



Original Research

Can Percutaneous Internal Ring Suturing Procedure Take the Place of Open Method in the Surgical Treatment of Girls with Inguinal Hernia?

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Abstract

Objectives: Percutaneous internal ring suturing (PIRS) method for inguinal hernia (IH) repair in girls is increasingly used in clinics especially experienced in minimal invasive surgery. We aimed to evaluate and compare our results of laparoscopic PIRS and the open procedure for IH repair in girls in our series.

Methods: We retrospectively evaluated female patients in our pediatric surgery clinic who underwent IH surgery between 2012 and 2017 and results were assessed statistically.

Results: We identified 293 girls operated in our clinic with IH. In 164 of them, PIRS procedure (group 1) was performed; 73 had right, 26 had left, and 65 (39.6%) had bilateral IH. Among these 65 patients, 16 had only right and 11 had only left IH according to preoperative examination, which turned out to be bilateral during laparoscopy. In the open surgery group (Group II), there were 129 patients. Seventy-eight patients had right, 38 had left, and 13 (10%) had bilateral IH. Sliding fallo-pian tubes were present in seven of Group I versus 21 of group II ($p<0.001$), while sliding ovaries were present in seven of Group I versus 16 of Group II ($p=0.015$). Recurrence was observed in only one patient in Group I ($p>0.05$).

Conclusion: The higher rate of bilaterality is still the problem for laparoscopic procedures. Despite over-diagnosis, no more complications were not detected due to PIRS. High ratio of sliding tubes and ovaries can be due to traction for preparing the sac in open surgery. Hematoma can be a serious problem to complete PIRS procedure. Preferred technique from the surgeon's point of view is in favor of PIRS procedure. In addition, PIRS procedure can be more protective for internal genitalia, but more studies with higher numbers and longer follow-up period are needed.

Keywords: Girls, hernia repair, indirect inguinal hernia, ovary sliding, percutaneous internal ring suturing, laparoscopic hernia repair

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The inguinal hernia (IH) has been described since the Greek and Egyptian inscriptions in 1500 BC and the anatomy of the inguinal canal began to be illustrated with the beginning of modern medicine in the 19th century.^[1] In 1871, Marcy et al. defined the current successful treatment of pediatric IH as the high ligation of the hernia sac which

became the standard treatment for indirect IH since then.^[2] This procedure was modified according to the gender, sliding organs, and the presence of direct component.^[3] As a standard, in open surgery in girls, a proximal sac is prepared to the inner ring level, twisted, and ligated and the inguinal canal is closed. It is also necessary to detect and hang

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the round ligament, because otherwise the uterus can be flaccid after the high ligation.^[3,4] The main difficulty of this treatment is whether the presence of an abdominal organ sliding into the proximal sac or not. It has been shown that a sliding organ is present in 40% of all girls with hernia and standard surgery has to be performed to protect this organ within its opening, but due to modified interventions, the recurrence rate is increased in these patients.

In 1945, after peritoneoscopy was described as a diagnostic procedure, laparoscopy became a common procedure for the treatment of intra-abdominal diseases and began to take its place also in IH treatment.^[5] Initially, laparoscopy was used for the assessment of the contralateral hernia throughout ipsilateral hernia sac.^[6] In 1997, El Glory et al. described the laparoscopic hernia repair procedure in 28 female patients, for the 1st time. In their description, a hernia sac was inverted and closed by an endoscopic loop.^[7] In 1998, Schier et al. described an intracorporeal Z suture in 14 female patients and a 2.7% recurrence rate which was higher than the open procedure.^[8] In addition, it was also seen that the intracorporeal hernia repair requires the experience of laparoscopic suturing for closure of the inguinal opening without injury to ovaries, fallopian tubes, vessels, cord, and other structures.^[9-11] The extraperitoneal approaches described afterward had successful results and lower recurrence rates, but all of these were in need of additional devices.^[12,13] Subcutaneous assisted ligation technique is described as an extraperitoneal purse-string suture closure for the internal ring and hydrodissection was used for splitting the structures from hernia sac.^[11-13] In 2003, Prasad et al. used a device like an awl to turn around an internal ring.^[10] In 2009, Endo et al. explained a novel extraperitoneal technique with an awl-like device and a very low recurrence rate of 0.2%.^[14] In 2006, Patkowski et al. described a new approach for internal ring closure without using any special device as the percutaneous internal ring suturing (PIRS).^[15] A low recurrence rate with PIRS in 205 female patients at a mean follow-up of 3.5 years was reported.^[16]

