

# Single-incision laparoscopic percutaneous extraperitoneal closure for inguinal hernia in children: an initial report

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Received: 14 May 2010 / Accepted: 27 September 2010 / Published online: 26 October 2010  
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## Abstract

**Background** This report describes the first use of single-incision, two-port access for single-incision laparoscopic percutaneous extraperitoneal closure (SILPEC) to manage inguinal hernia in children.

**Methods** Between December 2009 and April 2010, 92 SILPECs of inguinal hernia and hydrocele were performed for 62 patients at Osaka City University Graduate School of Medicine. The SILPEC technique was performed using two ports (a 4.2-mm port placed using the open technique and an additional 4.2-mm port) inserted through the same periumbilical skin incision with different entrances through the abdominal wall. A 19-gauge LPEC needle (a special instrument with a wire loop at the tip to hold the material for circuit suturing around the internal inguinal ring) was used to close the orifice of the hernial sac extraperitoneally with circuit suturing around the internal inguinal ring. Data regarding patient demographics, type of hernia, operating time, complications, postoperative hospital stay, and recurrence were prospectively collected.

**Results** The mean operative time was 26.9 min. The estimated blood loss was almost nil, and no intraoperative complications occurred.

**Conclusion** The use of SILPEC for inguinal hernia and hydrocele in children appears to be safe, effective, and reliable.

**Keywords** Hernia · Minimally invasive surgery · SILPEC

In 1995, Takehara et al. [1] introduced a new simplified method known as laparoscopic percutaneous extraperitoneal closure (LPEC) for the treatment of inguinal hernias in children. The LPEC approach usually involves the placement of two abdominal ports through separate wounds: a periumbilical port for the optics and a working port to the right lower abdomen. The LPEC procedure for inguinal hernia in children is safe, effective, and reliable, with a low recurrence rate equal to that obtained with conventional open repair.

In this report, we describe, to the best of our knowledge, the first use of a single incision to insert two ports for successful performance of LPEC for inguinal hernia in children. The only disadvantage of conventional LPEC is that it results in a wound to the right lower abdomen. Accordingly, single-incision laparoscopic surgery (SILS), also known as laparoendoscopic single-site surgery or single-port access surgery, currently is under active investigation for abdominal surgery. A number of advantages have been proposed including cosmesis (scarless surgery performed through an umbilical incision), reduced incisional pain, and ability to convert to standard multiport laparoscopic surgery if necessary.

Single-incision cholecystectomy [2, 3] was described as early as 1999, with the insertion of two trocars through the umbilical incision and additional stay sutures to stabilize the gallbladder. In addition, a number of recent reports on single-incision donor nephrectomies [4, 5] and other urologic applications [6, 7] have been described, as well as the use of single-incision sleeve gastrectomies for morbid obesity [8]. In this report, we review our initial experience with single periumbilical incision port access during the treatment of 31 children with inguinal hernia and hydrocele.

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## Materials and methods

From October 2009 to April 2010, a consecutive series of 62 patients (34 boys and 28 girls) were identified as having symptomatic inguinal hernia or hydrocele. The laparoscopic technique, including the possibility of open procedure, was described to each patient during the informed consent process. When applicable on the basis of the operative findings and feasibility, the use of only one incision was mentioned. No institutional review board approval was sought because the technique change to a single-incision laparoscopic percutaneous extraperitoneal closure (SILPEC), in our opinion, was akin to a simple port repositioning, which did not constitute a new experimental protocol.

### SILPEC procedure

With the patients placed in the supine position under general anesthesia, a single incision was made within a vertical incision or a semicircular incision of the umbilicus was performed. A 4.2-mm port was placed using an open technique for placement of a 30° 3-mm laparoscope. Pneumoperitoneum was created through this primary port using carbon dioxide to a maximum pressure of 8 mmHg.

Grasping forceps (3 mm) were inserted using the open technique through the same skin incision but with a different entry site through the abdominal wall. A 19-gauge LPEC needle (Lapaherclosure (Hakko<sup>®</sup>, Nagano, Japan), a special instrument with a wire loop at the tip to hold the material that can be used for circuit suturing around the internal inguinal ring) with suture material was inserted at the midpoint of the right or left inguinal line (Fig. 1).



