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Original article

## Feasibility of Laparoscopic Approach versus Open Approach for Inguinal Hernia Repair in Children

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### ABSTRACT

**Background:** One of the surgeries done on infants and early children most frequently is the correction of an inguinal hernia. Either the laparoscopic approach or the traditional open procedure can be used to accomplish this. The aim of this study was to compare the feasibility of laparoscopic approach versus open approach for the management of inguinal hernia in children. **Patients and Methods:** This prospective randomized clinical trial study was conducted at pediatric surgery department at Zagazig University Hospitals. This study included 24 patients. Patients were randomly divided into two groups. Each group included 12 patients. Group A underwent laparoscopic inguinal herniotomy. Group B underwent conventional open inguinal herniotomy. All laparoscopic operations were completed without conversion to open approach.

**Results:** There was no statistically significant difference between groups regarding number of surgeons, occurrence of postoperative complications and cosmetic outcome. There was statistically significant difference between groups regarding duration of open approach which was statistically significantly shorter than laparoscopic approach,  $p=0.0001$  and length of hospital stay was statistically significantly shorter in open approach versus laparoscopic approach,  $p=0.0001$ .

**Conclusion:** According to the results of this study which showed that the duration of open approach was statistically significantly shorter than laparoscopic approach and the length of hospital stay was statistically significantly shorter in open approach versus laparoscopic approach, so we conclude that open inguinal hernia repair is safe, more feasible and rapid technique.

**Keywords:** Inguinal hernia, Laparoscopy, Open repair, Pediatric surgery including intestinal necrosis, testicular/ovarian atrophy, or mortification [1].

### INTRODUCTION

One of the most prevalent surgical problems in the pediatric age range is inguinal hernia. Its incidence ranges from 0.8% to 4.4% increasing to 30% in premature babies with male to female ratio 10:1 and more common on the right side. It mostly results from the processus vaginalis' failure to naturally close [1].

All children with inguinal hernia should undergo surgery once fit for it due to the possibility of incarceration and catastrophic complications

Classically, open approach herniotomy has been used to treat inguinal hernia. The procedure entails cutting the hernial sac and performing a high ligation after removing the hernia sac from the spermatic cord [2].

Laparoscopic herniotomy was introduced in the early 1990s. The procedure involves either excising the hernial sac or sealing the patent processus vaginalis at the level of the internal ring [3].

Since the introduction of laparoscopic herniotomy, there has been disagreement over the most effective way to fix an inguinal hernia [2].

In children, open inguinal hernia repair is the most often used treatment method. On the other hand, laparoscopic procedures are becoming more common in modern medicine. There is now no conclusive agreement on whether method open or laparoscopic is better for children who require inguinal hernia surgery [3].

Proponents of the laparoscopic procedure assert that open repair is not feasible given laparoscopy's capacity to see and fix contralateral abnormalities without requiring additional incisions. Due to the high occurrence of patent processus vaginalis in infants between 44% and 57%, according to recent studies this is particularly crucial. Furthermore, laparoscopic surgery preserves the outer anterior abdominal wall when treating pediatric inguinal hernias from the point of origin. An increasing number of studies are confirming the viability, safety, and effectiveness of the laparoscopic method [4].

On the contrary, laparoscopic approach opponents argue that its increased expense as a result of the requirement for specialized monitors and instruments as well as the learning curve for mastery the required skills makes conventional open approach more feasible than laparoscopic approach [5].

#### **Aim of the work:**

This study aimed to compare the feasibility of laparoscopic and open approach for management of inguinal hernia in children.

#### **METHODS**

This prospective randomized clinical trial study was conducted in Pediatric Surgery department in Zagazig University Hospitals over a period of 10 months. The study included 24 children presented with inguinal hernia: 10 males (41.7%) and 14 females (58.3%). Their age ranged from 1 to 10 years with mean age  $3.63 \pm 2.58$  years.

The inclusion criteria were age group between 1 and 14 years old and the consent of the legal guardian for surgical intervention. The exclusion criteria were unfit for surgery, associated hernias or congenital anomalies that demand open approach, hernia with undescended testicles or previous major lower abdominal surgery.

The Declaration of Helsinki, the international Medical Association's guidelines of ethics for

studies involving humans, was followed in the conduct of this study. The study protocol was reviewed and approved by the institutional review board with the approval no (IRB#10467) and parents signed a detailed informed consent.

Patients were randomly divided into two groups: Group A (n=12) underwent laparoscopic inguinal herniotomy by closure of the hernial defect by intracorporeal purse-string suture ligation of the peritoneum with excision of the hernial sac while Group B (n=12) underwent open inguinal herniotomy entails severing the hernia sac from the spermatic cord, high-ligating the sac, and finally excising it. Preoperative, intraoperative and postoperative data were recorded and compared. Postoperative data covered the length of hospital stay, postoperative complications (pain, hematoma/edema, infection, recurrence, testicular atrophy and iatrogenic testicular ascent) and parents' satisfaction regarding the postoperative cosmetic outcome.