In the literature, there are many reports of PIRS proving its reliability and focusing on the recurrence rates, but there is no data comparing both techniques and consequences of this procedure in female patients. The aim of this study is to evaluate and compare the open and PIRS procedure in girls with IH.

Methods

Study Design and Patient Selection

The data of female patients with indirect IH who was operated in our Pediatric Surgery clinic between January 2012 and December 2017, aged from 1 month to 17 years, were

analyzed retrospectively. All patients were operated either with the open or the PIRS procedure due to the surgeon's preference. The results of the both surgery groups were compared in terms of demographic findings, clinical data, surgical findings, and recurrence. Patients were operated by pediatric surgery specialists and residents under supervision of these specialists. All patients were discharged on the same day other than premature infants who were followed up for 1 day for postoperative apnea. The study was approved by the Local Ethical Committee with the number 2679 on 11.02.2020. This research did not receive any specific grant.

The Statistical Package for the Social Sciences (SPSS) (version 15.0 software) program was used to analyze the results. All primary and secondary outcomes were represented by dichotomous variables (presence/absence). The results are expressed as mean±standard deviation (SD) or as median (minimum–maximum) for continuous variables, and as percentage in qualitative variables. The distribution of variables was analyzed with One Sample Kolmogorov–Smirnov testing. Differences were assessed by Mann–Whitney U-test. Nominal variables were assessed by Pearson Chi-square test. Statistical significance was considered as $p < 0.05$.

Operative Procedures

The open procedure was performed according to the description of Marcy.^[2] The high ligation of the hernia sac was done for the indirect IH. That procedure was modified according to the presence of direct hernia. The presence of an organ sliding into the proximal sac was checked before ligation. If any sliding was detected, the organ protective surgery was applied and a purse string suture was added. The canal was closed after high ligation.

The PIRS procedure was performed at a 10–20° trendelenburg position, under the endotracheal or laryngeal mask general anesthesia.^[17] Either 3 or 5 mm trocar placed into the abdomen with Hasson technique for the telescope. Insufflation pressure was arranged between 6 and 10 mmHg, based on the patient's age and weight. Initially, diagnostic laparoscopy was done for contralateral IH and additional intra-abdominal pathologies. A surgeon was on the right side of the patient, an assistant for the camera was on the left side, and a scrub nurse was next to the surgeon on the right side. Laparoscopy tower was located on the left and lower part of the patient. The location of the team remains the same irrespective of the side. In general, usage of the tip of the telescope was enough to reduce the ovary, fallopian tubes, and bowel. The entrance of the needle was found by the tip of the forceps from outside. Small incisions with 1 or 2 mm in size were performed for the interven-

tions. A 21-gauge needle with 2.0 or 3.0 prolene suture with loop formation was inserted into the abdomen through the lateral side of the internal ring. The needle was pulled out of the abdomen and the loop of thread was left in the abdomen. The needle with prolene suture was inserted again into the abdomen through the medial side of the internal ring including the round ligament. The needle with suture was passed into the previous thread, and then, suture was set forward. The needle and then the loop with suture were pulled outside and the knot was done extracorporeally. Additional needles were sometimes used to open the internal ring to pull the peritoneal foldings and plicae (Fig. 1). If enough peritoneal tissue could not be found near the internal ring, the lateral fatty tissue with peritoneum was included in the loop for the tight closure of the internal ring. Under laparoscopic view the closure of the internal ring and absence of any damage to internal organs were evaluated and recorded. If contralateral hernia is observed, the same procedure is performed on the other side. At the end, the umbilical port is removed and covered with pressured dressing.^[15,16]

