



# Percutaneous Internal Ring Suturing (PIRS) for pediatric inguinal hernias: Single Institutional Experience

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## ABSTRACT

**Aim:** To evaluate feasibility and safety of laparoscopic-assisted percutaneous internal ring suturing technique in congenital inguinal hernias in children.

**Methods:** This study was carried out in the Department of General Surgery at tertiary care teaching hospital in North India from Feb 2018 to Nov 2019. Laparoscopic-assisted Percutaneous Internal Ring Suturing (PIRS) was performed in 39 inguinal hernias of 32 patients. We recorded patients' age at surgery, gender, laterality, intraoperative findings, surgical time, and follow up findings.

**Results:** Thirty-nine laparoscopic hernia repairs were performed in congenital inguinal hernia patients in which 5 were bilateral, 25 unilateral and contralateral patent processus vaginalis (CPPV) was identified intraoperatively in 2 patients and repaired in the same sitting. The age range of the patients was 2 years to 8 years, with mean age 6.1 years. Mean surgery time was 36.4 minutes (range 14 – 47 min) for unilateral and 47.8 minutes (range 28 – 55 min) for bilateral PIRS. There was no recurrence identified with a median follow up of 6 months. One patient developed suture granuloma, which was managed conservatively.

**Conclusion:** Percutaneous Internal Ring Suturing (PIRS) is a safe and effective method for treating inguinal hernia in children.

**Keywords:** laparoscopic herniotomy, congenital hernia, inguinal hernia, minimal access

## I. INTRODUCTION:

Inguinal hernia (IH) is a common surgical condition in the children. All pediatric inguinal hernias require surgery to prevent the development of complications like incarceration or strangulation. Conventionally, open inguinal herniotomy has been the treatment of choice; however, the laparoscopic approach is increasingly being used in current practice.

Minimal access surgery has been shown to be feasible and safe in children since 1975(1).El-

Gohary et al. (2) described first laparoscopic repair of inguinal hernias in children in 1997. Since then, various techniques have been described with different port configurations and various needle options with or without hydro-dissection as a part of the procedure(3).

Patkowski et al.(2006) (4) described a simple, single port method for laparoscopic repair of pediatric inguinal hernias called percutaneous inguinal ring suturing (PIRS), which enables the surgeon to perform percutaneous closure of internal inguinal ring using nonabsorbable suture.

In present study, we report our experience with PIRS as a two-person team for minimal access repair of pediatric inguinal hernia.

## II. METHODS:

This study was performed in the Department of General Surgery at tertiary care teaching hospital in North India from Feb 2018 to Nov 2019. All children presenting to surgical OPD with a diagnosis of inguinal hernia underwent laparoscopic-assisted Percutaneous Internal Ring Suturing (PIRS). In addition, all patients underwent routine preoperative investigations, i.e. complete blood count, coagulation profile, viral markers with a pre-anaesthetic checkup a day before surgery.

The authors have been routinely using PIRS at our institute since 2018, before which all inguinal hernia repairs were being performed by open approach. In addition, all parents were given information about the PIRS procedure during the outpatient visit, and all parents gave informed consent about the procedure.

All PIRS procedures were performed by the same team of two consultant surgeons with extensive experience of minimal access surgery. All patients received general anaesthesia, and the airway was maintained using laryngeal mask airway (LMA). A supra-umbilical incision was given with both arms tucked to the patient's side in the supine position. Pneumoperitoneum was created with veress needle with 10 mmHg insufflation pressure. A single 5 mm port with trocar was then