Preoperative preparation involved history taking, clinical examinations and laboratory investigations including complete blood picture, coagulation profile, kidney function tests, and viral hepatitis markers. Abdomino-pelvic ultrasound was performed for all patients.

Patients were kept nil by mouth for at least 6 hours prior to the surgery except for breast feeding (4 hours) and clear liquids (2 hours). A prophylactic antibiotic was given 0.5-1 hour before the procedure or at induction of anesthesia, after a negative skin sensitivity test.

#### **Operative procedure:**

All patients had general anesthesia. Induction is done by inhalation of sevoflurane with a secured IV line. Then intubation with appropriate ETT is done. Then O<sub>2</sub> and isoflurane inhalation are given. Muscle relaxant is given with controlled ventilation.

#### **In laparoscopic herniotomy**

The camera operator was positioned contralaterally to the side of pathology, while the surgeon was positioned at the head of the patient. At the patient's feet was where the video column was placed. In order to minimize the abdominal contents, the patient was put in a supine posture with the operating table inclined between 15° and 20° Trendelenburg. For patients younger than a year old, the average intra-abdominal pressure was 6–8 mmHg, and for older children, it was 8–10 mmHg. The bladder was emptied before beginning of the operation. Patients under 1 year

of age were placed in trans-table position for a better work ergonomics.

The umbilicus was used to introduce a single, 5-mm trocar. A 30-degree angled laparoscope was inserted via this trocar, and a CO<sub>2</sub> flow rate of 1-2 L/min was used to maintain a pneumoperitoneum at 8–10 mmHg. Bilateral internal inguinal rings were checked carefully for assurance of indication and exploring the competence of the other inguinal ring. Through independent stab incisions made on the lateral border of the rectus muscles at the midclavicular lines, two more 3-mm trocars were inserted. Using a dissector and scissors, the dissection process began. The initial incision was made in the parietal peritoneum above the internal inguinal ring after the sac had everted. Next, the hernia sac is dissected, with the vas in men and the vascular structures being separated in order to complete the procedure. Using a 3-0 Vicryl laparoscopic needle holder, the suture needle was placed within the abdominal cavity through the right side trocar. At the level of the internal inguinal ring, a purse-string suture was made, removing only the peritoneum and either leaving the distal sac remnant in place or excising it. The same steps were repeated in the contralateral internal inguinal ring in case of bilateral inguinal hernia.

### In open herniotomy

The surgeon was positioned adjacent to the pathology. A supine position was adopted for the patient [6]. Prior to the procedure, the contents of the hernia must be fully decreased into the peritoneal cavity. The skin of the inguinal crease, directly lateral to the pubic tubercle, was incised. The usual size of the skin incision was 1-2 cm. The fascia of the scarpa was located and cut. The anteromedial portion of the cord was found to contain the hernia sac, and upon medial retraction of the sac, the vas deferens and testicular arteries beneath were visible. The sac was cut open. Extra peritoneal fat was frequently used as a marker for the mobilization of the proximal sac to the internal ring. After it was established that the sac was empty. It was twisted around itself and sutured (usually with a rounded needle and braided absorbable 3/0 suture). The sac was then removed, and the wound was closed in layers.

### Post-operative follow-up:

Patients started oral feeding of soft diet 2 hours after complete recovery and they were discharged home after 4 hours. Patients were followed up for 6 months. The first visit was 7 days postoperatively, the second visit was 30 days

postoperative and the third visit was after 3 months. The Last visit by the 6<sup>th</sup> month, Patients who skipped follow up visits was contacted by phone.

### Statistical analysis

Using IBM SPSS Statistics for Windows, Version 23.0 (Armonk, NY: IBM Corp. 2015), all data were gathered, tabulated, and statistically evaluated. Numbers and percentages were used to convey qualitative data, whereas the mean  $\pm$  SD & (range) was used for quantitative data. The t test was used to compare two groups of normally distributed variables. The Mann-Whitney test was used to compare two sets of non-normally distributed variables. The percentages of categorical variables were compared using the Fisher exact test or the Chi-square test. Every test had two sides. A statistically significant P-value was defined as  $p < 0.05$ , whereas a statistically non-significant P-value was defined as  $p > 0.05$  (NS).

## RESULTS

The study included 24 patients within the age range from 1 year to ten years with mean age  $3.63 \pm 2.58$  years. Ten cases were males (41.7%) and 14 cases were females (58.3%). The patients in this study were randomly divided into two equal groups, 12 cases in each. Group A underwent laparoscopic hernia repair while group B had conventional open inguinal hernia repair. Both groups were comparable regarding gender distribution of studied children, age range, maturity, duration of disease, laterality, hernia side, type of hernia and ultrasound defect size, **table 1**.

