

# One-Trocar Laparoscopic Transperitoneal Closure of Inguinal Hernia in Children

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## Abstract

**Background** Laparoscopy is an alternative procedure for pediatric inguinal hernia; however, reported techniques necessitate two or three trocars and excellent intra-abdominal skills. This study was designed to describe and evaluate the preliminary result of one-trocar laparoscopic-assisted transperitoneal closure for inguinal hernia in children.

**Methods** A total of 33 children with inguinal hernia (body weight range, 2270 g to 58 kg) were included in this study from March to November 2007. Under a 5-mm laparoscopic guidance, the hernia defect was enclosed by a nonabsorbable suture, which was introduced into the abdomen by an 18-gauge vascular access on one side of the hernia defect and withdrawn on the opposite side by a homemade hook-pin through a needle puncture wound. Then, extracorporeal knot tying was performed.

**Results** A total of 52 procedures were performed, and the mean operating time was  $46.2 \pm 16.2$  (range, 18–87) minutes. No cauterization was used during the operations and there was no serious operative morbidity. The mean follow-up period was  $7.6 \pm 2.5$  (range, 4–12) months. No recurrence was observed during this period.

**Conclusions** This easy technique provides the benefits of laparoscopic herniorrhaphy and combines the advantages

derived from the novel use of a hook-pin and vascular access simplicity, low cost, safety, minimized tissue trauma, and improved cosmetics. In addition, only one umbilical trocar wound and another needle puncture point were made. Therefore, this procedure is recommended for pediatric inguinal hernia.

## Introduction

During the last two decades, the emphasis on laparoscopy and its advantages of minimal invasiveness and excellent cosmetics has made the technique most useful for inguinal hernia in children. Although not as widely used as conventional open herniotomy, laparoscopic herniorrhaphy has clear advantages, especially those related to the evaluation of possible contralateral opening and avoidance of trauma to the vas deferens and spermatic vessels.

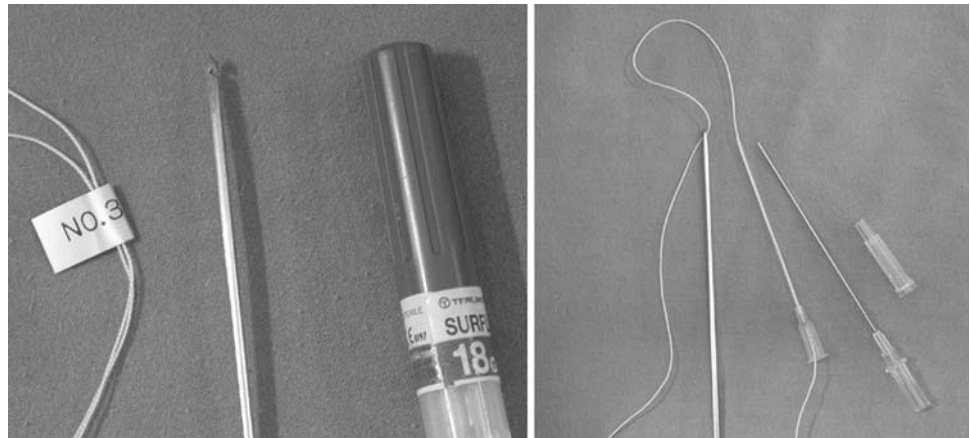
Among various laparoscopic techniques, laparoscopic-assisted percutaneous extraperitoneal closure of the hernia is a recently well-developed technique, which makes an external pursestring suture around the hernia defect without any division of the sac [1–5]. Reported incidence of recurrence (0–4.3%) and postoperative hydrocele (0–2.3%) may not be high [1–4], and the majority of these occurs within the early stage of developing the new procedures [1]. However, minimally invasive techniques were accomplished with three abdominal wounds [1–4] or by special devices, such as a curved stainless steel awl, Lapaherclosure, and LPEC needle [2–4]. Too many abdominal incisions are of little value in a small child, and the necessity of a special operating device influences a pediatric surgeon's willingness to perform the procedure.

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**Fig. 1** Simple instruments included nonabsorbable suture, a hook-pin device made by an orthopedic pin, and an 18-gauge IV indwelling cannula (*left*). A pursestring suture around the hernia defect was made by these instruments (*right*)



Recently, we have developed a modified technique for laparoscopic percutaneous transperitoneal closure of pediatric inguinal hernias, using a simple homemade hook-pin and vascular access (Fig. 1). Only one 5-mm umbilical trocar and a 1.8-mm puncture wound were necessary. In this series, the authors evaluate its technical feasibility, safety, and preliminary results.

