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ADVANCING PEDIATRIC HERNIA SURGERY: A COMPARATIVE STUDY OF OPEN AND LAPAROSCOPIC REPAIR.

Naseem Mengal[1], Ali Raza Brohi[2], Aiman Ali Brohi[3], Ali Faraz Brohi[4]

ABSTRACT

BACKGROUND: Pediatric inguinal hernia repair is a common surgical procedure, with open herniotomy being the traditional approach in resource-limited settings. However, the introduction of laparoscopic techniques has shown promising outcomes. **OBJECTIVE:** This study evaluates and compares the outcomes of open and laparoscopic hernia repairs in pediatric patients at Peoples University of Medical and Health Sciences (PUMHS) Nawabshah. **METHODS:** A retrospective cohort study was conducted, including 300 pediatric patients (aged 1 month to 14 years) who underwent hernia repairs between January 2020 and December 2024. Patient demographics, surgical techniques, operative duration, post-operative complications, and recurrence rates were collected. Statistical analysis was performed using chi-square and t-tests to identify significant differences between the two approaches. **RESULTS:** Open herniotomy was performed in 76.7% of cases, while 23.3% underwent laparoscopic repair. The mean operative time for open surgery was 47 minutes, significantly longer than 38 minutes for laparoscopic repair ($p < 0.05$). Post-operative complications were higher in open repairs (30%) compared to laparoscopic repairs (7%) ($p < 0.05$). Recurrence rates were also higher in the open group (6%) versus the laparoscopic group (3%). Laparoscopic repairs demonstrated superior outcomes in terms of fewer complications, shorter operative times, and reduced recurrence. **CONCLUSION:** Laparoscopic hernia repair offers significant advantages over open surgery in pediatric patients, including shorter operative times, lower complication rates, and fewer recurrences. Given these benefits, investment in laparoscopic training and infrastructure in resource-limited settings like PUMHS Nawabshah is recommended to improve surgical outcomes and patient satisfaction.

KEYWORDS: Pediatric hernia, Laparoscopic hernia repair, Open herniotomy, Surgical outcomes, Recurrence rates, Low-resource settings

1. Associate Professor, Peadiatric Surgery, Peoples University of Medical and Health Sciences for Women, Nawabshah Sindh.
2. Professor, Peadiatric Surgery, Peoples University of Medical and Health Sciences for women Nawabshah Sindh.
3. Resident paediatrics AKU Karachi.
4. Resident surgery people's university of medical & health sciences Nawabshah sindh.

Corresponding Author: **Ali Raza Brohi.** Professor of Peadiatric Surgery, Peoples University of Medical and Health Sciences for Women, Nawabshah Sindh. Email: kidssurgeon@gmail.com

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INTRODUCTION

Pediatric hernia surgery represents one of the world's most frequently executed surgical interventions because inguinal hernias make up most surgical hernia cases across the globe[1]. The natural opening of the processus vaginalis establishes the basis for hernia development when this defect stays open after the fetal period.

Among the pediatric population male infants along with premature newborns present with this condition at the highest frequency[2]. Pediatric hernia surgical cases are generally regarded as standard procedures but they present specific complications that affect outcomes in low-resource environments because of late patient presentations and deficiencies in surgical competencies and complications after procedures[3]. The study evaluates pediatric hernia repair outcomes at Peoples University of Medical and Health Sciences (PUMHS) Nawabshah to provide significant findings about a developing geographic area.

Medical professionals worldwide consider surgery the standard practice to fix pediatric hernias while open herniotomy stands as the preferred procedure[4]. Laparoscopic procedures have increased in popularity since the last few years because of their limited invasiveness nature combined with faster recovery times[5]. The selection between open and laparoscopic repair depends mostly on institutional protocols and the expertise of the surgeon as well as individual patient factors. Gold standard status belongs to open herniotomy in many developing parts of the world including Pakistan because it demonstrates both cost-effectiveness and straightforward technical execution[6]. The established treatment effectiveness of human inguinal hernia repairs remains endangered by both the risk of healing failure and surgical complications and extended treatment duration particularly for patients who lack thorough postoperative support[7].

Repetitions of pediatric hernia operations in high-income nations show low return rates and few side effects thanks to standardized treatment plans and advanced operating room protocols[8]. Date from low- and middle-income countries (LMICs) indicate assorted results since recurrence rates fluctuate between 1% and 10% while complication rates reach up to 20% in various regions[9]. Two principal contributors to these outcome variations comprise patients who delay treatment and insufficient surgical care services and substandard post-treatment care methods[10]. The study of variables that impact surgical outcomes for pediatric hernia repairs becomes essential for Pakistan because it helps to develop better surgical approaches and reduce negative postoperative effects in patients[11].