As regards the intraoperative data, no statistically significant distinction could be found between both approaches as regard the number of surgeons needed during the operation and intraoperative complications which included bleeding, lesions in the ovaries, and injury to the vas deferens/spermatic arteries. However, a statistically significant difference was found in the duration of operation were the laparoscopic approach needed longer duration than the open approach,  $p=0.0001$  as shown in **table 2**.

Postoperatively, **table 3** there were no statistically significant difference between the studied approaches regarding postoperative complications which included pain, infection, recurrence, testicular atrophy and iatrogenic testicular ascent but patient's outcome in Group (A) show that 1(8.3%) had Scrotal hematoma, while in Group (B) 6(50%) had Scrotal edema. the differences

between the groups did not reach statistical significance. The length of hospital stay was

statistically significant longer after the laparoscopic approach, p=0.0001.

**Table 1:** Patients criteria and preoperative assessment

Variables	Laparoscopic Approach N=12	Open Approach N=12	P
	N (%)	N(%)	
<b>Gender</b> n (%)			
Males	4(33.3)	6(50.0)	0.408
Females	8(66.7)	6(50.0)	
<b>Age per years</b>			
Mean ±SD	4.08± 1.44	3.16±3.37	0.053
Range	2-6	1-10	
<b>Maturity</b> n (%)			
Pre term	1(8.3)	5(41.7)	0.15
Full term	11(91.7)	7(58.3)	
<b>Duration of disease (weeks)</b>			
Mean ±SD	2.92±1.5	2.33±0.98	0.36
Range	1-6	1- 4	
<b>Laterality of hernia</b>			
Unilateral	9(75.0)	8(66.7)	0.99
Bilateral	3(25.0)	4(33.3)	
<b>Hernia side</b>			
Right side	11(75.0)	8(66.7)	0.18
Left side	4(25.0)	8(33.3)	
<b>Types of hernia</b>			
Inguinal	7(58.3)	10(83.2)	0.37
Inguinoscrotal	4(33.3)	2(13.5)	0.62
Associated hydrocele	3(25.0)	3(25.0)	1
<b>Ultrasound Defect size(mm)</b>			
Mean ±SD	7.38±2.14	6.58±3.1	0.44
Range	2-10.4	4-15	

**Table 2:** Intraoperative data

Variables	Laparoscopic Approach N=12	Open Approach N=12	P
	N(%)	N(%)	
<b>Number of surgeons</b>			
One	2 (16.7)	4(33.3)	0.64
Two	10 (83.3)	8(66.7)	
<b>Duration of operation(min)</b>			
Mean ±SD	49.75±19.75	19.25±9.26	0.0001*
Median (Range)	60(27-78)	16.5(12-42)	

**Table 3:** Postoperative data

Variable	Laparoscopic Approach N=12	Open Approach N=12	P
<b>Length of hospital stay per hours</b> Mean $\pm$ SD (Range)	24 $\pm$ 3.6 (3-18)	3.3 $\pm$ 0.77 (2-5)	0.0001*
<b>Complications 7 days post operatively</b>			
Pain	5	8(66.7)	0.219
Hematoma/ Edema	1(8.3)	6(50.0)	0.069

## DISCUSSION

As regard demographic data of the patients included in this study, they were comparable among both groups where no statistically significant differences were found in age or gender distribution. As age in group (A) ranged between 2-6 years with mean $\pm$ S.D. 4.08 $\pm$ 1.44 years while in group (B) ranged between 1-10 years with mean $\pm$ S.D. 3.16 $\pm$ 3.37 years, **p = 0.053**. Also gender in group (A) showed that 4(33.3%) were male and 8(66.7%) were female while in group (B) 6(50.0%) were male and 6(50.0%) were female, **p = 0.408**.

The findings of this investigation were consistent with those of the **Al-Taher et al.** study, as they reported that their study was conducted on 155 patients at the Jordan University Hospitals. One-hundred and fifty-five patients were divided into 2 groups; Group I included 100 patients; Group II included 55 patients. Group I (n = 100) underwent open herniotomy (OH) Group II (n = 55) received laparoscopic herniotomy (LH) by intracorporeal suturing of the internal ring in the patent processus vaginalis. The hernia sac was separated from the spermatic cord and then high-ligated in order to achieve this. Age and gender did not significantly differ from one another (p = 0.16).

This study's outcomes were comparable to those of **Suttiwongsing et al.** [7], who split their patient population into two groups: group A underwent laparoscopic hernia repair, while group B underwent open herniotomy. At the time of the first procedure, both groups' median ages were three years old, and there were twice as many men as women. Between the two groups, there were no differences that were statistically significant.