Results

A total of 293 female patients with IH were operated in our clinic and annual distribution of the patients according to the groups is shown in Figure 2. PIRS procedure (Group I) was performed in 164 (56%) of them with a mean age of 5.3 years (1 month–17 years). In the open surgery group (Group II), there were 129 patients with a mean age of 4.8 years (1 month–17 years). There was no statistical difference for age. In Group 1, 73 (44.5%) patients had right, 26 (15.8%) had left, and 65 (39.6%) patients had bilateral IH. Among 65 bilateral IH patients in Group I, 16 had only right and 11 had only left IH according to pre-operative physi-

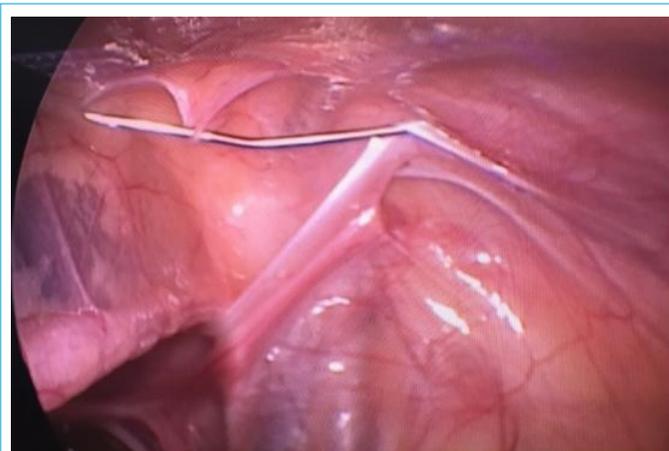


Figure 1. Holding the round ligament with an additional needle for enough exposure to perform the percutaneous internal ring suturing procedure.

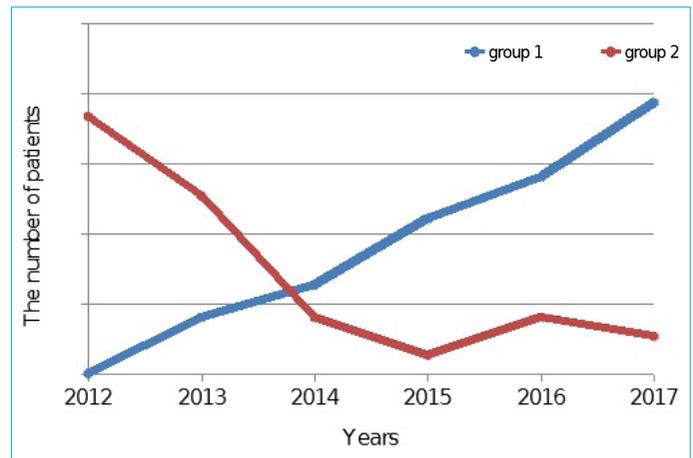


Figure 2. The annual distribution of the patients according to the groups.

cal examination, which turned out to be bilateral during laparoscopy. In Group II, 78 (60.5%) patients had right, 38 (29.4%) had left, and 13 (10%) had bilateral IH. The bilaterality of IH was significantly higher in Group I ($p < 0.05$).

Statistical Analysis

Sliding fallopian tubes were present in seven of Group I and 21 of Group II ($p < 0.001$), while sliding ovaries were present in seven of Group I and in 16 of Group II ($p = 0.015$). Conversion from laparoscopic to open procedure was done in one patient who was <2 months of age due to ovarian sliding and narrow intervention area. In the same patient, the PIRS procedure was performed to the contralateral side (Fig. 3).

In Group I, in addition to IH, umbilical hernias of four patients were also repaired during the procedure. In a 4-month old patient, a huge ovarian cyst was identified and punctured during the procedure (Fig. 4). Inguinal hernias were recognized and treated during laparoscopic splenectomy in one patient and during laparoscopic appendectomies in four patients who had no perforated appendicitis.

In Group I, four patients were complicated with hematoma near the internal ring but only in one patient the hematoma avoided the laparoscopic view and hernia repair was completed with open procedure (Fig. 5). The follow-up of hematomas was done with ultrasound and no serious bleeding was observed. Granuloma was developed in one patient. No additional complication was observed in Group II.