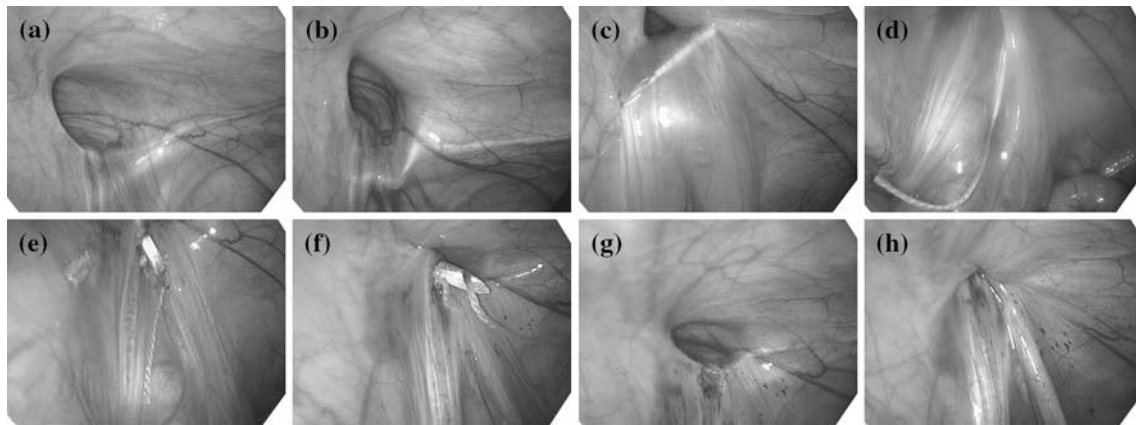
## Materials and methods

Between March and November 2007, a total of 34 consecutive children who were enrolled for the purpose of solving the inguinal hernia problem were reviewed. The study only included the case of inguinal hernias without a coexisting hydrocele. Patients presenting with occult inguinal hernias during laparoscopy of other reasons also were excluded because the closure of the defects would be accomplished by additional working ports. Of the 34 children, one 6-month-old boy presenting with incarcerated inguinal hernia also was excluded, because external manual reduction was unsuccessful and two additional working ports were necessary to facilitate reduction. Of the remaining 33 children, there were 24 boys and 9 girls with a mean age of  $3.6 \pm 3.9$  years (range, 23 days to 16 years). Right-sided inguinal hernia was present in 14 patients, left-sided in 17, and bilateral in 2. Two children suffered from metachronous hernias from previous conventional open approach on the other side. The mean body weight was  $17.8 \pm 13.6$  kg (range, 2270 g to 58 kg). Their parents all signed consent forms. All the operative procedures were performed by the first author (YTC).

## Surgical technique

After general anesthesia, the patients were placed in a supine position. The TV screen was placed at the patient's feet [1]. The surgeon operated by standing on the patient's

left side and the camera assistant was on the right side. One 5-mm nondisposable metal trocar was introduced through the umbilicus in an open method. The abdomen was insufflated to 10–12 mmHg pressure, and a 5-mm, 30° laparoscope (Karl Storz GmbH & Co, Tuttlingen, Germany) was introduced into the peritoneal cavity. The corresponding skin of the orifice of the hernia defect was first marked by means of transabdominal illumination of the laparoscopy [6]. At the marked site, an 18-gauge vascular access (Surflash I.V. catheter, I.D.  $0.95 \times 64$  mm, Terumo Corporation, Tokyo, Japan) was introduced and moved ahead slowly until the tip of the needle reached the preperitoneal space on the roof of the hernia defect. Then, 5–8 ml of isotonic saline solution was infused via the vascular access into this space (hydrodissection) to obtain the preperitoneal dissection and avoid subsequent trauma to the vas deferens and spermatic vessels (Fig. 2b, c). Under direct vision, the catheter was advanced along the preperitoneal space on one side of the hernia defect and passed into the intra-abdominal space. The indwelling needle was removed and a nonabsorbable suture (mostly non-soaked silk 3–0) was threaded through the sheath of the catheter, with the other end of the suture remaining above the skin (Fig. 2d). (It is important to maintain control of the sheath of the vascular access at all times until the suture is passed into the abdomen.) The sheath was then withdrawn. Through the previous needle puncture wound, a homemade hook-pin (I.D. 1.8 mm, MES-CF01-063-21, Mizuho, Tokyo, Japan), which was initially designed for laparoscopic gastrostomy [7], was introduced along the opposite side of the hernia defect into the intraperitoneal space to pick up the silk, and the suture was then pulled through the abdominal wall (Fig. 2e, f). The hernia defect was closed and the circuit suturing was tied extracorporeally (Fig. 2g, h). Cauterization was unnecessary during the procedure. The same procedure was performed on the contralateral side if there was patent processus vaginalis. No stitch was required for the needle puncture wound,