**Fig. 1** Laparoscopic herniorrhaphy. A 30° 3-mm laparoscope and 3-mm grasping forceps was inserted through the umbilicus. A special needle (Lapaherclosure) with suture then was passed at the level of the inguinal ring to place a purse-string suture around the internal inguinal ring

The orifice of the hernial sac was closed extraperitoneally with circuit suturing around the internal inguinal ring using the LPEC needle. To avoid causing injury, care was taken to cross over the spermatic duct or the gonadal vessels. The first half of the circuit suturing was started extraperitoneally from the anterior to the posterior edge of half the internal inguinal ring using the LPEC needle with a nonabsorbable 3–0 suture material. After half of the circuit suturing was completed, the suture material was removed from the LPEC needle.

Circuit suturing of the opposite half of the rim of the internal ring was placed extraperitoneally using the same technique, and the suture material was held with the wire loop inside the LPEC needle. The LPEC needle then was removed from the abdomen with the suture material. The circuit suturing was tied extracorporeally, and the internal inguinal ring was completely closed without skipping any areas. The suture was tied from outside (Fig. 2). The umbilical wound was closed by suturing of the peritoneum and fascia. The needle wounds were closed using a skin bond (Fig. 3).

## Results

In the 34 boys examined, 50 internal inguinal rings were closed (18 unilaterally and 16 bilaterally including 16 contralateral large patent processus vaginales [PPVs]). In the 28 girls, 42 internal inguinal rings were closed (14 unilaterally and 14 bilaterally including 14 contralateral large PPVs) (Table 1).

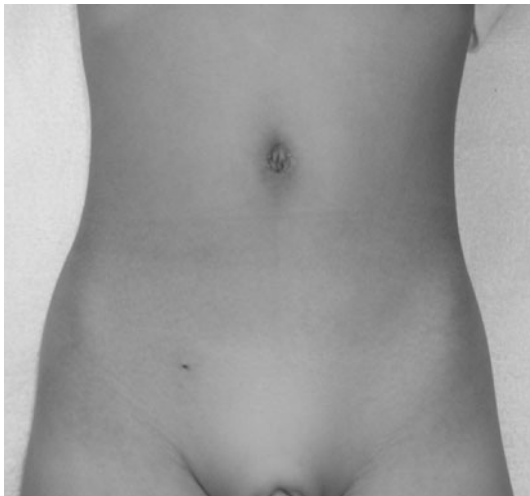
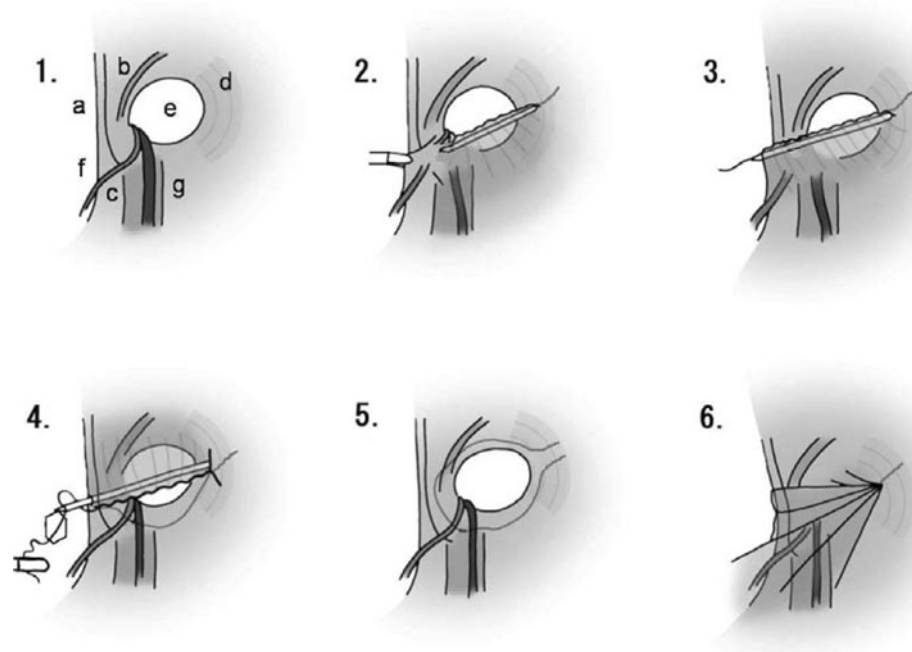
Inguinal hernia and hydrocele occurred with an incidence of 12.9% among the patients younger than 3 months, of 9.6% among the patients 3–12 months old, of 25.8% among the patients 1–3 years old, and of 51.6% among the patients older than 3 years (Table 2). The operating time for SILPEC was shorter for the girls than for the boys and tended to be shorter when the surgeon had more experience.