Post-operative follow-up period was 37 (6–56) months in Group I and 31 (6–57) months in Group II. One patient from Group I was re-operated due to recurrence with PIRS procedure. Recurrence was not observed in Group II ($p > 0.05$), but four patients (3.1 %) in Group II had a second operation for contralateral IH. Cosmetic results of the PIRS procedure were excellent.

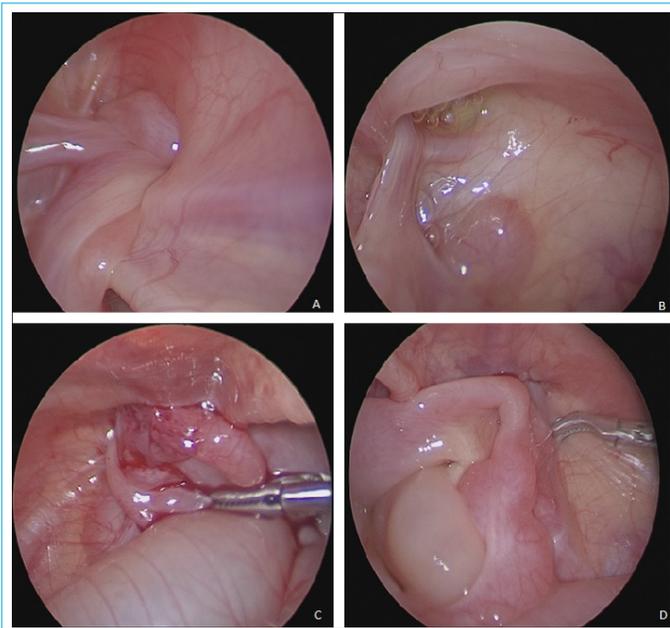


Figure 3. (a) The view of an inguinal hernia with ovarian sliding on the left side and not reduced. (b) An incarcerated inguinal hernia with ovary in the right side and reduced. (c) The view of ovarian and tubal tissues after the open procedure. (d) The view of the internal ring closure after the percutaneous internal ring suturing procedure in the same patient.

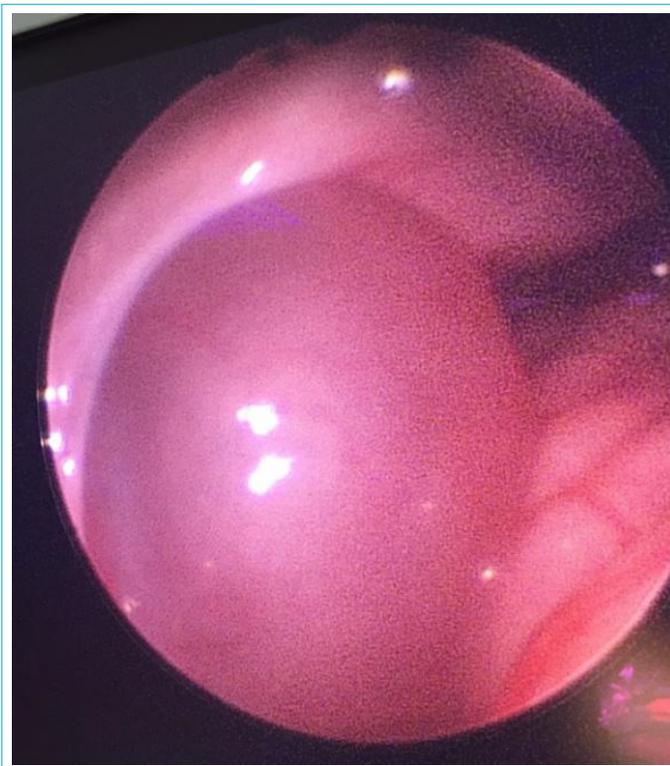


Figure 4. Coincidentally established a huge ovary cyst in girl with 4 months ago.