According to this study, there was no statistically significant variation between the

groups as regard number of surgeons sharing in surgery.

**Shibuya et al.** [8] claimed that there was a learning curve for the surgeons doing the procedure and that this was consistent with the experience of the two doctors who were skilled in the LR technique and had conducted several hundred procedures before ceasing to use it in the years prior to 2017. The amount of treatments surgeons must do to become proficient in laparoscopic surgeries varies widely, according to prior research.

According to this study, the LH group's mean operating time was statistically significantly longer than the OH group's either in unilateral or bilateral sided hernia (**p<0.05**).

However, the study of **Zhu et al** [9] reported shorter operative time of bilateral hernia (p=0.001), better scar appearance, less postoperative complications in the laparoscopic group.

Similar to **Suttiwongsing et al.** which indicated that the mean operative time in the LH group was significantly longer than in the OH group in all cases (p=0.013), the results of this study also showed that the operative time for unilateral herniotomies in both male and female patients was significantly longer in the LH group than in the OH group (27.9 $\pm$ 9.6 vs 24.5 $\pm$ 11.5 min, p=0.045 and 20.5 $\pm$ 7.4 vs 15.7 $\pm$ 7.1 min, p=0.004) [7].

The outcomes of this investigation were comparable to those of **Leng et al.** [10] which had 376 inguinal hernia patients who underwent two distinct surgical methods. Group A which included 73 patients underwent laparoscopic herniotomy and group B which included 303 patients underwent open herniotomy claimed that in group B, the mean operating time was 37.8 minutes as opposed to 48.0 minutes for unilateral care (p = 0.02).

However, **Al-Taher et al. [3]** claimed while the two groups' overall mean operative times were comparable,  $45.5 \pm 15.4$  for open group and  $45.7 \pm 15.1$  min for laparoscopic group with  $p$  value = 0.83.

According to this study, there were no differences between the two groups that were statistically significant. Results for patients in Group (A) revealed that 1 (8.3%) had scrotal edema, whereas 6 (50%) in Group (B) had the same condition. However, neither group had any infections, recurrences, testicular atrophy, or iatrogenic ascent of the testis. Later that same day of operation, every patient went back to their regular activities. None of the individuals in either group who had a unilateral hernia also had a contralateral metachronous hernia. On the evening of the day of the procedure or the following day, they were released from the hospital after an uneventful postoperative recovery.

Nevertheless, according to **Olesen et al. [11]**, a recent meta-analysis showed that the incidence of recurrence is minimal (0.3% in the laparoscopic group and 1.1% in the open group) and does not differ substantially between the cohorts undergoing laparoscopy and those undergoing open surgery ( $p=0.34$ ).

According to this study, none of the patients in either group who had a unilateral hernia also had a contralateral metachronous hernia. **Zhu et al. [9]**, however, found that among patients with unilateral hernias, none in the laparoscopic group developed a contralateral metachronous hernia, whereas 10.1% in the open group did ( $p=0.001$ ). Additionally, 65% of patients developed a metachronous hernia three months following the initial hernia surgery. Following the first open hernia repair, patients who were female and had an initial left-sided hernia were more likely to develop a contralateral metachronous hernia.

The results of this study indicated that the length of hospital stay was significantly higher for the laparoscopic technique ( $24 \pm 3.6$ ) compared to the open approach ( $3.3 \pm 0.77$ ),  $p=0.0001$ . On the other hand, the time taken to fully recover was significantly shorter for the laparoscopic group ( $p=0.013$ ) [3].

**Suttiwongsing et al [7]**, revealed that recurrence happened seven months after surgery in just one case in the LH group. Knot disruption was the cause of the recurrence. Only the OH group experienced major complication damage to

spermatic elements and long-term testicular atrophy was not discovered. In our analysis, there was no discernible difference in the two groups' total complication rates. Unfortunately, the brief follow-up period restricted the accuracy of the result.

**Al-Taher et al [3]** revealed that 5% of cases in the open cohort experienced recurrences after an average of 13 months of follow-up, but the laparoscopic group did not record any recurrences.

According to this study, there were no statistically significant differences ( $p>0.05$ ) in the two groups' cosmetic outcomes, which took the parents' pleasure into account.

The findings of this study were in line with those of **Al-Taher et al. [3]** which found no statistically significant changes in the two groups' cosmetic outcomes ( $p=0.70$ ).

The small number of the sample size and the short follow up period are considered limitations of the current study

## CONCLUSION

Open inguinal hernia repair is safe, more feasible and rapid technique. Excellent esthetic outcomes, no testicular atrophy, no iatrogenic ascent of the testis, and a significantly shorter hospital stay were the outcomes.

## Declaration of interest

The authors report no conflicts of interest. The authors along are responsible for the content and writing of the paper.

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## Citation

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