The operating time was comparable with the time needed for SILPEC. For unilateral hernia repair, the operating time for SILPEC was 21–29 min for the boys and 17–30 min for the girls. The operating time for bilateral hernia was 27–65 min for the boys and 18–34 min for the girls. No complications occurred during surgery, and there was no recurrence during the follow-up period, which ranged from 1 to 8 months. No hydroceles or testicular atrophy occurred after surgery.

## Discussion

In pediatric surgery, scarring can be highly visible, for example, on the face, neck, chest, and abdominal wall.

**Fig. 2** Single-incision laparoscopic percutaneous extraperitoneal closure (SILPEC) of a right-sided patent processus vaginales (PPV). Anatomy of a male is shown including **A** umbilical plica, **B** inferior epigastric vessels, **C** external iliac vein, **D** transverse abdominal muscle, **E** PPV orifice, **F** spermatic duct, and **G** testicular vessels



**Fig. 3** The resulting wound (1 week after surgery)

Evidence exists to suggest that such scarring in children can result in reduced self-esteem, impaired socialization skills, and lower self-ratings during problem solving. It is not clear whether abdominal scarring has these negative effects because the scars are hidden by clothing and not persistently visible. In any case, the psychosocial impact of visible abdominal scarring needs further study because it is the one consequence of a surgical procedure that persists long after the pain has resolved and recovery is complete.

Although cosmesis is the most apparent benefit of SILS, the procedure may yield further benefits in terms of pain and recovery. Currently, SILS operations are used clinically for stealth surgery to manage a number of abdominal

**Table 1** Characteristics of the patients who underwent single-incision laparoscopic percutaneous extraperitoneal closure

No. of patients	62
Sex (males/females)	34/28
Age: <i>n</i> (%)	
Younger than 3 months	8 (12.9)
3 months to 1 year	6 (9.6)
1 year to 3 years	16 (25.8)
Older than 3 years	32 (51.6)
Reason for surgery: <i>n</i> (%)	
Inguinal hernia	50 (80.6)
Hydrocele	12 (19.4)
Associated morbidities necessitating combined surgery	
Underscended testis	6 (9.6)
Ovarium, ovarian duct	6 (9.6)

**Table 2** Operative findings

Laterality of the patent processus vaginalis (PPV): <i>n</i> (%)	
Right	22 (35.5)
Left	10 (16.1)
Bilateral	30 (48.4)
Median operation time: min (range)	
Unilateral: males ( <i>n</i> = 18)	23.5 (21–29)
Unilateral: females ( <i>n</i> = 14)	21.3 (17–30)
Bilateral: males ( <i>n</i> = 16)	36.1 (27–65)
Bilateral: females ( <i>n</i> = 14)	25 (18–34)
Complications: <i>n</i> (%)	0 (0)

conditions. Although SILS clearly results in excellent cosmesis (no visible scars), its primary disadvantages include the restricted degrees of freedom of movement, the limited number of ports that can be used, and the proximity of the instruments to each other during the operation, all of which increase the complexity and technical challenges of the procedure.