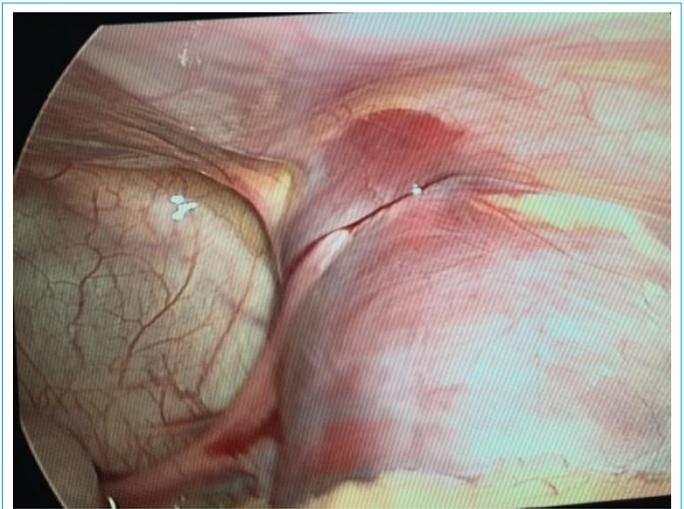


Figure 5. Hematoma complication during the percutaneous internal ring suturing procedure in patients with 6 years.

Discussion

The standard treatment of pediatric IH has been defined as the high ligation of the hernia sac since 1871. The standard procedure is open IH repair; however, it has some potential risks of wound infection, hematoma, recurrence of hernia, and inevitable cosmetic results for girls. Various maneuvers are required to prevent recurrence. Surgical procedure varies from high ligation to additional purse string suture and modifications according to sliding hernia. However, the same PIRS procedure can be applied for all girls with indirect IH. Our study results revealed that the PIRS procedure can be performed for all age groups beginning from the neonatal period and there was no significant difference between the age distribution of both groups. In addition, in our series, the annual distribution of the patients was favored the PIRS procedure. The main reason for this choice is increased laparoscopy training in clinics with minimal invasive surgery. Therefore, all surgeons including senior residents prefer the PIRS procedure instead of the open procedure in our tertiary clinic.

Our study showed that the rate of sliding fallopian tubes and ovaries is significantly less in Group I. Ovarian sliding is high during the open procedure which is nearly 40% of all females with IH in Puri's series.^[18,19] High sliding hernia ratio in girls might be due to excess traction of the sac for preparation to the high ligation. In literature, cases with infertility have been reported due to adhesions of previous hernia surgeries. Cam at al. reported that the previous bilateral hernia repair in the childhood period resulting in adhesions between tubes to the abdominal wall might be the cause of infertility in women.^[20] Hansen et al. explained that a mid-tubal stenotic area due to previous bilateral IH

repair in a 27-year-old woman^[21] Urban and friends also reported that mid tubal occlusion and infertility subsequent to an IH repair.^[22] What is more, unilateral cases of fallopian tube damage may be under-reported. During open operation, ovaries and tubes might be damaged more easily than laparoscopic hernia repair and it can be impossible to understand any injury in unilateral IHS. In our series, one patient with bilateral inguinal hernia was repaired with PIRS procedure on one side and other sides with converted to the open procedure due to serious ovary sliding (Fig. 3). The ovary was so contiguous and buried to the internal ring after open procedure. On the other hand, the ovary and structures were not adherent to the internal ring on the contralateral side due to the satisfied PIRS procedure. One patient was not enough to explain that the PIRS procedure was more protective, but it would not be possible to understand that reason unless every female infertility case with a history of inguinal hernia surgery was not assessed by laparoscopy. In addition, a huge ovarian cyst can be detected and treated by laparoscopy during PIRS procedure even in neo-natal period and it can be punctured easily to prevent torsion like one patient in our series in Figure 4.^[23] Therefore, PIRS technique is a completely extraperitoneal procedure and undergoes the laparoscopic view so risk of damage to female internal organs and the adhesion possibility due to the traction of sac are lower. PIRS procedure should be especially chosen for females with bilateral IH. These consequences show that PIRS procedure is more protective procedure for girls with inguinal hernia.