inserted through the same incision. A 5 mm, zero degrees telescope was then used to visualize bilateral internal rings (Figure 1). After visual confirmation, a 2mm stab incision was given on the skin overlying the internal ring. A loop of nonabsorbable 2-0 monofilament suture was loaded through the barrel of a 22-gauge hollow-bore spinal needle, and the needle inserted through the 2 mm incision and advanced extraperitoneal around lateral half of the internal ring (Figure 2). The loop was introduced into the peritoneal cavity after piercing the peritoneum on the inferolateral aspect of the internal ring (Figure 3). The suture loop was advanced into the peritoneal cavity and the needle was removed, leaving the loop in place. The needle was advanced through the same skin puncture site; however, along the peritoneum covering the medial half of the internal ring, this time under direct vision taking care not to injure vas deferens or testicular vessels (Figure 4). The peritoneum was pierced on the inferomedial aspect of the internal ring, and the needle then passed through the previously introduced loop. One end of a nonabsorbable 2-0 monofilament suture was introduced into the needle and advanced into the loop (Figure 5). The needle was then removed, and the loop was withdrawn, catching the intraperitoneal free suture end and passing it out of the stab incision. Any gas trapped inside the scrotum or labia was squeezed out, following which the suture was tied extracorporeally, obliterating the internal ring and knot buried in the subcutaneous plane. Closure of the internal ring was confirmed via direct visualization and the absence of re-insufflation of the hernia sac (Figure 6). The umbilical incision was closed using absorbable 3-0 sutures and inguinal stab incision using adhesive skin strips. Patients were orally allowed after 4 hours and discharged the next day, if feeding normally and without pain. Parents were advised to follow up in surgical OPD at the 4<sup>th</sup> postoperative day and then at 3-month intervals. In some cases, follow up was done telephonically due to parents migrating to another city. We recorded patients' age at surgery, gender, laterality, intraoperative findings, surgical time, and follow up findings.

### III. RESULTS:

Thirty-nine laparoscopic hernia repairs were performed in 32 inguinal hernia patients during the time period mentioned above. There were 23 females and 9 males with a mean age at surgery of 6.1 years (range 2yr – 8yr). At the time of presentation, after clinical history and examination, 15 patients were diagnosed as right-

sided inguinal hernia, 12 patients with left-sided and 5 patients with bilateral inguinal hernia. In addition, contralateral patent processus vaginalis (CPPV) was identified intraoperatively in 2 patients and repaired in the same sitting.

Surgery time was calculated as time from umbilical incision to the dressing of skin incisions. Mean surgery time was 36.4 minutes (range 14 – 47 min) for unilateral and 47.8 minutes (range 28 – 55 min) for bilateral PIRS. Operative times demonstrated a decreasing trend as the authors got more proficient with the technique. There was no incidence of conversion.

There was no recurrence identified with a median follow up of 6 months. All parents were satisfied with the operative scar which was minimal except for one patient who developed suture granuloma, which was managed conservatively and improved.

### IV. DISCUSSION:

Minimal access surgery is gaining wider acceptance in all surgical specialities due to less postoperative pain, shorter hospital stay, better cosmesis and improved patient satisfaction. For example, open repair of inguinal hernia in children has been considered the gold standard; however, laparoscopic surgery enjoys distinct advantages of improved vision of structures, identifying contralateral patent processus vaginalis and bilateral repair through the same incision(5).

In 1977, El-Gohary et al.(2) described the first laparoscopic repair of inguinal hernias in children. Since then various techniques have been described in the literature. Initially, multi-port techniques were used with intracorporeal suturing using graspers. Later, extracorporeal suturing methods were developed which were used initially on female patients due to the perceived risk of injury to vas deferens and testicular vessels. In the authors' experience, it is better to operate on female inguinal hernia patients during the initial phase of the learning curve, around 15-20 cases.

Patkowski et al.(2006) (4) described a simple, single port method for laparoscopic repair of pediatric inguinal hernias called percutaneous inguinal ring suturing (PIRS), which enables the surgeon to perform percutaneous closure of internal inguinal ring using nonabsorbable suture.

Jukić M et al. (2019) (6) compared inflammatory stress response between laparoscopic PIRS and open modified Marcy techniques. They concluded that the PIRS technique shows significantly lower surgical stress in comparison to open hernia repair.



Since the initial description of the technique, several studies have been published using PIRS as the operative technique for inguinal hernia repair in children (Table 1). However, the overall incidence of recurrence was 3.4% (Range 0 - 18.6%). Similarly, Chen et al. (2016)(7) published a meta-analysis of 37 studies where Single-site laparoscopic percutaneous extraperitoneal closure (SLPEC) or its modifications like PIRS was the treatment method and found the overall incidence of recurrence was 0.70% (range 0 - 15.5%).

The mean incidence of CPPV was 18% (range 6.8 - 25.6 %) in various studies (Table 1). However, the incidence of CPPV as high as 43% (7) has been reported in the literature, demonstrating the advantage of laparoscopy concerning visualizing both inguinal rings simultaneously with contralateral repair possible in the same session. In our relatively small sample size, we found 2 instances of CPPV which could be repaired during the same procedure.