**Fig. 2** Intraoperative photo showing a 2-year-old boy receiving the procedure. Note right side inguinal hernia (a). Introduction of the vascular access into the preperitoneal space along right side of the right inguinal hernia defect (b, c). Injection of normal saline via the vascular access separates the vas deferens and testicular vessels from

the peritoneum and allows the vascular access to cross over. A non-soaked silk 3-0 was threaded down the sheath of the catheter into the abdominal cavity (d). The hook-pin was introduced along the left side of the defect into abdominal cavity to pick up the silk (e, f). Closure was confirmed laparoscopically (g, h)

whereas the closure of the peritoneum and fascia was necessary for the umbilical wound.

## Results

Fifty-two procedures were performed in 33 patients and contralateral patent processus vaginalis was present in 17 patients. All patients did well during the procedure, and there was no need to add an additional working port or convert the procedure to an open approach. Additional procedures performed at the same time included umbilical hernia repair in five patients, circumcision in two, excision of the left postauricular sebaceous cyst in one, and simple frenectomy in one patient. There was no serious operative complication. One retroperitoneal hematoma was noted during operation and resolved with observation. The mean operating time was  $46.2 \pm 16.2$  (range, 18–87) minutes. All of the patients could be discharged on the same day except for those infants with a history of prematurity. The mean follow-up period was  $7.6 \pm 2.5$  (range, 4–12) months, with no recurrence or postoperative hydrocele occurring up to the time of writing.

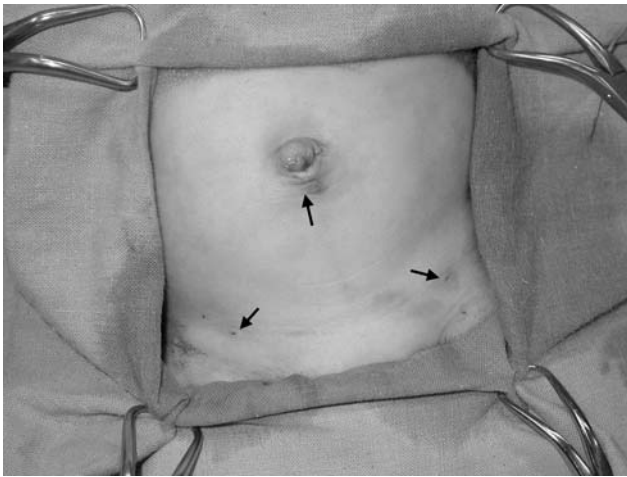
## Discussion

Laparoscopic inguinal hernia repair in children has become an alternative to conventional open herniotomy. Although there is still no generally accepted uniform laparoscopic technique, ligation of the hernia defect without division of the sac, which leads to scarring and obliteration of the space distally, is a recently developed concept [1–5, 8–15]. Common complications after conventional operation, such

as scrotal edema and hematoma, are diminished [8]. The previous reports concerned intracorporeal sutured repair with the knot remaining in the abdominal cavity [8–14]. Some doctors would be concerned about the transformation from a formerly extraperitoneal procedure to an intraperitoneal procedure, which may increase intra-abdominal complications. Laparoscopic-assisted percutaneous extraperitoneal closure with variable special devices is another option [1–4]. However, the special devices are not easy to obtain and still necessitate an additional grasping forceps (another skin incision) to direct the suture [2–4]. Several authors have suggested the needlescopic technique and transabdominal wall stab incisions to narrow the wound [2, 4, 8, 10–12].

In the present series, both the orthopedic pin and the vascular access were readily available. The hook-pin was easily made by a saw. With the two easily available instruments, percutaneous closure of the inguinal hernia could be achieved without an additional working port. In addition, our method provides excellent cosmetics because of only two wounds for unilateral hernia and three wounds for bilateral hernias. The wound scar of the laparoscopic port was hidden in the umbilicus and the puncture wounds made by the working devices were minimal (Fig. 3).