In our study, bilaterality in the PIRS group is higher, which seems to be a disadvantage for this method due to overdiagnosis during contralateral evaluation in laparoscopy. However, as a result of this, none of our patients in Group 1 were in need of a second operation, while four patients (3.1%) in Group 2 were operated upon due to the contralateral hernia. Similarly, in Puri's series, 8% of patients who were operated with the open method needed second operations due to contralateral IH.^[19] In a large series of 1052 patients followed up for 11 years, contralateral hernia developed in 5 years in 9.6–13.7 % of girls and in a meta-analysis if the initial hernia had been on the right side, contralateral hernia developed in 11% of patients.^[24,25] It is obvious that nearly 10% of patients having previous hernia operations need second surgery due to contralateral IH. The laparoscopic approach can increase overdiagnosis, but no additional morbidity was detected in our series due to the bilaterality.

Hematomas are generally small and non-serious complications during IH repair with PIRS procedure, but actually can be annoying. The reasons for hematoma are hemorrhages from peritoneal small vessels, epigastric vessels, or

iliac external vessels. Hematomas are generally located and limited and they are sourced from small peritoneal vessels. If bleeding arises from epigastric and iliac vessels, the hemorrhage can be serious. Especially in newborns and small babies, epigastric vessels are located so close to the internal ring. They can be easily damaged by the needle during intervention. Peritoneum is helpful to limit the hematoma and bleeding. Small bleedings can be stopped by the same suturing during the procedure. Hematomas are sometimes an annoying complication, because they impede the vision of the internal orifice during laparoscopy, which might obscure the completion of the PIRS procedure. The hemorrhage from the external iliac vein developed in one patient in our series due to puncture. It was not expanded and limited by peritoneum without any intervention. It has also been described in the literature either.^[15] In our series, any serious hematoma was not developed during the open procedure, but it is possible theoretically. As a standard knowledge about classical IH repairs, during operation if the expansion of blood within the peritoneum or preperitoneal space, it means the injury of corona mortis or iliac vessels. Large hematoma can rarely need to be opened for decompression or repair of vessels.^[26]

Recurrences were seen in one patient at the beginning period in Group 1. In one patient, a very small hole was detected due to the failure of the suturing and re-repaired by the PIRS procedure. In highlights of our experience, the PIRS suture should be performed all around to the internal ring circumferentially and this suturing should include the round ligament. No recurrence was detected in Group 2. Although recurrence was developed in one patient in Group 1, this finding was not statistically significant about the recurrence between two groups. The main superiority of the open procedure is low recurrence rate, but the PIRS procedure reached the same levels about the low rate of recurrence in girls with IH.

The main limitation of our study is that the data were collected retrospectively and there were not enough data for incarcerated, strangulated hernias for comparison of both techniques and thirdly comparison of the duration of surgeries were not possible as our clinic has residents for training.

Conclusion

PIRS procedure can be performed with the same method from 1-month age to 17 years. In general, one trocar and one needle are enough to complete the PIRS procedure. The higher rate of bilaterality is still the problem for laparoscopic procedures. Despite overdiagnosis, the laparoscopy prevents second operations due to contralateral hernia. High ratio of sliding tubes and ovaries can be due

to traction for preparing the sac in open surgery. It can be resulted with adhesions and maybe it results in infertility especially in girls with bilateral IH. Hematoma can be a serious problem for PIRS procedure, especially for completing PIRS procedure laparoscopically. In addition, PIRS procedure can be more protective for internal genitalia, but more studies are needed.

Disclosures

Ethics Committee Approval: The study was approved by the Local Ethical Committee with the number 2679 on 11.02.2020.

Peer-review: Externally peer-reviewed.

Conflict of Interest: None declared.

Authorship Contributions: Concept – M.A.; Design – M.A.; Supervision – A.İ.D., N.S.; Materials – M.D., M.K.; Data collection &/ or processing – M.K., M.D.; Analysis and/or interpretation – M.A.; Literature search – N.S.; Writing – M.A.; Critical review – M.A., A.İ.D.

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