The average mean operative time was 24.7 min (range 10 min – 43 min) for unilateral surgery. However, in our study, the mean operative time was much longer at 36.4 min probably due to the initial phase of a learning curve, and there was a decreasing trend as the authors got more proficient with the technique.

Wolak PK et al. (2021) (8) compared the operative time for unilateral inguinal hernia repair in children performed with either an open approach or PIRS. They concluded that the PIRS procedure is faster than the open approach and might be preferred, especially in females.

There is evidence that nonabsorbable suture remarkably reduces the incidence of recurrence/hydrocele (7) compared with absorbable suture (0.51% vs. 19.0%,  $P = 0.000$ ), which is why

we decided to use nonabsorbable suture in our procedures.

A study done by Rehman et al. (2018) (9) included urinary catheterization of all patients which in our experience was not essential due to relatively short operative duration and our practice of making the patients pass urine just before entering the OT routinely.

There have been reports of complications like iliac vessel puncture during the procedure, controlled by external compression (10). Fortunately, we did not come across any such intraoperative complication.

Thomas et al. (2016) (10) observed a repaired internal ring 4 months after PIRS directly. They found that the peritoneum re-organized to close the internal ring and suture placed by PIRS was visualized below the peritoneum. However, this is, in authors' knowledge, only reported visual follow-up of PIRS technique.

Kilda A et al. (2021) (11) compared recurrence rates post inguinal hernia repair in children using LICPV (Laparoscopic Intracorporeal Closure of the Processus Vaginalis) and PIRS operating techniques and found a significantly higher recurrence rate among the PIRS group over the LICPV group (18.6% versus 4.11%,  $p < 0.05$ ). The mean time taken for recurrence after the PIRS procedure was 3.3 months. In our study, no recurrence was identified within 6 months of follow up.

The limitations of our study are a small sample size and median follow up of 6 months which is short considering some reports in the literature of inguinal hernia recurrence even after 2.5 years of laparoscopic surgery. Therefore, larger randomized controlled trials with longer follow-up must be conducted to evaluate the impact of the PIRS technique for inguinal hernia repair in children.



Reference	Year Published	Study Design	No of Patients	Average Age	Gender (M/F)	Laterality (U/B)	CPPV	Operative time (U/L)	Recurrence
Patkowski D (4)	2006	Prospective	106	3.4 y	86/20	72/34	22 (20.7%)	19.3 min	3 (2.83%)
Wolak PK (12)	2014	Prospective	55	5.33 y	16/39	47/8	10 (18.2%)	29 min	1 (1.8%)
Thomas DT (10)	2016	Prospective	213	5.6 y	134/79	188/25	35 (16.4%)	14.3 min	3 (1.4%)
Ergimel B (13)	2016	Retrospective	148	5.83 y	0/148	91/57	26 (17.6%)	NA	0
Frybová B (14)	2020	Prospective	73	5.66 y	25/48	55/18	5 (6.8%)	34 min	3 (3.3%)
Rao R (15)	2020	Retrospective	90	0.4 y	69/21	70/20	23 (25.6%)	43 min	3 (2.7%)
Kilda A (11)	2021	Retrospective	70	6.48 y	NA	NA	NA	NA	13 (18.6%)
Pogorelić Z (16)	2021	Prospective	188	4 y	126/62	148/40	NA	10 min	0
Kara YA (17)	2021	Prospective	227	NA	NA	NA	48 (21.1%)	23.3 min	7 (3.08%)
Tyagi V & Goyal S (present study)	2021	Prospective	32	6.1 y	9/23	27/5	2 (6.3%)	36.4 min	0

Table 1: Studies using PIRS as the operative technique for inguinal hernia repair in children

**Conclusion:** Percutaneous Internal Ring Suturing (PIRS) is a safe and effective method for treating inguinal hernia in children, particularly female.