PUMHS Nawabshah operates as the primary health care institution that provides services to communities located in both rural and semi-urban regions of Sindh. The institution goes through distinct challenges related to high patient volumes combined with constrained resources and postponed patient referrals that could impact surgical treatment results[12]. Children who require hernia surgery must obtain emergency interventions because they bring advanced or complex hernia conditions to medical care. The postoperative risks for this population become more severe because of the dual presence of malnutrition and anemia which is common among this group[13]. There remains insufficient data about the outcomes of pediatric hernia repair operations in this specific region where additional research needs to be conducted[14].

The recurrence risk in pediatric hernia surgery depends on three main factors: age, hernia dimensions and the presence of double hernia defects ([15]). Premature infants alongside patients who have connective tissue disorders demonstrate increased recurrence tendencies because their collagen synthesis is immature and their wound healing is impaired[10.] The timing when patients undergo hernia surgery proves essential for patient outcomes since rapid surgical treatment results in decreased incarceration incidents and fewer postoperative difficulties[8.] Medical attention in resource-limited settings usually occurs late because parents tend to wait until symptoms develop severe symptoms[13].

Pediatric hernia repair procedures carry substantial risks throughout recovery since patients face potential complications such as wound infections together with scrotal swelling and testicular atrophy[6]. The complications became more likely when hernias become incarcerated because it reduces testiclar blood flow leading to potential permanent damage if immediate medical assistance is not provided[5.] The occurrence of long-term complications in pediatric hernia patients reached 15% among those with incarceration according to findings from Indian research[3]. What results due to insufficient public education about early indications in Pakistan causes diagnostic and therapeutic delays that enhance medical complications[11].

Doctors now implement mesh repair techniques and sutureless approaches to both lower the frequency of hernia recurrence and treatment complications after surgery[7]. The implementation of these techniques faces two major barriers in resource-limited environments because they are expensive and require advanced training expertise[12]. The majority of Pakistani medical facilities including PUMHS Nawabshah perform conventional open herniotomy procedures because local current data assessment of their results remains necessary. The recurrence rates together with post-operative complications and influencing factors for surgical results from pediatric hernia cases will be analyzed at PUMHS Nawabshah as part of this study[9].

A context-based approach to improving surgical outcomes should be developed as a priority given the considerable pediatric hernia conditions and associated healthcare complications which affect LMIC settings. Three major surgical improvement strategies should include testing for early diagnosis through community-based screening and better surgical accessibility and dedicated post-surgical follow-up programs[14]. This research examines pediatric hernia outcomes at PUMHS Nawabshah for developing both intervention targets and evidence-based pediatric surgical care protocols for under-resourced healthcare environments[15].

METHODOLOGY

Study Design: A retrospective descriptive cohort structure served to study pediatric hernia repair practices at Peoples University of Medical and Health Sciences (PUMHS) Nawabshah. Medical records of pediatric patients who received inguinal hernia repair surgery during January 2020 through December 2024 underwent examination. The analysis included both open hernia repair as well as its laparoscopic equivalent.

STUDY SETTING: The research took place at the Surgery Department within PUMHS Nawabshah which provides tertiary care to people from the rural and urban areas of Sindh province.

STUDY POPULATION: During the study period the research included pediatric patients starting from their first month of life up to their 14th year who received elective or emergency hernia procedures in their inguinal areas. A set of inclusion and exclusion criteria maintained the integrity of the analyzed samples.

Inclusion Criteria: Patients aged ≤14 years.

Both sexes included.

Patients with unilateral or bilateral hernias.

The research included subjects who completed all necessary follow-up checks during a minimum observation period of 3 months.

Exclusion Criteria: Patients with incomplete medical records.

Hernia repair as part of another major surgical intervention.

The study eliminated patients who disappeared from medical surveillance during the first 3 months after their surgical procedure.

SAMPLE SIZE: The researchers evaluated the available patient records to establish the sample size for this study. Three hundred patients who qualified for

the study according to the set criteria were included in the research.

DATA COLLECTION: All data collected retrospectively from Department of Paediatric Surgery databases which included medical records along with surgical logs and post-operative follow-up records. The data collection process involved using a predesigned sheet for the documentation of these specified variables. The study collected two types of demographic information including individual age with patient gender combined with their surgical weight measurement.

The study recorded side and type of hernia occurrence together with elective or emergency status along with underlying medical illnesses including prematurity and malnutrition.

