# Laparoscopic Pediatric Inguinal Hernia Repair with Percutaneous Internal Ring Suturing with Finer Needle and Suture; A 5-Year Experience of A Single Surgeon

## Perkütan İnternal Ring Süturizasyonu Tekniği ile Daha İnce İğne ve Sütur Kullanılarak, Laparoskopik Pediatrik İnguinal Herni Onarımı; Tek Cerrah, 5 Yıllık Deneyim

Aybegüm KALYONCU AYÇENK

Department of Pediatric Surgery, Ordu University Faculty of Medicine, Training and Research Hospital, Ordu, Türkiye

## ABSTRACT

**Objective:** Percutaneous internal ring suturing (PIRS) method is an effective minimally invasive laparoscopic method that was preferred for indirect hernia repair in children. The aim of this study is to report the evaluation of surgical results in our PIRS series modified with finer needle and suture with the diagnosis of indirect inguinal hernia, communicating hydrocele and incarcerated inguinal hernia.

**Material and Methods:** This was a retrospective study that included children aged 3 months to 12 years who under went PIRS technique dueto inguinal hernia between 2017 and 2022. Per-operative findings, surgical time, follow-upfindings, complications, and recurrence data were evaluated.

**Results:** One hundred patients underwent a total of 129 PIRS procedures. Right side were diagnosed in 63 (63%) of the patients (1 communicating hydrocele and 1 recurrent inguinal hernia). One communicating hydrocele and one recurrent inguinal hernia were present on the left side of 32 (32%) patients. Five patients were diagnosed bilaterally (one incarcerated hernia). 24 patients (29%) with no symptoms were found to have contralateral hernias: 11 on the right (45%) and 13 on the left (55%) side. The average duration of surgery for unilateral PIRS was 13.5 minutes and bilateral PIRS was 24.3 minutes. Average follow-up duration was nine months. There were complications in nine patients (9%). Recurrence was observed in 3 (3%) of 100 patients.

**Conclusion:** PIRS is a simple and safe alternative to open hernia repair in terms of surgical outcomes for the management of inguinal hernia in children.

**Key Words:** Children, Complication, Inguinal hernia, Laparoscopic, Percutaneous, Recurrence

## ÖZ

**Amaç:** Çocuklarda indirektinguinalherni onarımında perkütaninternal ring süturizasyonu (PİRS) minimal invaziv, kolay uygulanan ve güvenli bir laparoskopik cerrahi tedavi yöntemidir. Bu çalışmada indirektinguinalherni, kominikanhidrosel ve inkarsereinguinalherni tanılarıyla daha ince iğne ve sütur kullanılarak modifiye edilmiş PİRS tekniği ile opere edilen hastaların cerrahi sonuçlarının değerlendirilmesi amaçlanmıştır.

**Gereç ve Yöntemler:** Bu çalışmada 2017-2023 yılları arasında, 3-12 yaş aralığında, PİRS tekniği ile opere edilen hastaların dosyaları retrospektif yöntemle taranmıştır. Hastaların yaşı, cinsiyeti, kilosu, inguinalherni/kominikanhidrosel/inkarsereherni tanı ve taraf bulgusu, hastalık öyküsü, cerrahi bulgusu, cerrahi süresi, komplikasyon ve rekürrens bilgisi çalışmaya dahil edilmiştir.

0000-0002-9853-3803: KALYONCU AYÇENK A

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**Ethics Committee Approval / *Etik Kurul Onayı*:** This study was conducted in accordance with the Helsinki Declaration Principles. This study was approved by the Ordu University Clinical Research Ethics Committee (protocol No.2023/104-14.04.2023).

***Contribution of the Authors / Yazarların katkısı*: *KALYONCU AYÇENK A:*** Constructing the hypothesis or idea of research and/or article, Planning methodology to reach the Conclusions, Organizing, supervising the course of progress and taking the responsibility of the research/study, Taking responsibility in patient follow-up, collection of relevant biological materials, data management and reporting, execution of the experiments, Taking responsibility in logical interpretation and conclusion of the results, Taking responsibility in necessary literature review for the study, Taking responsibility in the writing of the whole or important parts of the study, Reviewing the article before submission scientifically besides spelling and grammar.