**Disclosures:** Authors have no conflicts of interest or financial ties to disclose.

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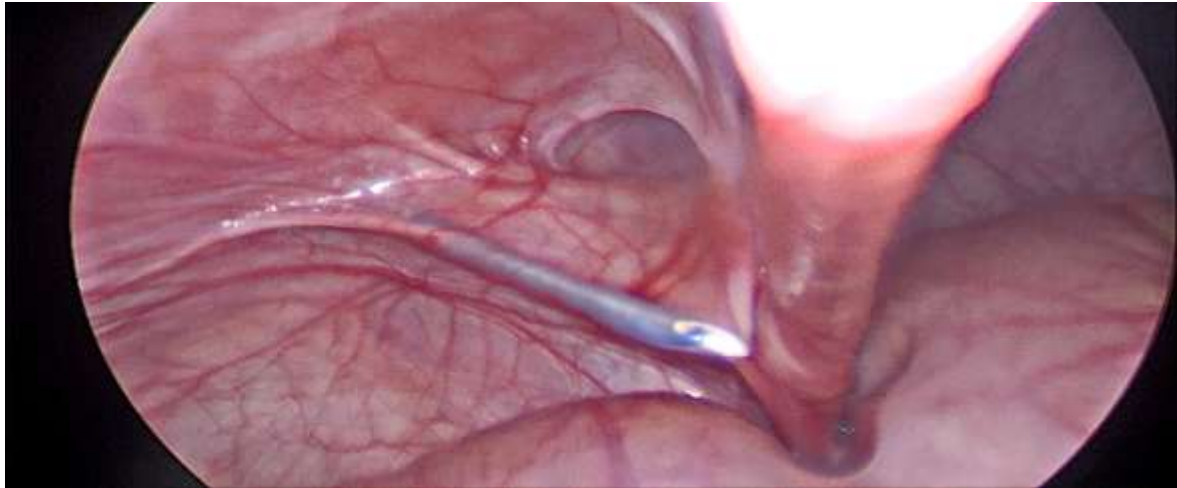
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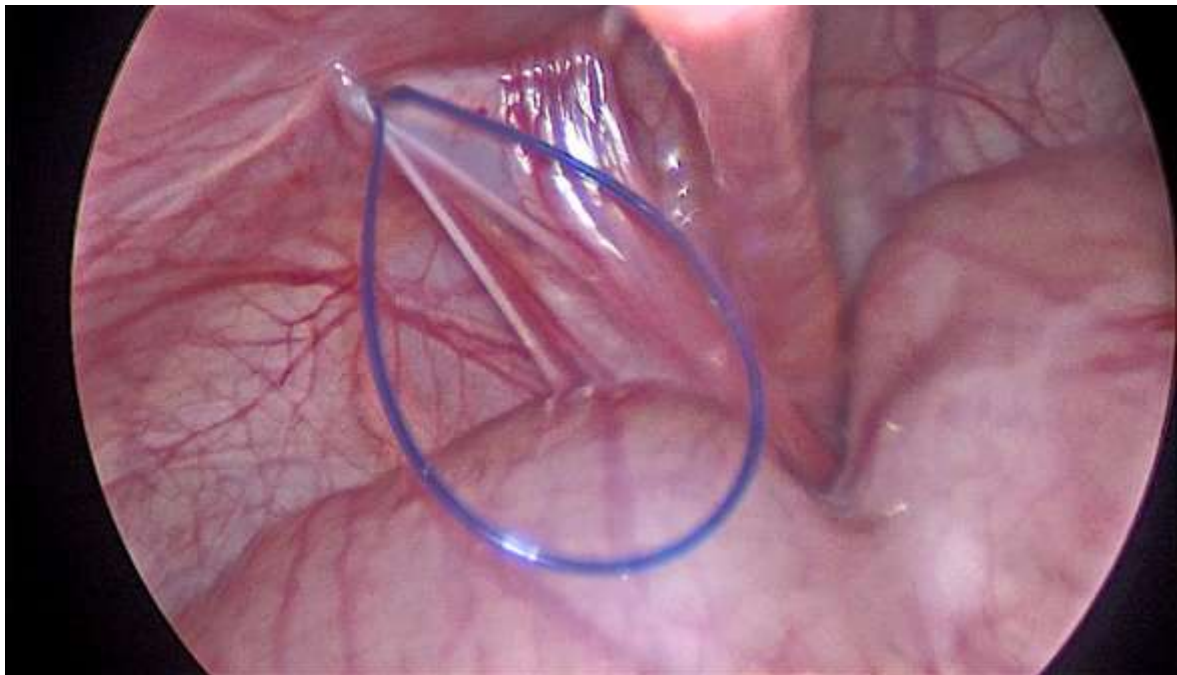
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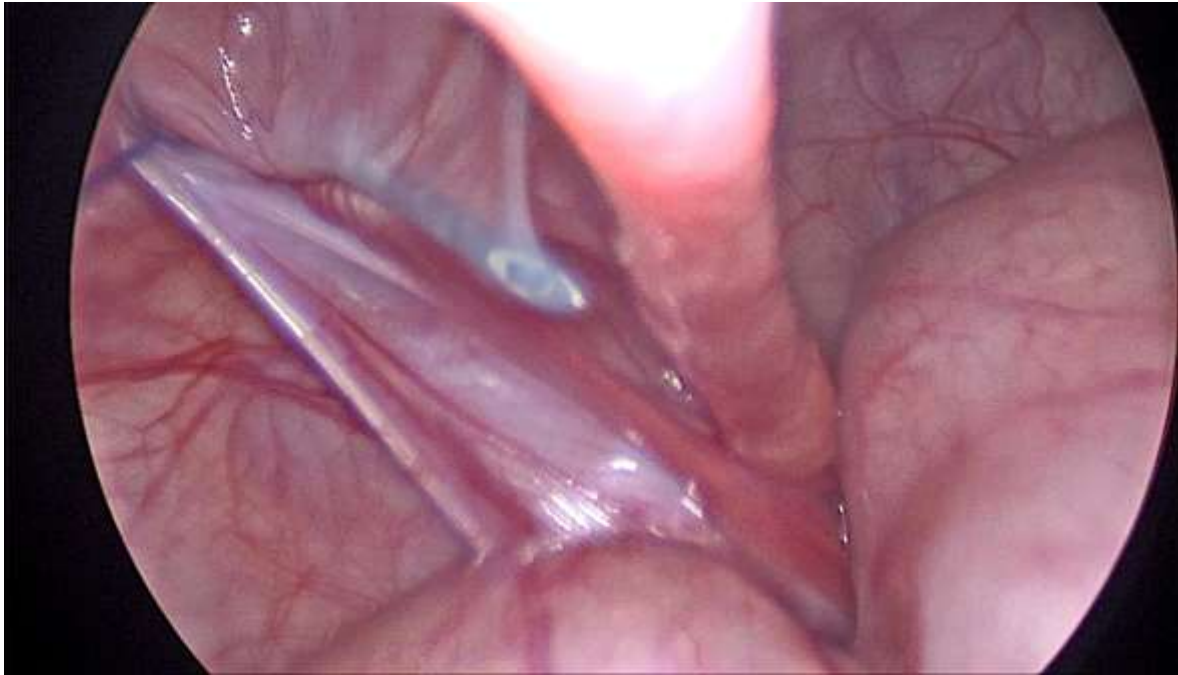
**Figure 1:** View of deep inguinal ring in a left sided inguinal hernia patient



