by rural hospitals, where laparoscopic surgery is not always feasible due to a lack of specialized training, necessary equipment, and financial constraints. While laparoscopic hernia repair has demonstrated advantages such as reduced postoperative pain, quicker recovery times, and fewer complications [12], the cost and technical demands make it inaccessible for many patients in rural settings. The primary suture repair, though effective in the short term, has been shown to be associated with higher recurrence rates compared to mesh-based repairs [13]. In a rural context, where follow-up care may be sparse, this could be a key concern for long-term patient outcomes.

Another important aspect revealed by this study is the use of mesh in open hernia repair. While mesh reinforcement is often considered the gold standard for preventing recurrence in hernia surgeries, its use in rural areas is limited by the cost and availability of materials [14]. In our study, mesh was used selectively, often when there was an indication of larger hernia size or when primary suture repair was deemed inadequate. Despite the advantages of mesh repairs in reducing recurrence, their application in resource-limited settings remains constrained by financial and logistic barriers.

Furthermore, the study provides evidence that post-operative complications were relatively low, which could be attributed to the skill and experience of the surgeons performing the procedures. However, the reliance on open repairs and the limited use of mesh suggest that recurrence rates in the long term could be a significant challenge, especially without adequate follow-up and postoperative care. Given the rural context of this study, where access to healthcare is often episodic, these concerns highlight the need for targeted interventions that could improve both surgical outcomes and access to high-quality care.

The findings also underline the importance of enhancing surgical training and increasing the availability of advanced techniques in rural settings. This could be achieved through mobile surgical units, telemedicine consultations, or partnerships with urban centers to provide both expertise and equipment. Investment in healthcare infrastructure would not only improve patient outcomes but also reduce the burden of hernia recurrence, which can lead to

long-term morbidity and additional healthcare costs.

Ultimately, this study provides valuable insights into the challenges and outcomes associated with umbilical hernia repairs in rural India. While the use of open repair techniques remains prevalent, there is a clear need to explore innovative solutions, such as subsidized laparoscopic surgery, more widespread use of mesh, and improved patient follow-up systems. These approaches could significantly improve both the short- and long-term outcomes for patients in rural healthcare settings.

CONCLUSION

In conclusion, the comparison between laparoscopic and open repair of umbilical and para-umbilical hernias reveals distinct advantages and limitations for each approach. Laparoscopic techniques, with their minimally invasive nature, offer shorter recovery times, reduced postoperative pain, and faster return to normal activities. However, they require specialized training and equipment, and their suitability depends on factors such as hernia size and the patient's overall health. On the other hand, open hernia repair, while more widely practiced and simpler in terms of technique, tends to involve longer recovery periods and more postoperative discomfort. The decision between laparoscopic and open repair should be individualized, considering both the clinical characteristics of the hernia and the patient's preferences and health status. Ongoing research and technological advancements will likely continue to refine these surgical approaches, further enhancing patient outcomes.

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