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Correspondence Address / Yazışma Adresi:

**Aybegüm KALYONCU AYÇENK**
Department of Pediatric Surgery,
Ordu University Faculty of Medicine, Training and Research Hospital, Ordu, Türkiye
E-posta: aybegumkalyoncu@gmail.com

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**Bulgular:** 100 hastaya 129 PİRS prosedürü uygulanmıştır. Preoperatif değerlendirmede 63 hastada (%63) sağ taraf bulgusu saptanmıştır (1 kominikanhidrosel, 1 rekürreninguinalherni). 32 hastada (%32) sol taraf bulgusu saptanmıştır (1 kominikan hidrosel,1 rekürreninguinalherni). 5 hastada bilateral taraf bulgusu mevcuttur (1 inkarsereherni). 24 hastanın (%29) asemptomatikkontralateralhernisi saptanmıştır. Bu hastaların 11'i (%45) sağ tarafta, 13'ü sol taraftaydı (%55). Tek taraflı PİRS onarımı ortalama cerrahi süresi 13.5 dakika, bilateral PİRS onarımı ise 24.13 dakika sürmüştür. Tüm hastaların ortalama takip süresi 9 aydır. Hastaların 9'unda komplikasyon gözlenmiştir (%9). 3 hastada rekürrens saptanmıştır (%3).

**Sonuç:** İndirektinguinalherni tedavisinde cerrahi sonuçlar değerlendirildiğinde PİRS yöntemi, açık herni onarımına bir alternatif olarak kolay uygulanan, güvenli ve minimal invaziv bir tedavidir.

**Anahtar Sözcükler:** Çocuk, Komplikasyon, İnguinal herni, Laparoskopik, Perkütan, Rekürrens

## INTRODUCTION

Congenital indirect inguinal hernia is the most prevalent disease in children, affecting 1–5% of the population (1). Boys are diagnosed with indirect inguinal hernia more frequently than girls and 60% of cases occur on the right side 10% are diagnosed as bilateral hernias. In newborns, the risk is significantly increasing to 5% of full-term and %30 of preterm infants (2, 3). High ligation of the hernia duct at the level of the internal ring is the only therapy for indirect inguinal hernia. (4). Although open herniorrhaphy continues to be the dominant treatment for inguinal hernia, laparoscopic repair has gained widespread acceptance. In 1997, El-Gohary et al. (5) reported for the first time the laparoscopic repair of inguinal hernias in female patients. Since then, laparoscopic procedures are typically performed via two or three incisions and require internal ring suturing. In 2006, Patkowski D. described the PIRS procedure, which is performed via a single umbilical optic port and an external skin puncture (6).

Since numerous laparoscopic techniques have been reported, pediatric surgeons have begun to debate the limitations of the open technique, which include the need for wide inguinal tissue dissection, the inability to detect contralateral metachronous hernias, and the inability to differentiate between direct and indirect inguinal hernias. The risk of complications with an open technique ranges from 1% to 3.5%, and the risk of testicular atrophy is 1% (7, 8). All dissections performed on the cord during surgery result in impaired testicular vascularization and volume loss (9). Especially infants, who have anatomical challenges such as the fragility of the hernia sac and the susceptibility of the spermatic cord to open technique dissection, require more technical surgical skills (10). Conversely, minimally invasive surgical techniques are developing swiftly throughout the world. Extraperitoneal laparoscopic repair of inguinal hernias has a low recurrence rate, minimal scarring, detection and repair of contralateral metachronous hernias, and less pain than open surgery (5). Children undergoing laparoscopic and open inguinal hernia repair have comparable operative durations, complication rates, and recurrence rates for unilateral hernias. Laparoscopic bilateral hernia repair has been demonstrated to be faster (11). This study aims to report the surgical outcomes of our modified PIRS series, which utilizes a finer needle and suture.

## PATIENTS and METHODS

This is a retrospective analysis of a single center involving patients who were diagnosed with inguinal hernia and communicating hydrocele between 2017 and 2023 and repaired with the PIRS technique. The demographic characteristics, side of inguinal/ incarcerated hernia/communicating hydrocele at the time of diagnosis, medical history, per-operative findings, operation, surgical time, follow-up findings, complications, and recurrence rates of patients were recorded. A single surgeon performed all the procedures. This study was approved by the Ordu University Clinical Research Ethics Committee (protocol No.2023/104-14.04.2023).

### Patients Demographics

The study included a total of 100 patients. Of these patients, 48 girls and 52 boys, mean age 40 months (2–144 months), 95 patients were operated on with the diagnosis of inguinal hernia, two patients with communicating hydrocele, two patients with recurrent inguinal hernia (the first operation was performed as an open herniorrhaphy at another center), and one patient with the diagnosis of incarcerated hernia. During the preoperative examination of these patients, 63 were marked on the right side, 32 on the left, and five were marked on both sides.