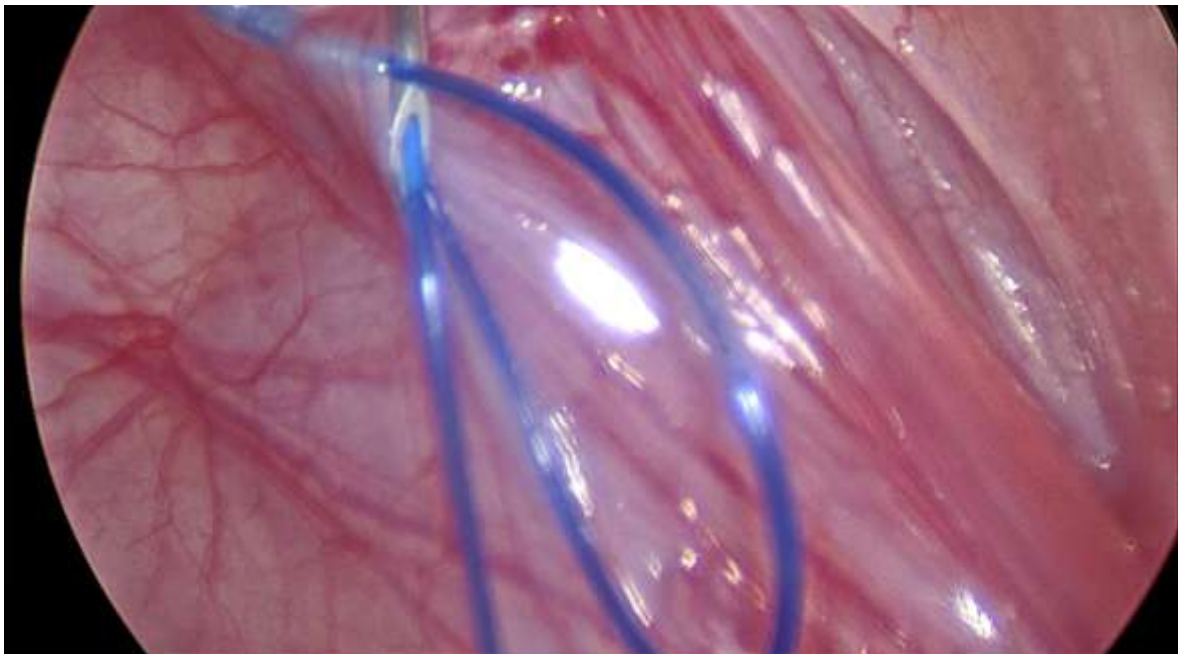
**Figure 2:** Spinal needle advanced under the peritoneum around lateral half of the internal ring with loop of nonabsorbable suture



