



Paediatrics Surgery

A STUDY COMPARING REPAIR OF PAEDIATRIC INGUINAL HERNIA USING CONVENTIONAL THREE PORT LAPAROSCOPIC TECHNIQUE AND LAPAROSCOPIC ASSISTED INTERNAL RING SUTURING (LAIRS)

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ABSTRACT **Background:** Inguinal hernia surgery is one of the most frequently performed operations in infant and children. Minimal invasive techniques have now become the procedure of choice. Various modifications of single port techniques have been described. We did a study comparing the results of three port technique and LAIRS to assess whether LAIRS can be accepted as a better alternative. **Materials and methods:** A Randomized controlled study was carried out which included thirty-seven children (1 to 12 years of age) with inguinal hernia. The subjects underwent either conventional laparoscopic or repair using LAIRS technique. The outcomes recorded were duration of surgery, post-operative pain, return to routine activity, complications, cosmetic-satisfaction and recurrence over a period of six months follow-up. **Results:** Among thirty-seven children, a total of 43 hernia repair procedures were carried out, including 20 by conventional, and 23 using LAIRS method. No procedures were converted to open. Mean operative time using LAIRS technique was for 23.67±15.40 minutes for unilateral and 47.50±15.0 minutes for bilateral cases; in conventional technique, it was 39.61±10.25 minutes. Most of the patients had mild post-operative pain. There were four recurrences, one in LAIRS and three in conventional group. All patients were satisfied with their scars, although scores were better in LAIRS group. **Conclusion:** Incidence of recurrence were higher in the conventional technique. The LAIRS technique always took lesser operative time and had better cosmetic satisfaction. Considering these and obviating the need of endosuturing, the LAIRS method should be regarded as a better alternative to conventional technique.

KEYWORDS : inguinal hernia, Laparoscopy, LAIRS, operative-time, Recurrence

INTRODUCTION

Inguinal hernia surgery is one of the most frequently performed operations in infant and children. Open herniotomy is regarded as the gold standard of treatment^{1,2,3,27,28}. However, in the recent years laparoscopic hernia repair is routinely performed in many centres and its efficacy and safety are well documented, and it has become the procedure of choice for inguinal hernia repair in children.

The laparoscopic procedure offers several advantages over open technique e.g., being minimally invasive, absence of groin incision, diagnosis of contralateral occult hernia with the possibility to repair it in the same procedure, diagnosis of atypical hernia, minimal risk of injury to the cord structures, and better cosmetic results. The added advantage of laparoscopy in girls is that the Mullerian structures are better visualized and hence eliminates the need for additional investigations like Karyotyping and sonography. This is important as inguinal hernia in girls may be the manifestation of complete androgen insensitivity syndrome (CAIS) with absence of Mullerian structures.

The basic concept in these procedures is to close the internal inguinal ring. In conventional laparoscopic repair, the two working ports, apart from the camera port, are used to perform intracorporeal suturing of the internal hernial ring, following circumferential incision of the peritoneum at the deep ring. Many modifications of the traditional laparoscopic approach have been developed, like subcutaneous endoscopically assisted ligation (SEAL), percutaneous internal ring suturing (PIRS). The single port techniques have used various instruments to deliver the suture in the abdominal cavity.

LAIRS was firstly performed by Neogi S et al¹⁶, in which commonly available intravenous cannulae were used to guide the sutures to laparoscopically close the internal inguinal ring, using a single camera port.

As there is only single port, the post-operative scar is very insignificant. Also, it is a simpler technique with respect to other

similar laparoscopic procedures. There is short operating time involved. We wanted to see these effects in a larger cohort so that, this technique can be established as a standard one. The use of intravenous cannula in this technique also avoided the high cost and non-availability of spinal or epidural needle.

AIMS AND OBJECTIVES:

This study aims to compare the outcomes of the conventional laparoscopic repair and Laparoscopic Assisted Internal Ring Suturing (LAIRS) of paediatric inguinal hernia.