By contrast, SILPEC is easy to perform with the proximity of the instruments. Originally, LPEC was deemed easier to perform than other methods for laparoscopic repair of inguinal hernias in children. Laparoscopic repair of inguinal hernias in children has been reported previously [9–11], with such procedures requiring three ports (1 for the laparoscope, 1 for the grasping forceps, and 1 for the needle holder).

Conventionally, laparoscopic repair involves closing the hernia opening by suturing in the abdominal cavity, with the suture material tied intracorporeally and the knot remaining in the abdominal cavity. However, we were able to encircle the orifice of PPV using Lapaherclosure without skipping any areas. Thus, SILPEC does not require complicated manual skill. Under laparoscopy, with care taken to avoid injuring the spermatic duct and gonadal vessels, a circuit suture is placed extraperitoneally around the hernia orifice of the internal inguinal ring without touching the cord structure.

The LPEC procedure leaves two abdominal scars, whereas SILPEC leaves one scar nicely hidden in the umbilicus. Moreover, no recurrence was observed in our study.

The advantages of the SILPEC procedure include not only a cosmetic benefit due to the minimally invasive nature of the repair but also a lower risk of injury to the spermatic duct and vessels. These results suggest that SILPEC for inguinal hernia in children is safe, effective, and reliable, with a low recurrence rate equal to that obtained with conventional open repair. We therefore also suggest its use for the repair of groin hernias in young adults.

**Disclosures** Masaya Yamoto, Yoshiki Mortomi, Miki Yamamoto, and Shigefumi Suehiro have no conflicts of interest or financial ties to disclose.

## References

1. Takehara H, Yakabe S, Kameoka K (2006) Laparoscopic percutaneous extraperitoneal closure for inguinal hernia in children: clinical outcome of 972 repairs done in 3 pediatric surgical institutions. *J Pediatr Surg* 41:1999–2003
2. Bresadola F, Pasqualucci A, Donini A, Chiarandini P, Anania G, Terrosu G, Sistu MA, Pasetto A (1999) Elective transumbilical compared with standard laparoscopic cholecystectomy. *Eur J Surg* 165:29–34
3. Piskun G, Rajpal S (1999) Transumbilical laparoscopic cholecystectomy utilizes no incisions outside the umbilicus. *J Laparosc Adv Surg Tech A* 9:361–364
4. Desai MM, Rao PP, Aron M, Pascal-Haber G, Desai MR, Mishra S, Kaouk JH, Gill IS (2008) Scarless single-port transumbilical nephrectomy and pyeloplasty: first clinical report. *BJU Int* 101:83–88
5. Gill IS, Canes D, Aron M, Haber GP, Goldfarb DA, Flechner S, Desai MR, Kaouk JH, Desai MM (2008) Single-port transumbilical (E-NOTES) donor nephrectomy. *J Urol* 180:637–641; discussion 641
6. Hirano D, Minei S, Yamaguchi K, Yoshikawa T, Hachiya T, Yoshida T, Ishida H, Takimoto Y, Saitoh T, Kiyotaki S, Okada K (2005) Retroperitoneoscopic adrenalectomy for adrenal tumors via a single large port. *J Endourol* 19:788–792
7. Castellucci SA, Curcillo PG, Ginsberg PC, Saba SC, Jaffe JS, Harmon JD (2008) Single-port access adrenalectomy. *J Endourol* 22:1573–1576
8. Reavis KM, Hinojosa MW, Smith BR, Nguyen NT (2008) Single-laparoscopic incision transabdominal surgery sleeve gastrectomy. *Obes Surg* 18:1492–1494
9. Montupet P, Esposito C (1999) Laparoscopic treatment of congenital inguinal hernia in children. *J Pediatr Surg* 34:420–423
10. Schier F, Montupet P, Esposito C (2002) Laparoscopic inguinal herniorrhaphy in children: a three-center experience with 933 repairs. *J Pediatr Surg* 37:395–397
11. Gorsler CM, Schier F (2003) Laparoscopic herniorrhaphy in children. *Surg Endosc* 17:571–573