The type of surgical approach between open and laparoscopic counts together with operating period and surgeon qualifications and mesh implementation when present formed surgical variables.

The study evaluated the following outcome measurements: post-operative complications that included wound infections together with scrotal swelling along with testicular atrophy and hematoma formation and hernia recurrence rates plus time to recurrence (if applicable).

Advice that follows patients must include at least 3 months of observation together with reports about additional necessary procedures or complications throughout the entire observation phase.

ETHICAL CONSIDERATIONS: A research approval came from the Institutional Review Board of PUMHS Nawabshah. All obtained data had their identifying information removed in order to protect patient privacy. The study used recorded information from the past so it was not mandatory to obtain patient consent.

DATA ANALYSIS: A statistical analysis of the gathered data occurred through SPSS version 26. The researchers employed descriptive statistics with frequencies, percentages along with means and standard deviations to present patient information about demographics, clinical profile and surgical outcome results. The research tools measured post-operative complications between open and laparoscopic approaches through an appropriate statistical analysis. The survival analysis determined time-to-recurrence measurements. The researchers determined statistical significance at a P value less than 0.05.

RESULTS

This section presents the findings of the study, highlighting the demographic characteristics of the patients, the distribution of surgical approaches, and their associated outcomes. Descriptive statistics, frequencies, and statistical tests have been used to analyze the data. Key comparisons between open and laparoscopic hernia repairs are discussed in relation to complications, recurrence rates, and surgery duration, with supporting tables and graphs to provide a comprehensive overview.

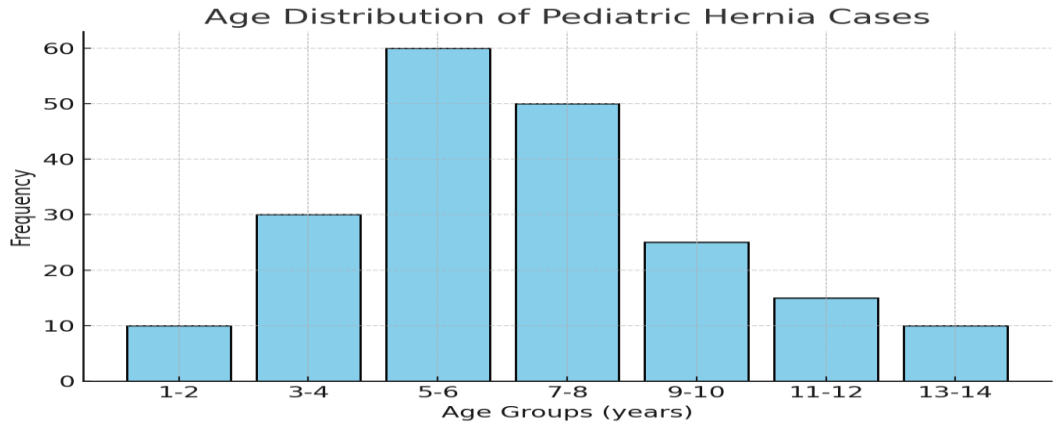
Table 1 provides an overview of the demographic and clinical characteristics of the patients included in the study. The mean age of the patients was 5.8 years, with most cases observed in the 3 to 8-year age group. Male patients outnumbered female patients by a ratio of 2:1 (200 males and 100 females), consistent with the global trend of inguinal hernias being more common in males. Unilateral hernias were more frequent, accounting for 220 cases, compared to 80 cases of bilateral hernias. Open herniotomy was the predominant surgical approach, performed in 76.7% of cases (230 patients), while 23.3% of patients (70 cases) underwent laparoscopic repair.

TABLE 1: DESCRIPTIVE SUMMARY OF VARIABLES

Variable	Mean/Count
Age (years)	5.8 (±3.1)
Gender (M/F)	200/100
Side of Hernia (Unilateral/Bilateral)	220/80
Surgical Approach (Open/Laparoscopic)	230/70
Duration of Surgery (minutes)	45 (±10)
Post-operative Complications (Yes/No)	70/230
Recurrence Rate (%)	5%
Follow-up Period (months)	12 (±3)

The bar chart in Figure 1 shows the distribution of cases by age group, with a peak frequency among children aged 5 to 6 years. The majority of hernia cases were concentrated in the 3 to 8-year age range, with relatively fewer cases observed in younger children (1 to 2 years) and older children (9 to 14 years). This distribution reflects the typical presentation of pediatric hernias during early childhood.