### Operation Technique

All procedures were performed under general anesthesia with local anesthesia administered to the umbilical and inguinal incision sites. The patients received a single dose of prophylactic antibiotics. In a supine position, a 5-mm trocar was inserted into the abdomen using the open Hasson technique. Allprocedures were utilized with an insufflation pressure of 8 mmHg. A 5mm telescope with a 30-degreeviewing angle was utilized. After exploring the internal ring areas on both sides, testicular vessels, cord or ovary, and adjacent tissues, a 2mm stab incision was made to the hernia-related area. During repair, a 20G angiocath needle and a 3/0 non-absorbable monofilament suture were used (Figure 1). Due to the use of a thinner needle, loops, and sutures were created by leaping at least twice from the peritoneum along the canal wall. In males, while suturing the canal using the standard PIRS technique, special care was taken to avoid the cord and vascular elements. To prevent postoperative hydrocele, external pressure was applied to the inguinal canal while the suture was secured in

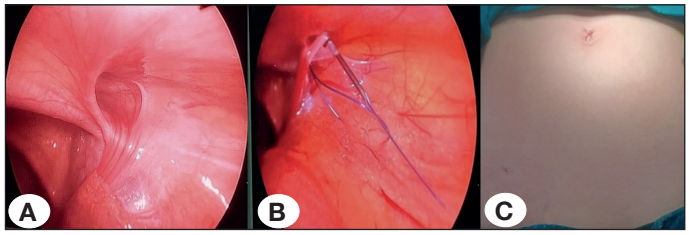


**Figure 1: A)** Patent processus vajinalis, **B)** İnternal ring suturing with 20 G angiocath and 3/0 non-absorbablesuture, **C)** Postoperative view.

the extracorporeal region. Using the same technique, a second suture was placed in patients who were deemed to have an open area after the procedure. When a metachronous hernia was discovered during the primary side repair, the contralateral side was also repaired. The patients were fed two hours after surgery and discharged on the same day. Following discharge, patients were evaluated in the outpatient clinic one week, one month, and six months later.

## RESULTS

One hundred patients underwent a total of 129 PIRS procedures. 48 of these patients were female (48%), 52 were male (52%), their average age was 40 months (2–144 months), and their average weight was 15kg (Table I). The right side was the diagnosis for 63 (63%) of the patients who presented to the outpatient clinic (1 communicating hydrocele and 1 recurrent inguinal hernia). One communicating hydrocele and one recurrent inguinal hernia were present on the left side of 32 (32%) patients. Five patients (5%) had bilateral side diagnoses. 24 patients (29%) with no symptoms were discovered to have contralateral hernias preoperatively: 11 on the right (45%) and 13 on the left (55%) side. All were repaired inthe same session.

15 of 100 patients were infants, or younger than one year-old (15 percent). With the diagnosis of metachronous hernia, bilateral PIRS was performed on six of the nine patients who underwent surgery for unilateral hernia. One of these patients was a one-year-old who underwent surgery for a left incarcerated hernia. During the operation, it was discovered that the ovary caused incarceration; consequently, an additional conduit was inserted and the ovary was reduced. There were no complications during the metachronous hernia repair procedure. A 6-month-old infant was diagnosed with bilateral inguinal hernia owing to a left-sided ovary and underwent surgery for the condition. One additional functional port was added, and the operation was concluded.

Six patients did not achieve effective closure following the primary hernia side suture; therefore, the second suture was performed using the same technique, and the procedure was successful. On the side with two sutures, only one of these six patients experienced a recurrence.

**Table I: Patient characteristics of variables, complication and recurrence total rate.**

| | |
|---|---|
| Age, median, month | 40 |
| Weight, median (kg) | 15 kg |
| Gender* | |
| Female | 48 (48) |
| Male | 52 (52) |
| Side* | |
| Right | 63 (63) |
| Left | 32 (32) |
| Bilateral | 5 (5) |
| Contralateral Hernia* | 24 (29) |
| Right | 11 (45) |
| Left | 13 (55) |
| Complication Total* | 9 (9) |
| First 50 patient | 6 (12) |
| Last 50 patient | 3 (6) |
| Recurrence Total* | 3 (3) |
| First 50 patient | 2 (4) |
| Last 50 patient | 1 (2) |

***** *n(%)*

The average duration of surgery for unilateral PIRS was 13.5 minutes and bilateral PIRS was 24.3 minutes. No patient underwent an open operation. The average length of hospitalization for patients is nine hours.

Complications were observed in 9 patients (9%).İliac hematoma developed during the procedure in 3 patients. The hematoma was controlled by external pressure. No recurrence was observed in the follow-up of two of these patients. Complications such as pain, wound infection, ileus were not observed in any of the patients Six patients complained of suture palpation at the inguinal incision site in the first month of follow-up. This complaint was resolved during the sixth month of patient follow-up.Recurrence was observed in 3 of 100 patients (3%). The first of these patients was a 30-month-old female patient, and recurrence was observed in the 6$^{th}$ month.Considering the operation note of this patient, it was observed that 2 sutures were placed on the left side where recurrence was observed. Open herniorraphy was performed to this patient.During the operation, both sutures were seen under the skin as a loop independent of the processus vaginalis. The second patient, a 36-month-old girl, presented with recurrent right inguinal hernia in the second month.In this patient, PIRS operation was performed for the second time. In the second operation, a smaller canal opening was observed compared to the first. No suture was observed. No recurrence was observed in the follow-up. The third patient was 3.5 months old, diagnosed with bilateral inguinal hernia with a history of prematurity.In this patient, recurrence was observed on the 9$^{th}$ postoperative day on the right side with a wider opening. Open herniorraphy was performed to this patient.