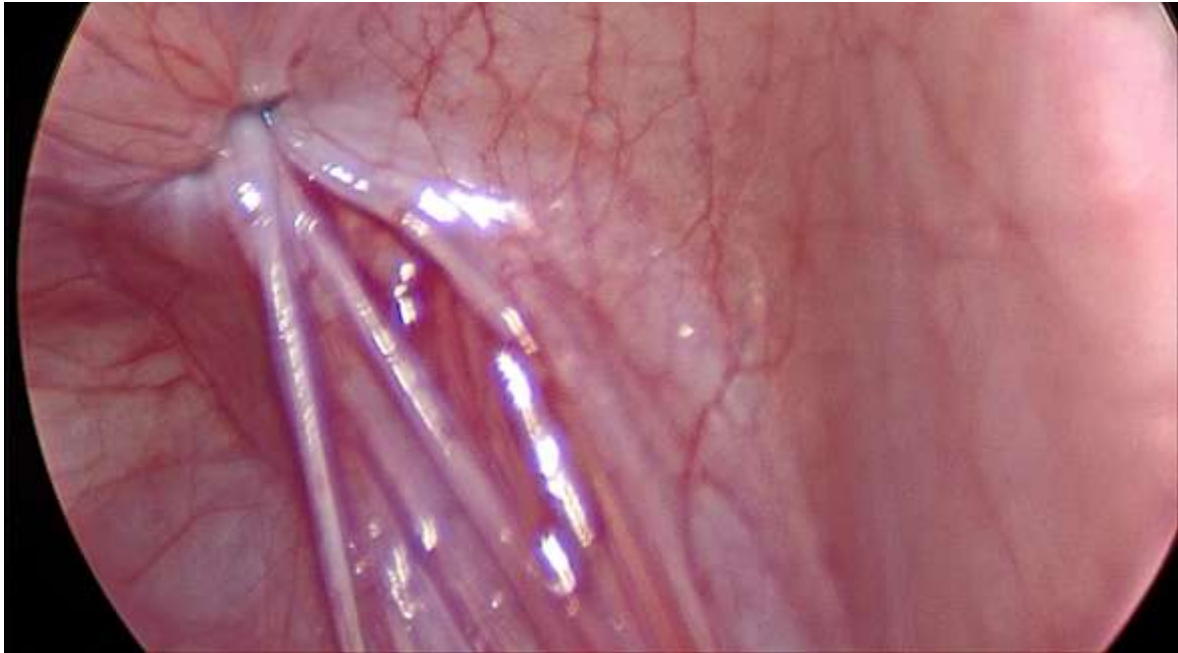
**Figure 3:** Loop introduced into the peritoneal cavity after piercing peritoneum



**Figure 4:** Needle advanced again along the peritoneum covering medial half of internal ring



**Figure 5:** End of nonabsorbable suture introduced into the needle and advanced into the loop



**Figure 6:** Suture tied and closure of internal ring was confirmed