MATERIALS AND METHODS:

Study design: Prospective randomized controlled study

Setting: The study was carried out in the Department of Paediatric Surgery at Maulana Azad Medical College and associated Lok Nayak Hospital, New Delhi

Study Period: 18 months, from July 2021 to January 2022

Sample size: 40

Sample size calculation:

At 95% confidence level and 80% power, taking the recurrence rate of hernia as 4.3% by three port laparoscopic technique and expecting 0% recurrence rate by LAIRS technique in paediatric inguinal hernia patients, sample size was calculated as 177, but due to then current situation of ongoing global pandemic of COVID-19, only 40 subjects were included in the study, with 20 in conventional laparoscopic arm and 20 in LAIRS technique arm.

Inclusion criteria-

1. Boys and girls of age range infancy to 12 years.

Exclusion criteria-

1. Patients with recurrent hernia

2. Atypical hernia
3. Complicated/ irreducible hernia
4. Hernia associated with undescended testis
5. Syndromic children
6. Covid-19 positive patients
7. Parents refusing consent

Procedure and Methodology

The study included thirty-seven children (1 year to 12 years of age) with inguinal hernia. The subjects were randomized using block randomization and underwent either conventional laparoscopic hernia repair or repair using LAIRS technique. All surgical procedures were performed by a single surgeon, a senior consultant of the department for the purpose of homogeneity of the results.

Informed consent was obtained after examining in detail the procedure involved. The Outcome recorded were duration of surgery, post-operative pain (FLACC score), return to routine activity, complications, cosmetic satisfaction (PSAS score) and recurrence of hernia over a period of six months follow up. All the outcome measure were statistically analysed.

Operative Technique:

The patients were placed supine on operating table, and administered general anaesthesia. The monitor was placed on the side of hernia, and the surgeon stood on the opposite side. No preoperative or post operative antibiotics were given. A 5 mm umbilical port was inserted using open technique and pneumoperitoneum created using a pressure of 8 to 10 mm Hg.

- Sutures used- Propylene 4-0 in LAIRS. Polyglactin 4-0 in conventional.
- Other instruments- Intravenous cannula of 18 and 20 G (in LAIRS technique)
- Skin closure- Similar for all patients (with Glue)

Conventional laparoscopic technique-

Creation of the main umbilical camera port (5mm) and two 3mm ports, for working instruments, was inserted under direct vision at the lateral border of both recti at the level of the umbilicus (Figure 1).



Figure 1: Port placement in conventional hernia repair

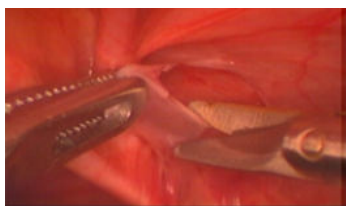


Figure 2: Incision of peritoneum around internal inguinal ring (Conventional)

Inspection of the abdominal cavity and pelvis was done. The peritoneum around the deep ring was circumferentially incised (Figure 2) In males the Vas and the gonadal vessels were separated carefully from the peritoneum medially. Purse string suture using Polyglactin 4-0 was put around internal hernial ring in subperitoneal space, free of vas and testicular vessels in males, and intracorporeal knot tied (Figure 3,4).

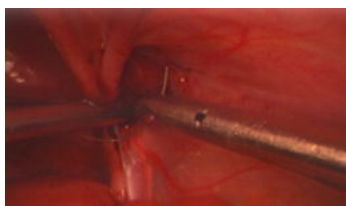


Figure 3: Placement of purse-string suture around the internal ring (Conventional)

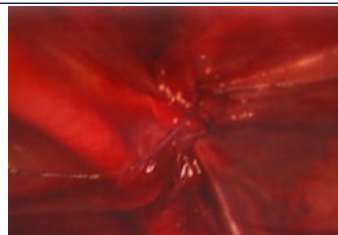


Figure 4: Closed internal ring after knot tying of the suture (Conventional)

LAIRS technique- Camera port was created through the umbilicus and a 5 mm trocar was inserted. A 30-degree telescope was used to inspect the abdominal cavity and pelvis including uterus, adnexa (in females) and status of the bilateral internal rings (Figure 5 & 6).

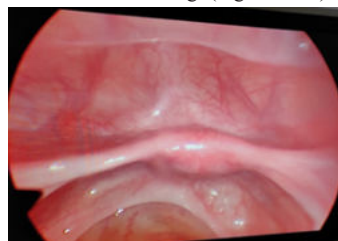


Figure 5: Per-operative picture showing the uterus and adnexa.

