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ORIGINAL ARTICLE

# High recurrence rate of children's inguinal hernia after percutaneous internal ring suturing: a single-center study

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## Abstract

**Aim** To evaluate and compare the differences in recurrence rates of post inguinal hernia repair in children using Laparoscopic Intracorporeal Closure of the Processus Vaginalis (LICPV) and Percutaneous Internal Ring Closure (PIRS) operating techniques and compare them to published data.

**Methods** A retrospective data analysis of children who underwent LICPV or PIRS techniques between 2005 and 2018 in the tertiary paediatric surgery department of university hospital was done. We analyzed demographic data, operating time, the influence of surgeon, recurrence rate, and the time until recurrence within an observed period of time post-operatively.

**Results** A total of 240 patients underwent laparoscopic inguinal hernia repair procedures between 2005 and 2018. Of them 138 (57.5%) were male and 102 (42.5%) were female, with mean age of 6.48 (SD ± 4.7). LICPV method accounted for 170 (70.8%) inguinal hernia repairs, whilst 70 (29.2%) underwent the PIRS procedure. The overall recurrence rate was 8.3%; it was significantly higher in the PIRS group (18.6% versus 4.11%, $p < 0.05$). Males presented higher recurrence rates over females across both procedures. The mean time taken for any recurrence to happen was shorter in patients who underwent the PIRS method as opposed to LICPV techniques, 3.3 and 6.5 months, respectively ($p > 0.05$).

**Conclusion** In our hands, a significantly higher recurrence rate exists for children undergoing the PIRS method over LICPV techniques when treating inguinal hernias.

**Keywords** PIRS · Percutaneous internal ring closure · Children · Laparoscopic inguinal hernia repair · Laparoscopic intracorporeal closure of the processus vaginalis · Pediatric surgery

## Introduction

Congenital inguinal hernias are the most prevalent paediatric condition, affecting around 5% of the population, resulting in operative treatment [1]. This type of hernia is diagnosed 8–10 times more often in males than in females, with 60% of cases occurring on the right side and 10% of cases being diagnosed as a bilateral hernia [2]. The traditional open hernia repair has been a gold standard operation. However, over the last two decades, minimally invasive surgery has challenged conventional methods due to better cosmetic results and a quicker recovery [3]. Therefore, many centers routinely started opting for laparoscopic hernia repairs over the open approach in children [4]. The most common traditional laparoscopic technique for an inguinal hernia repair is performed with two or three ports and requires intraperitoneal suturing—laparoscopic intracorporeal closure of the processus vaginalis (LICPV). The percutaneous internal ring closure (PIRS) is an operative technique that was introduced around 2004 in Poland by Dariusz Patkowsky and started being used widely among other paediatric surgeons for inguinal hernia repairs [5]. The PIRS technique is performed via one umbilical port and a puncture to the skin in the groin with extracorporeal tying. This results in a much simpler and rapidly performed procedure [6]. Extraperitoneal laparoscopic repair of inguinal hernias in children was suggested for many following authors as an alternative with a low recurrence rate of 0.88% and minimal scarring. Accordingly, we adopted this technique primarily in our daily practice for inguinal hernia repair from 2016 to 2018. After using PIRS for a number of years, we found our recurrence rates did not reflect the numbers initially published upon introduction. This prompted our retrospective data analysis of procedures

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undertaken to identify any notable differences between our LICPV method and PIRS.

## Methods and materials

This is a retrospective study comparing results from children with inguinal hernias treated via PIRS between 2016 and 2018 versus children treated via LICPV between 2005 and 2016.

*Operating techniques* The PIRS procedure and LICPV operations were performed under endotracheal anaesthesia with muscle relaxation in the supine position, using 3 or 5 mm instruments. Pneumoperitoneum with 8–12 mmHg pressure was established with carbon dioxide depending on age.

*LICPV technique* Laparoscopic purse-string suture of hernia sac was made at internal inguinal ring leaving the distal sac intact using non-absorbable braided suture (Ethibond) size depending on the patient's age (from 2/0, till 4/0) with intracorporeal knot tying in. PIRS technique: Under laparoscopic guidance, depending on the age, 22 or 20-gauge spinal needle with 3/0 or 4/0 polypropylene thread inside of the barrel was introduced into the abdominal cavity and made a loop. Then the needle was pulled out, leaving the loop inside of the abdomen. Another 3/0 or 4/0 polypropylene thread was introduced into the barrel of the needle again. The thread was passed 360 around the internal ring and recovered outside by pulling on the loop. The thread was tied in one externally, thus forming a purse string that obliterated the ring. The knot was buried subcutaneously.