Because the present procedure is extracorporeal closure of the hernia sac, it eliminates the need for intra-abdominal laparoscopic skills, such as intracorporeal knot-tying and additional ports to manipulate the needle [8, 10, 12–14]. Under endoscopic visualization, a junior surgeon can easily perform the procedure with little preparatory laparoscopic drills. The plane of the hernia orifice can be easily adjusted in two dimensions under the 30° laparoscopy, and it is unnecessary to recreate that and make it three-dimensional. The biofeedback of the procedure, including visual and



**Fig. 3** Postoperative picture of an 86-day-old, 2270-g, male infant with bilateral inguinal hernias. Compared with the jaws of the surrounding rather huge towel clamps, the wounds (arrows) were minimal

tactile sensation, can provide the same information as those of many radiologically guided techniques.

Although the hernia sac was closed extracorporeally, the current technique is definitely a transperitoneal procedure and not an extraperitoneal procedure. Thus, the risks of intra-abdominal complications were not totally eliminated. Fortunately, serious complications, such as unintentional puncturing of the iliac vein and intra-abdominal viscus [5], did not occur. In the present series, eight of the children (24.2%) weighed <5 kg. However, the present method was time-consuming in small infants with limited working space. Schier [16] also suggests that laparoscopic hernia repair in small babies is a less technically demanding procedure than primary inguinal herniotomy.

A number of limitations have been identified in the series. The present method would fall short in managing incarcerated hernia with failed external manual reduction, and additional laparoscopic instruments were necessary to pull the hernial content back. Although the hernia defect would be accomplished by the current technique, boys with an inguinal hernia with a coexisting scrotal hydrocele also were excluded. Some other surgeons consider that simple aspiration of the noncommunicating hydrocele at the time of laparoscopic hernia repair is enough [1]; however, we recommend that the coexisting hydrocele would be resolved by additional scrotal approach. In our initial experience, one coexisting hydrocele in a 4-year-old boy, not included in the series during the same time period, reaccumulated after simple aspiration and necessitated additional surgical intervention.

Another potential disadvantage is that simple ligation of the hernia sac may contribute to recurrence of hydrocele or inguinal hernia [1, 5, 15]. The potential for hernia

recurrence or hydrocele formation in the future is indeed a factor if a small peritoneal gap (Fig. 2g) is left untreated with the current technique. Unlike a small gap at the location of the spermatic vessels and vas deferens, which were intentionally left untouched without preperitoneal dissection, in subcutaneous endoscopically assisted ligation and other laparoscopic extraperitoneal closure techniques [1, 5, 15], the gap in the present series was attributed to the fact that the hook-pin could not be precisely operated at the peritoneum level. Because it was not easy to introduce the hook-pin and the vascular access into the intra-abdominal space at the same puncture point, the intra-abdominal puncture points of the two devices might crossover, overlap, or not touch. Therefore, the gap of the enclosed suture could not be avoided and the hernia sac was not completely ligated at the level of internal ring. Notwithstanding the possibility of a peritoneal gap, preperitoneal hydrodissection in the present series would protect and bypass the vas/vessels, destroy the structure of orifice of the hernia sac, and provide a tensionless knot tying, which might enhance the tightness of the knot and eliminate later recurrence [14, 15]. Because the preperitoneal space is filled with avascular fat tissue and loose areolar tissue, we performed this procedure very easily; it took only a few minutes to create a preperitoneal tunnel.

Because this was a technique of percutaneous closure of inguinal hernia, simultaneous ligation of subcutaneous tissues (sometimes nerves) of inguinal canal between the skin and hernia sac was inevitable [17]. Although the hook-pin and the vascular access could be introduced at the same skin puncture wound, it was difficult to stay in the same tunnel for putting in the vascular access and later on, the hook-pin, before they reached the preperitoneal space. This might possibly increase the postoperative morbidity in the long run. However, compared with the traditional herniotomy, which might open external oblique and ring, manipulate the spermatic cord, destroy the inguinal canal, and cause significant postoperative tenderness in the inguinal region [18], the advantage of this kind of procedure was indirect approach to the internal inguinal ring, avoidance of opening the inguinal canal, and minimization of tissue trauma. The incidence of chronic groin pain in the current technique, which might occur in pediatric open herniotomy [19], should be further investigated.

## Conclusions

This treatment modality preserves the benefits of laparoscopy with avoidance of trauma to the vas deferens and spermatic vessels and eliminates the necessity of another assistant instrument port. Compared with the current laparoscopic extraperitoneal closure techniques, the method



we have developed is easy to perform and the instruments are readily available. Only one umbilical wound and another puncture point need to be created. Hydrodissection to the preperitoneal plane may 1) elevate the peritoneum to avoid causing injury to the vas deferens and spermatic vessels, and 2) decrease tension on the knot tying when closing the hernia opening. It would be a better and more effective procedure with minimal complications for pediatric inguinal hernia.

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