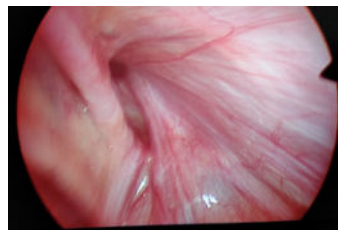


Figure 6: Patent internal inguinal ring

A loop of Polypropylene 4-0 was introduced through the 18G cannula, and a 20G cannula used to deliver Polypropylene 4-0 which was subsequently delivered out of the abdominal cavity by the former loop (Figure 7).

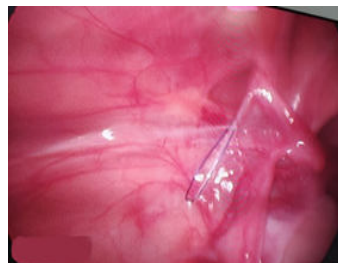


Figure 7: Loop of Polypropylene being introduced (LAIRS)



Figure 8: Closed internal ring after tying of the suture (LAIRS)

The sutures were applied so as to encircle the internal hernia ring by Polypropylene on medial and lateral edges, and the completion of this step was rated by total occlusion of the ring (Figure 8).

The suture thus brought out of abdominal cavity subcutaneously was tied and buried under skin. The duration of surgery was noted by the anaesthetist and was recorded in the proforma.

Follow Up

Patients were followed up post operatively at an interval of 7 days, 1

month and 6 months period respectively. Outcomes were compared regarding duration of surgery, post-operative pain (FLACC scale was used to assess pain), return to routine activity, complications, recurrence and cosmetic satisfaction (PSAS scale).

Statistical analysis

The collected data were transformed into variables, coded and entered in Microsoft Excel. Data were analyzed and statistically evaluated using SPSS-PC-25 version. Normality of data was tested by Kolmogorov-Smirnov test. Quantitative data was expressed in mean, standard deviation and depend on normality distribution difference between two comparable groups were tested by student's t-test (unpaired) or Mann-Whitney 'U' test. Qualitative data were expressed in percentage and statistical differences between the proportions were tested by chi-square test or Fisher's exact test. 'P' value less than 0.05 was considered statistically significant.

RESULTS:

Among thirty-seven children of inguinal hernia, total of 43 hernia repair procedures were carried out. The mean age of children were 5.67±3.43 years in conventional group and 5.85±3.28 years in LAIRS group. There were 21 male (56.75%) (1 with bilateral hernia) and 16 female (43.25%) (4 with bilateral hernia) children (Table 1).

Table 1: Basic profile of study subjects and procedure done

Type of hernia	
Unilateral	33 (86.8%)
Bilateral	5 (13.2%)
Type of procedure	
Unilateral conventional	18
Bilateral conventional	1
Unilateral LAIRS	15
Bilateral LAIRS	4

Nineteen children underwent hernia repair using conventional 3 port technique, while 19 underwent repair using LAIRS technique. Five cases were of bilateral inguinal hernia. 4 of them underwent repair by LAIRS technique (8 procedures) and one by conventional technique (2 procedures). Thus, overall, there were 20 hernia repairs using conventional method (including 12 procedures in males and 8 in females), while 23 repairs using LAIRS method (including 11 procedures in males and 12 in females) (Table 2).

Table 2: Comparison of type of hernia between conventional and LAIRS group

Type of hernia	Conventional group (n=20)	LAIRS group (n=23)	P value
Right	14 (70%)	7 (30.4%)	0.02
Left	4 (20%)	8 (34.8%)	
B/L	2 (10%)	8 (34.8%)	

Right inguinal hernia was repaired in 21 procedures (14 by conventional, 7 by LAIRS) and left-sided repair done in 12 procedures (4 by conventional, 8 by LAIRS). There were 10 repairs for bilateral hernia (2 by conventional, 8 by LAIRS). No procedures were converted to open.

There were no incidences of spermatic cord injury, or injury to vas, or testicular atrophy, although there was one incidence of injury to iliac vein leading to intraoperative hematoma formation.