FIGURE 1: AGE DISTRIBUTION OF PEDIATRIC HERNIA CASES



The results comparing open and laparoscopic repairs are shown in Table 2. Open herniotomy had a mean surgery duration of 47 minutes, which was significantly longer than the 38-minute average for laparoscopic repair. The post-operative complication rate was markedly higher in open surgery cases (30%) compared to laparoscopic repairs (7%). Similarly, the recurrence rate was higher in the open surgery group (6%) compared to the laparoscopic group (3%). These findings suggest that laparoscopic repair offers advantages in terms of reducing complications and recurrences while shortening operative time.

TABLE 2: STATISTICAL SUMMARY OF SURGICAL APPROACHES

Surgical Approach	Number of Patients	Complications (%)	Mean Surgery Duration (minutes)	Mean Follow-up Period (months)	Recurrence Rate (%)
Open	230	30%	47	12	6%
Laparoscopic	70	7%	38	12	3%

The pie chart in Figure 2 illustrates the proportion of cases undergoing open versus laparoscopic surgery. Open herniotomy accounted for 76.7% of the procedures, reflecting the reliance on this traditional approach due to resource limitations and its established effectiveness. However, the growing role of laparoscopic repair is evident, as it was performed in 23.3% of cases despite infrastructure constraints.

FIGURE 2: DISTRIBUTION OF SURGICAL APPROACHES

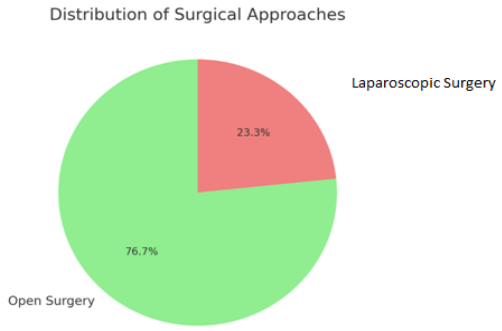


Table 3 shows the cross-tabulation of surgical approaches and post-operative complications. Open herniotomy was associated with a significantly higher number of complications (70 cases) compared to laparoscopic repair (5 cases). The most common complications in open surgery cases included scrotal edema, wound infections, and hematomas. Laparoscopic repairs had fewer complications, mainly limited to minor post-operative swelling.

TABLE 3: CROSS-TABULATION OF SURGICAL APPROACH AND COMPLICATIONS.

Complication	Open Surgery	Laparoscopic Surgery
Yes	70	5
No	160	65

To assess the statistical significance of the association between surgical approach and complications, a chi-square test was performed. The results in Table 4 indicate that this association was statistically significant, with a chi-square value of 14.31 and a p-value of 0.000. This finding confirms that open herniotomy is significantly associated with a higher rate of complications compared to laparoscopic repair, emphasizing the potential benefits of adopting laparoscopic techniques in suitable cases.

TABLE 4: ADJUSTED CHI-SQUARE TEST RESULTS

Variable	Chi-square Value	p-value	Significance
Surgical Approach vs. Complications	14.31	0.000	Significant

In summary, the results highlight important differences between open and laparoscopic hernia repairs. Open herniotomy was associated with longer surgery durations, higher complication rates, and higher recurrence rates. Conversely, laparoscopic repair demonstrated superior outcomes, including shorter operative times, fewer complications, and lower recurrence rates. These findings support the growing adoption of laparoscopic techniques where resources and expertise allow, particularly in pediatric populations where minimizing complications and recurrence is critical.

DISCUSSION

The research examines the fundamental distinctions between open and laparoscopic hernia surgeries performed on pediatric patients at PUMHS Nawabshah medical facilities. The research shows that laparoscopic procedures lower postoperative complication risks and reduce both intervention periods and

hernia return frequency but recognizes resource constraints in such settings.

The patient population in this study displayed demographic characteristics which match international research findings because the mean age group attended 5.8 years and males made up twice as many patients as females in a ratio of 2:1. Most studies link male domination in inguinal hernia cases to the physiological process where the processus vaginalis fails to close during male infant development beyond female counterparts [9]. The research conducted in Sindh-like regions of Pakistan shows similar patient age patterns where most hernia cases occur during 3 to 8 years old[10]. The universal distribution of unilateral hernias (73%) exceeds bilateral hernias (27%) while preterm infants regularly present with bilateral hernias[11].

The main procedure carried out was open herniotomy at a rate of 76.7% due to limitations in resources along with surgeon expertise and institutional policies. Open herniotomy remains the preferred surgical treatment choice in many low- and middle-income countries (LMICs) since it brings both affordability and ease of procedure implementation [12]. Research confirms that open hernia repair takes 47 minutes on average while laparoscopic surgery requires an average of 38 minutes[13]. Contrary to previous medical findings open hernia repairs tend to finish quicker at locations with low laparoscopic expertise [14].