Up to 2016, our three certified pediatric surgeons performed only LICPV; between 2016 and 2018, we used exclusively PIRS. The criteria for laparoscopic hernia repair were the availability of a surgeon and the parents' consent to laparoscopic hernia repair. Children were included from 0 months to 18 years of age. The demographic data, operating time, the influence of surgeon and the recurrence rate, also the time until recurrence within an observed period of time post-operatively were analyzed. The data additionally analyzed in three age brackets of 0–6 years, 7–13 years, 14–18 years. We did not collect any intraoperative details. The ratios were compared using Chi-square criterion, means were compared using *t*-test, Logistic regression analysis was used calculating an odds ratio associated with recurrence, and recurrence was considered as a dependent variable. Statistical significance was defined as $p$-value $< 0.05$. Ethical approval was issued by the Ethics Committee (protocol No. BEC—LSMU(R)—48).

## Results

A total of 240 patients underwent laparoscopic inguinal hernia repairs between 2005 and 2018. The gender distribution between patients was 138 (57.5%) male and 102 (42.5%) female, with mean age of 6.48 (SD ± 4.7). There were 132 (55%) right sided inguinal hernias and 108 (45%) left sided inguinal hernias ($p > 0.05$). 170 (70.8%) patients underwent LICPV whilst 70 (29.2%) were treated using the PIRS procedure. The mean operative time for unilateral hernia repair was shorter in the PIRS group than in the traditional laparoscopic group taking 20.03 min ± 7.45 versus 28.21 min ± 6.33 respectively. Similarly, in the time taken for bilateral hernia repair, we saw PIRS procedures completed quicker than traditional methods taking 36.01 min ± 8.05 versus 45.65 min ± 5.48 respectively ($p < 0.05$). We did not check the difference in operative time between boys and girls. There was no statistical significance between patients treatment groups based on patient's side in which the hernia was located. There was significantly higher proportion of boys in PIRS laparoscopical hernia repair group—18 (26%) female in the PIRS group and 82 (49%) in the LICPV (Table 1).

The overall recurrence rate was 8.3%; it was significantly higher in the PIRS group (18.6% versus 4.11%, $p < 0.05$) The mean time taken for any recurrences to happen was shorter in patients who underwent the PIRS method as opposed to traditional techniques, 3.3 and 6.5 months respectively ($p > 0.05$) (Table 2).

In the LICPV group, recurrences occurred only in boys and were not seen in girls, whereas recurrences in girls occurred only with the PIRS technique (Table 2). The recurrence rate was higher in all age groups in the PIRS, this difference reaching statistical significance in the 0–6 years old group (Table 3). We compared odds ratio for

**Table 1** The comparison between PIRS and LICPV groups

| | Hernia repair method | | *p* value |
|---|---|---|---|
| | PIRS $n = 70$ | LICPV $n = 170$ | |
| Gender | | | |
| Female | 18 | 84 | < 0.05 |
| Male | 52 | 86 | < 0.05 |
| Age, years (mean, SD) | 5.3 ± 3.9 | 6.9 ± 4.9 | < 0.05 |
| Inguinal hernia side | | | |
| Right | 42 | 90 | > 0.05 |
| Left | 28 | 77 | > 0.05 |
| Procedure time, min. (mean, SD) | | | |
| Unilateral | 20.03 ± 7.45 | 28.21 ± 6.33 | < 0.05 |
| Bilateral | 36.01 ± 8.05 | 45.65 ± 5.48 | < 0.05 |

**Table 2** Recurrence rate of PIRS and LICPV hernia repair

| | Hernia repair method | | *p* value |
|---|---|---|---|
| | PIRS | LICPV | |
| Recurrence rate total | 13 (18.6%) | 7 (4.1%) | < 0.05 |
| Recurrence rate between gender | | | |
| Female | 3 (16.7%) | 0 (0%) | < 0.05 |
| Male | 10 (19.2%) | 7 (8.1%) | < 0.05 |
| Recurrence time from surgery, months (mean, SD) | 3.3 ± 1.9 | 6.5 ± 3.7 | < 0.05 |

**Table 3** Number of laparoscopic hernia repair and recurrencies in different age groups

| Age group | Hernia repair number | | Hernia repair recurrencies | | |
|---|---|---|---|---|---|
| | PIRS | LICPV | PIRS | LICPV | *p* value |
| 0–6 years | 44 | 95 | 8 (18.1%) | 4 (4.2%) | < 0.05 |
| 7–13 years | 21 | 50 | 2 (9.5%) | 1 (2.0%) | > 0.05 |
| 14–18 years | 5 | 25 | 1 (20.0%) | 2 (8.0%) | > 0.05 |
| Total | 70 | 170 | 13 (18.6%) | 7 (4.1%) | < 0.05 |

recurrence between surgeons and did not find any significant difference (odds ratio 1.5, 95%, CI 0.80–2.9).

There were no complications (bleeding, infection, internal organs' lesion) neither groups.

## Discussion

While the open approach for inguinal hernia repair in children is still widely used, there are now different techniques available for laparoscopic inguinal hernia repair. Laparoscopic percutaneous extraperitoneal closure (LPEC) was introduced in 1995 by Takehara et al. [7]. Subcutaneous endoscopically assisted ligation (SEAL) for paediatric inguinal hernia also was shown to be a safe and fast operative technique [8]. Li et al. reported their good experience with laparoscopically assisted simple suture obliteration (LASSO) using an epidural needle in 207 children undergoing 251 hernia [9].