Mean operative time using LAIRS technique was for 23.67±15.40 minutes for unilateral and 47.50±15.0 minutes for bilateral cases. Mean operative time in conventional technique was 39.61±10.25 minutes for unilateral and 45 minutes for the bilateral case, showing statistically significant difference between the two techniques (Table 3).

Table 3: Comparison of Mean duration of surgery between conventional and LAIRS group

Mean duration of surgery	Conventional group	LAIRS group	P value
Unilateral	39.61±10.25	23.67±15.40	0.01
B/L	45	47.50±15.0	

Initial few cases during the study took comparatively longer duration. The first case of conventional technique took 40 minutes, while the first

LAIRS case took 75 minutes.

The first LAIRS case involved even longer time due to hampered vision of adnexa by sigmoid colon during the procedure. An extra port had to be inserted to aid the procedure, although, suturing was done using single port only.

Immediate post operative period

Most of the patients had mild pain in post-operative period, with FLACC score ranging from 1 to 3. Five patients had pain score of 4, including 1 in conventional and 3 in LAIRS wing. The mean pain score was 2.80±0.76 in conventional group while 2.65±0.71 in LAIRS group, the difference being statistically insignificant (Table 4).

Table 4: Comparison of FLACC score for postoperative pain between conventional and LAIRS group

	Conventional group (n=20)	LAIRS group (n=23)	P value
FLACC score for postoperative pain	2.80±0.76	2.65±0.71	0.52

All the patients resumed routine activities within 1-2 days.

Follow up

One case out of 23 repairs (4.35%), who underwent LAIRS for B/L hernia, presented with recurrence in the first week post-operatively. Three (15%) other patients, out of 20 conventional repairs, presented with recurrence, which occurred 3 months, and 5 months post-operatively (Table 5).

Table 5: Comparison of Recurrence of hernia between conventional and LAIRS group

	Conventional group (n=20)	LAIRS group (n=23)	P value
Recurrence of hernia	3 (15%)	1 (4.35%)	0.32

The LAIRS case with recurrence had undergone a repair of bilateral inguinal hernia repair, in which a complete hernia was diagnosed on right side, while bubonocoele was diagnosed on the left side. He presented on the first follow-up visit after one week post-operatively with evidence of recurrence on the right side. He underwent redo surgery by conventional method, and per-operatively no suture was seen on the recurrent hernial ring (Table 10).

Table 10: Profile of recurrent cases

Recurrent case	Primary procedure	Duration since repair	Treatment for recurrence	Follow-up
1. RIH	Conventional	3 months	Conventional	Underwent recurrence again 3 months after second surgery. Being worked-up for suspected connective tissue disease
2. LIH	Conventional	5 months	Conventional	Uneventful till date
3. B/L	LAIRS	1 week	Conventional	Uneventful till date
4. RIH	Conventional	5 months	Conventional	Uneventful till date

Three (15%) other patients, out of 20 conventional repairs, presented with recurrence, which occurred 3 months, and 5 months post-operatively.

The second recurrent case, who had undergone conventional repair, presented with recurrence 3 months after the surgery, for which redo surgery was done, but the hernia recurred again after 3 months. At the time of completion of this study he was being prepared for redo surgery and planned for work-up of associated muscular or collagen disorder.

The p value of difference between recurrence among conventional and LAIRS technique was 0.32, which was statistically insignificant.

Cosmetic satisfaction

All patients were satisfied with their scars, although significantly higher mean total PSAS scores were demonstrated for patients who

underwent LAIRS compared to the conventional technique (LAIRS, 8.09±0.51; conventional, 7.60±0.50, p<0.01), which was statistically significant.

Complications:

In one case of clinically diagnosed left inguinal hernia, both internal inguinal rings were seen closed upon laparoscopy, and so the procedure was abandoned and was excluded from the study.

In one female case of bilateral inguinal hernia undergoing repair by LAIRS technique, a hematoma formation occurred due to vascular injury on the left side while attempted cannula insertion for delivery of loop of suture; although the procedure was completed and both the rings were closed successfully (Table 11).

In one case, repaired by LAIRS technique, there was mild serosanguinous discharge from umbilical port site when he came on first follow up visit, without any other associated symptoms. No antibiotics were given and it settled subsequently (Table 11).