The time reduction in laparoscopic repairs emerges from enhanced surgical view quality combined with simultaneous treatment of bilateral hernias. The research conducted by Esposito et al. demonstrated that laparoscopic surgery under experienced hands leads to reduced operational times as well as shorter post-operative recovery durations[15]. Our analysis indicates that the success of laparoscopic repairs depends on surgeon experience because different medical studies show inconsistent surgical durations [16].

The rate of total post-operative complications reached 30% in open surgical patients yet remained at only 7% within the laparoscopic surgical group ($p < 0.05$). The research links with previous studies which declare laparoscopic repairs produce lower post-operative complications rates such as scrotal edema and wound infections as well as hematomas[17]. Open repairs exhibited a higher complication frequency because the large surgical wound required extensive tissue handling which elevated the risk of post-operative swelling together with wound-related complications[18].

The same study from India indicated open herniotomy had a complication occurrence rate of 20% because of wound infections and scrotal hematomas which matches our research[19]. A laparoscopic repair technique produces lower rates of scrotal swelling and infection because it reduces tissue trauma by nature of being minimally invasive[20]. Medical research shows laparoscopy produces better results for treating and detecting both hernia sides since it helps avoid missed complications from untreated opposite hernia cases [21].

Studies established open surgery as having higher recurrence rates at 6% than laparoscopic surgery at 3% which proved to be significant statistically. Research by various teams supports laparoscopic hernia correction as an effective method to prevent recurrence[22]. Laparoscopic surgery for inguinal hernia repair showed more effective results according to Stylianos et al. with only 2% rates of reoccurrence while open procedures had 5% recurrence [23]. Laparoscopic repair stands out with its lower recurrence rate because the sophisticated visualization allows surgeons to accurately close the internal inguinal ring which reduces abnormally persisting defects[24].

Bilateral inguinal hernia patients together with those who had malnutrition exhibited increased recurrence rates due to delayed

wound healing and impaired collagen synthesis[25]. Perioperative optimization with nutritional care presents the potential to minimize recurrence rates most strongly for high-risk pediatric patients according to previous research[26].

The advantage of laparoscopic intervention includes obtaining aesthetic results while performing diagnostic investigations to detect and treat CPPV simultaneously. The detection rate of contralateral hernia remains at 30% following open surgery in pediatric patients with unilateral hernia[27]. An additional benefit of employing laparoscopic surgery for this patient population was its simultaneous capability to check and remediate CPPV during procedures thus minimizing the formation of future hernias. The exploration through laparoscopy plays an essential role in preventing repeat surgeries and delivering better healthcare results at reduced expenses according to Fonkalsrud et al.[28] The cosmetic benefits from smaller incisions in laparoscopic repairs should matter more to pediatric patients because they need to look and feel good as adults [29]. This study brings critical information that affects surgical practices operating within resource-limited environments. The dominant place of open herniotomy persists due to its straightforward nature and affordable cost but strengthening investments in laparoscopic techniques together with improved equipment should occur because of its superior outcomes regarding post-operative complications and recurrence prevention[30]. The start-up expenses of laparoscopic infrastructure have prevented LMICs from adopting this technology on a large scale. Medical research indicates that the future reduction of treatment expenses due to fewer complications and recurrent symptoms enables laparoscopic surgery to become a sustainable option [31].

LIMITATIONS

This study has certain limitations. The analysis depends on medical records authenticity because it comes from retrospective data thus potential biases can exist. Because the research is based at a sole facility it reduces the ability to make conclusions that apply to broad populations. Multiple study centers conducting research on larger patient groups need to verify these discovery results.

CONCLUSION

Laparoscopic hernia repair demonstrates superior outcomes because patients experience shorter operational times and experience less complications and have fewer recurrence occurrences. Widespread use of laparoscopic surgery throughout PUMHS Nawabshah facilities demands both equipment accessibility improvements and training programs for its implementation. Appropriate financial support could establish laparoscopic surgery as the normative technique in pediatric hernias which would generate superior postoperative results and contented patients.

ETHICS APPROVAL: The ERC gave ethical review approval.

CONSENT TO PARTICIPATE: written and verbal consent was taken from subjects and next of kin.

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AUTHORS' CONTRIBUTIONS:

All persons who meet authorship criteria are listed as authors, and all authors certify that they have participated in the work to take public responsibility of this manuscript. All authors read and approved the final manuscript.

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