When comparing the complication and recurrence rates between the first 50 patients and the last 50 patients, the complication rate in the first 50 patients is 12% (n:6) and the

recurrence rate is 4% (n:2), whereas in the second 50 patients, these rates decrease to 6% (n:3) and 2% (n:1), respectively.

## DISCUSSION

El-Gohary, Misra D, and Schier F. first performed laparoscopic inguinal hernia repair on children (5,12,13). However, in these three repair procedures, three apertures were utilized. In 2006, Patkowski et al. (6) developed the PIRS technique and published their first series. This technique utilizes a single telescope aperture. The most significant advantages of the PIRS method are its simplicity, its minimal material requirements, and its brief operation time.

Because of its low recurrence and complication rates, open herniotomy (OH) has been the standard treatment for pediatric inguinal hernias. However, there are numerous advantages to laparoscopic repair over OH repair. Advantages of laparoscopic repair include minimal invasiveness, scar advantage, less discomfort and pain medication, shorter operation time, faster postoperative recovery, and the ability to see contralateral hernias.

In Patkowski's series, a 2.0 non-absorbable monofilament suture is utilized with an 18-gauge needle in the PIRS technique. In this study, the PIRS technique was performed with a finer needle and suture (6). The rate of complications in Patkowski's series was 6.6%, while ours was 9%. In Patkowksi's series, the recurrence rate was 2.1%, whereas in our series, it was 3%. In the second 50 patients, the complication rate decreases to 6% when the learning curve is evaluated. In light of these findings, it is recommended that thinner needles and sutures be used in the PIRS technique for the peritoneal jumping in order to reduce invasiveness and increase manipulation ability.

Laparoscopy has a number of significant advantages, one of which is the shorter duration of the operation. In this study, the mean operation time for unilateral hernia repair was determined to be 13.5 minutes, while that for bilateral repair was 24.3 minutes. Also demonstrated by Francesco Morini's meta-analysis is the assumption that bilateral repair has a significant operative time advantage (14).

According to several reviews, the incidence of metachronous contralateral hernia ranges from 7 to 10%, with a higher incidence among younger patients and those with a left-sided initial hernia. Kokorowski et al. (15) reported that 30% of patients had contralateral hernias and that 7.3% of patients had clinically significant metachronous inguinal hernias. In this study, 29% of patients had contralateral hernias, all of which were surgically repaired. Studies revealed that 55% of these patients had a left-sided preoperative diagnosis. Children with a primary left-sided hernia have an increased risk of developing a right-sided metachronous hernia, as supported by this study. There was no difference in the female male ratio.

In the literature, it has been observed that laparoscopic PIRS has a significantly lower complication rate than open repair. Significantly higher rates of wound infection, bladder injury or perforation, postoperative hydrocele, iatrogenic cryptorchidism, and testicular atrophy were observed following OH (16). In our study, nine patients (9%) experienced complications. Three patients developed a Liac hematoma during the procedure. None of them were observed to have a recurrence. Complications such as pain, wound infection, ileus were not observed in any of the patients. Six patients complained of suture palpation at the inguinal incision site in the first month of follow-up. This complaint was resolved during the sixth month of patient follow-up.

However, it is debate over the preference of surgeons, due to the high recurrence rates in laparoscopic repair compared to the OH seen in various publications.The first of these publications is the Patkowski series in 2006, 140 PİRS performed and the recurrence rate is 2.9% (6). Wolak et al. (17) reported the 67 patient with PİRS technique, recurrence rate as 1.15% .Thomas et al. (18) reported 250 patient PİRS series, the recurrence rate was 1.4%. Wolak PK et al. (19) published in 2022, the recurrence rate was 4.4%. Neverthless, Francesco Moriniet al. (14) evaluated 8 randomized controlled trials about open versus laparoscopic hernia repair and found no difference in complication and recurrence rates in 2021.

We believe that the difference between these rates may be due to the influence of the laparoscopy technique's learning curve. In our study, the complication rate in the first 50 patients was 12% and the recurrence rate was 4%, whereas in the second 50 patients, these rates decreased to 6% and 2%, respectively.

## CONCLUSIONS

PIRS method is an effective technique for pediatric inguinal hernia repair. It is a method that is easy for the surgeon and has good results for the patient. The procedure has a short learningcurve.As a result of this study, we suggest that laparoscopy is a good alternative to open surgery for inguinal hernia repair, especially after the learning curve process.

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