Table 11: Comparison of Other Complications between conventional and LAIRS group

Other Complications	Conventional group (n=20)	LAIRS group (n=23)	P value
Haematoma	0	1 (4.3%)	1.0
Serosanguinous discharge	0	1 (4.3%)	1.0

DISCUSSION

Inguinal hernia is a common congenital problem in India. Open herniotomy is considered as the gold standard treatment for paediatric hernia^{1,2,3,27,28}. However, minimal access surgery, like in other parts of the body, is also gaining popularity in paediatric hernia repair. The conventional laparoscopic technique included three port intra-corporeal suturing of the deep ring peritoneum. Eventually, many techniques of single port hernia repair have been tried in the search for a quicker and a technique with a better cosmetic outcome.

In our hospital we get referrals from nearby states too. Thirty-seven children underwent hernia repair using laparoscopic method, depending on their suitable inclusion criteria, under whom 43 hernia repair procedures were carried out.

Mean operative time using LAIRS technique was for 23.67±15.40 minutes for unilateral and 47.50±15.0 minutes for bilateral cases. Mean operative time in conventional technique was 39.61±10.25 minutes for unilateral and 45 minutes for the bilateral case. F. Becmeur et al²⁵ in their study of convention repair, have reported an operating time of 23 to 30 minutes for unilateral and 30-40 minutes for bilateral cases. In study by Bharathi S et al³⁴, the mean operating time by conventional method was 25 minutes in unilateral and 40 minutes in bilateral, while by single port SEAL method, it was 15 minutes for unilateral and 25 minutes for bilateral cases. Patkowski et al¹⁰ in their work on PIRS method of hernia repair, have mentioned mean operating time of 19 minutes in unilateral and 24 minutes for bilateral cases. Schier F⁵ reported 16 minutes and 22 minutes for unilateral and bilateral cases respectively. The duration of surgery in our study was similar compared to these studies.

It is important to note that during the initial part of our study COVID protocols were being followed and the surgeons performed surgery using PPE kit and this did contribute to increase the operating time in the initial part.

Laparoscopic hernia repair is especially advantageous in female patients, as we can confirm the presence of adnexal structures, which also obviates the need of pre-operative imaging. In the first case done by LAIRS technique, the attempt to visualise the adnexa was hampered by distended sigmoid colon, for which an extra port had to be introduced. The extra port has not been used for suturing and the suturing was performed as per the protocol for LAIRS.

As expected with any laparoscopic procedure, the post operative pain experienced after laparoscopic hernia repair was quite less, and the patients were soon able to resume their routine activities, although they were advised not to undergo heavy playful activities for a few weeks. The pain scores (FLACC) of the patients in the immediate post operative period ranged from 2 to 4, with insignificant difference

between both the groups (LAIRS, 2.80±0.76; conventional, 2.65±0.71, p 0.52). Kozlov et al³⁹ in their study of 260 children, found no difference in post operative pain among the single port and multiport techniques. Similar reports were found by Moussavi et al. However, Rahman et al⁴⁰ did report less administered pain medication in the extra-corporeal single port technique group compared to the multiport intra-corporeal technique group.

There were four recurrences, one with LAIRS technique and three with conventional technique. One out of 23 repairs (4.35%), who underwent LAIRS for B/L hernia, presented with recurrence in the first week post operatively. The patient presented on the first follow up visit one week post-operatively with evidence of recurrence on the right side. Three other patients, out of 20 conventional repair (15%), presented with recurrence. The second recurrent case, who had undergone conventional repair, presented with recurrence 3 months after the surgery, for which redo surgery was done.

The other two recurrent cases of conventional repair presented 5 and 6 months post operative of their conventional repairs respectively. After their redo repairs, follow ups were uneventful. Per operatively, the appendix was found to be slightly hyperaemic in one of the cases who had recurrence, while in one patient, the appendix was seen encroaching near the internal ring, although it was not inflamed. The presence of inflamed appendix in vicinity of hernial ring could have caused an inflammatory environment, which could have resulted in improper healing and consequent recurrence in that case. However, the diagnosis of appendicitis was not established, and this coincidental finding may have had a role to play in the outcome. No other associated factors were found to be present in other two cases of recurrence.