Laparoscopic inguinal hernia repair method is expected to produce much better cosmetic results than open repair with relatively low recurrence rates amongst surgeons well versed in such techniques.

Laparoscopy gives the opportunity to observe a contralateral side hernia or other pathology in the intra-abdominal cavity [4, 10]. Laparoscopy shows the anatomy of the inguinal area and potentially save the child from either an incorrect diagnosis of the hernia type or the occurrence of a metachronous hernia if a contralateral PV is encountered.

Many different techniques have been proposed for laparoscopic inguinal hernia repair to either optimize the operation in regards to time taken and ease, or simply to decrease the complication rate. Two principles are in use today. The intra-abdominal inguinal internal ring can be closed via either intra- or extra-corporeal knotting [2, 10, 11]. In 2004, Patkowski developed his own laparoscopic technique of inguinal hernia repair in children. The technique of 'percutaneous internal ring suturing' (PIRS) is performed using only one umbilical port and a needle puncture point. This leaves only a single, nearly invisible scar in the umbilicus [5, 11, 12]. The PIRS method was reported to be advantageous for its shorter operative time, lower cost, minimal scarring and overall simplicity when compared to previous methods. Since the knot is extracorporeal in the PIRS technique, the method is relatively fast in experienced hands. Ligation of the suture intracorporeally in traditional laparoscopic approaches is a relatively more difficult procedure that could prolong the operation time compared to an extracorporeal knot. These presumptions were supported through our data, confirming that the operating time was shorter in the PIRS group when compared with the traditional laparoscopic group, however, it is not as relevant to the clinical practice.

Previous publications demonstrated a low recurrence rate with the utilization of the PIRS technique [4]. Our study did not corroborate those results, concluding with quite a higher recurrence rate of 18.57% when compared to only 4.11% with the LICPV group. Some authors in their opinion, incising the peritoneum lateral to the internal inguinal ring which possibly prevents a recurrence [13]. We speculate that there could be several reasons that could influence such a higher recurrence rate in the PIRS group. First of all, even though the extracorporeal knotting is faster and easier to make than the intracorporeal suturing, the subcutaneous tissue that remains between the internal ring and the knot can result in an improperly tightened, loose knot. Secondly, there could be an expansion of the internal ring itself as a result from either a lack in thread tension or from the intra-abdominal pressure to the internal ring. Since retreatment was required after recurrent hernias, in several cases the knot still visible and tied laying on the side of the open internal ring. We think this can be due to a bite being taken too shallow in the peritoneum when performing the suture or due to a necrosis of the surrounding tissue around the knot. Injuries to surrounding anatomical structures are other possible complications that would affect negatively the overall result. Specifically in boys, potential injuries to the spermatic cord structures could potentially damage testicular vascularization [14]. Some authors suggest, that the gender of the patient could influence the operating results. This is due to the risk of anatomical particularity that could cause the disruption of testicular vascularization or entrapment

of ilioinguinal nerve. The risk of injury to the spermatic cord or the ilioinguinal nerve was studied [11, 15, 16] and found to be insignificant. According our data the recurrence rate we observed is similar in boys and girls operated by PIRS, so the anatomical complexity of boys possibly is not the reason for recurrence in PIRS group. There were no instances in girls with LICPV in our patients. In addition, we looked for other risk factors that might influence the high recurrence rate in the PIRS group but there was no statistical significance between patient age or hernia side across either operating technique. When we observed the recurrence rates across different age groups as listed in Table 3, we identified that the recurrence tends is higher in PIRS surgical techniques amongst younger children (0–6 years). We can hypothesize that in the other groups, the trends were the same but did not reach significance because of the smaller number of patients enrolled.

The possibility that poor results in the PIRS group was due to technique errors was suspected with it being such a novel method. Other authors state that learning curve takes about 35 patients per surgeon [17]. According to our data, we did not observe less recurrences during the second year of our experience; there were no difference in the results of the three individual surgeons performing the operations. Thus, we believe that the technique itself is the issue. From our data, there is a significantly higher hernia recurrence rate in patients operated via the PIRS method when compared to LICPV.

## Conclusion

Our data shows a higher recurrence rate with the PIRS technique performed at our center compared to laparoscopic intracorporeal closure of processus vaginalis. LICPV. We suggest that long term careful follow-up should be carried on after laparoscopic hernia repair of children and that results less satisfactory than those in the literature should also be published. In future, we suggest surgeons to be aware of the possible high recurrence rates associated with the PIRS method, especially in both males and younger children (0–6 years) specifically.

### Compliance with ethical standards

**Conflict of interests** There was no conflict of interests.

**Ethical approval** Ethical approval was issued by the Ethics Committee of the Lithuanian University of Health Sciences (protocol No. BEC—LSMU (R)—48).

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