Patkowski et al¹⁰ have reported recurrence in 3 cases among 140 hernia repairs (2.14%) done by single port PIRS method. Bharathi S et al³⁴ have reported a recurrence in 7 out of 146 repairs (4.8%) done by SEAL method and in 2 out of 67 conventional repairs (2.98%). In their study, the probable causes of recurrence quoted were omission of part of the circumference of the ring while jumping over the vas and vessels, inappropriate plane of placement of the loop and knot, leading to subsequent loosening of ligature and early dissolution of absorbable thread before the obliteration of patency of the sac. Montupet and Esposito²⁶ have reported 4 cases of recurrence in 45 repairs (8.9%) done by conventional three port laparoscopy. Saha M⁴¹ in his study of 43 hernia repair procedures done by single port method, reported one case of recurrence (2.32%) done by conventional technique.

The recurrence rates of LAIRS technique done by us were similar to other studies involving single port repair. Among conventionally repaired cases, the one patient having recurrence was suspected to be having some type of collagen vascular or muscle laxity disease, as his hernia recurred again after redo surgery, and he had to undergo surgery for the third time. If this patient's recurrence is excluded, the rate is 10%, which is comparable to other studies.

In one case of LAIRS (4.3%), a hematoma formation occurred due to vascular injury on the left side while attempted cannula insertion for delivery of suture loop; although the procedure was completed and both the rings were closed successfully. Her follow up had shown no adverse sequelae. Bharathi S et al³⁴ have mentioned an incidence of 2.98% (2 out of 67) for vascular injuries in three port repairs and 1.37% (2 out of 146) in SEAL repairs. Patkowski et al¹⁰ have mentioned 3 (out of 140 repairs, 2.14%), cases of small haemorrhage after iliac vein puncture with no sequelae. Incidence of vascular injuries in these studies were comparable to our study.

Bharathi S et al³⁴ in their comparative study between 3 port and single port repair, have stated that cosmesis was good in all patients, but the three-port technique left behind three 5-mm scars in place of one by SEAL, and theoretically, that was an advantage of SEAL. Patkowski et al¹⁰ in their study on PIRS, have mentioned that the cosmetic results after PIRS were excellent, with no scars in the inguinal region and an almost invisible scar in the umbilicus.

Similarly, in our study, all the patients were satisfied with their scars, although significantly higher mean total PSAS scores were demonstrated for patients who underwent LAIRS compared to the conventional technique (LAIRS, 8.09±0.51; conventional, 7.60±0.50, p<0.01). Although other scoring systems were used by some authors, like SCAR scale by Wang et al⁴², a subjective scoring system by

Shalaby R et al¹⁵, we have not found any studies using the PSAS scoring system being used for evaluating post-operative cosmesis. Nevertheless, our results were comparable to other studies. The presence of single incision at umbilicus, the natural scar, which after healing, apparently leaves no visible mark, makes LAIRS patients happier as compared to conventional 3 port repaired patients, in whom, although small, but 2 additional faint port sites incision scars were visible.

CONCLUSION:

Open herniotomy is regarded as the gold standard of care in paediatric age group, but as seen in other operative fields, the trend is gradually being shifted towards minimal access techniques, and so is the case with laparoscopic hernia repair. This is especially helpful in female patients where one can also check the mullerian structure and obviate the need of pre-operative imaging studies. In males too, laparoscopic hernia repair has been found to be useful in terms of early return to routine activity, less post operative pain and better cosmetic results, although we have not found any studies comparing all these results in Indian context. Incidence of recurrence were higher in the conventional technique, but the difference was not significant. Comparing to conventional three port technique, the LAIRS technique always took lesser operative time, and had better cosmetic satisfaction, and both of these had statistically significant differences. Considering these and obviating the need of endosuturing, the LAIRS method should be regarded as a better alternative to conventional technique.

Limitations

The main limitation of our study was the small number of subjects, due to which some result data were skewed. A larger cohort, followed up to a longer duration of period would have provided a better analysis of our study. Another limitation is that the initial part of the study overlapped with COVID, and the surgeries were performed using PPE kits making it slightly difficult to manoeuvre.

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Conflict of interest: The authors declare that they have no conflicts of interest.

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