



Open and Laparoscopic Approach for Hernia Repair in Children: Review Article

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Abstract:

Inguinal hernia repair is the most frequently performed operation in pediatric surgery. Laparoscopic herniotomy is an approach for management inguinal hernia in children that has satisfactory clinical outcomes. Open herniotomy is often regarded as first-line treatment of inguinal hernia in children.

Keywords: Hernia Repair, Open, Laparoscopic, Children.

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Introduction:

The first reference to hernia repair in children has been credited to Celsus, who in AD 25 recommended removal of the hernia sac and testes through a scrotal incision. The first accurate description of inguinal hernias was made by Sir Percivall Pott writing in “A Treatise on Ruptures” published in 1756. Czerny advocated high ligation of the hernial sac through the external ring in 1877, which was superseded at least in adults by opening the canal, narrowing the internal ring and repair of the posterior wall as advocated by Edoardo Bassini in the 1880s (1).

Laparoscopic repair of inguinal hernias in pediatric patients was first described in 1997 by El-Gohary. Initially this operation was performed only in female

patients because the safety of the vas and vessels are of concern in males. Montepuot and Esposito were the first to use laparoscopy in the repair of inguinal hernias in male children using an intracorporeal purse-string suture to close the inguinal ring, while Schier described intracorporeal Z-suture closure first in girls only (1998) and then in boys (2000) (2).

El Gohary initial idea was to prevent the future development of a contralateral hernia and to avoid the operative and psychological trauma of a second procedure. Diagnostic laparoscopy, either through the hernia sac or via an umbilical incision, can accurately assess the presence of a contralateral hernia but has not been combined with laparoscopic loop ligation of the hernia sac. This procedure added little

time to the diagnostic laparoscopy and proved to be as effective as the conventional method but simpler and cosmetically superior (3).

New adaptations of fully intracorporeal techniques in girls only and in both sexes have continued to evolve over the years. In 2003, Chan and Tam added intracorporeal hydrodissection as a strategy to more easily avoid the vas and vessels in boys. Other adaptations of intracorporeal techniques involve incising the peritoneum, using peritoneum to cover the patent processus vaginalis, and laparoscopically excising the sac (4).

In 2003, the use of extracorporeal suturing was described. Since then, a variety of devices have been fashioned and modifications made to make the extracorporeal technique less technically challenging and/or to ensure improved ligation of the hernia sac. Hydrodissection has been used not only intracorporeally, but also in extracorporeal techniques. The most recent advances involve decreasing the number of incisions necessary for the repair. One technique has used diagnostic laparoscopy for hernia confirmation to create a smaller incision for an otherwise relatively standard open repair (5).

Open Approach

Background:

This technique is still considered the gold standard technique for most of pediatric surgeons. A transverse incision is made in the lowest inguinal skin crease above the external inguinal ring on the affected side. Be aware of the superficial epigastric vein

here to avoid bleeding. Scarpa's fascia is incised and the external oblique aponeurosis is identified. This is exposed and traced inferiorly to the inguinal ligament and medially to expose the decussating external (superficial) inguinal ring enveloping the emerging spermatic cord. This technique minimizes the risk of opening the inguinal canal too medially (6).

The undersurface of the superior leaflet of the external oblique is gently dissected free from the internal oblique and abdomen's transverse muscle. The inferior leaflet is mobilized down to the inguinal ligament. The iliohypogastric nerve lies at a higher level away from the cord. The layer of cremasteric muscle is teased open by blunt dissection onto the anteromedial surface of the cord and spread to expose the glistening peritoneum of the indirect hernia sac (7).

The sac is grasped with forceps and elevated anteromedially. Testicular vessels and vas deferens lie on the undersurface of the processus/hernial sac and are enveloped by it. Dissection is carefully completed and the hernia sac is delivered. Laparoscopy through the inguinal hernia sac may be performed at this point to evaluate for a contralateral patent processus vaginalis (PPV). The sac can be opened on the most distal end and a 2 mm or 3 mm trocar is advanced into the abdomen and secured with a tie to minimize insufflation leak. The abdomen is insufflated with CO₂ to 8–10 mmHg pressure and a 70-degree laparoscope is advanced through the trocar into the abdomen to view the opposite internal ring (5).

Laparoscopic Approach

Background:

Laparoscopic inguinal hernia repair has an established role in the management of this condition in children in trained hands. Indeed, it is fast becoming the gold standard for the treatment of inguinal hernia in children. The laparoscopic technique has the advantage that it is simple, feasible, and safe. Also, the contralateral internal inguinal ring and other hernia sites such as femoral, obturator, or internal hernia can be diagnosed and treated at same sitting and other occult pathologies may be diagnosed. The risk of injury to the vas deferens and cord structures in this procedure is lesser when compared to the conventional open technique (8).

In laparoscopy, the trocar is removed and the base of the sac twisted to ensure that all the contents are fully reduced. If there are contents and it is difficult to reduce, one should suspect a sliding component within the posterior wall of the sac. The neck of the sac is transfixed twice with a non-absorbable 4/0 (or 3/0 in older children) suture ligation. Avoid a free tie because of the risk of dislodgment (5).

Laparoscopic approaches for inguinal hernia repair:

A. Intraperitoneal approaches:

1. Endolooping (laparoscopic inversion ligation):

This method of laparoscopic inguinal hernia repair is widely used in female children. This is a modification of the intracorporeal technique, using three ports and non-absorbable sutures. It is thought that inversion and ligation of sac at the internal inguinal ring would reduce the risk of recurrence (0.8–2.5%) (8).

This technique involves grasping the farthest portion of the sac with a grasper placed through the ipsilateral working port and using an endoloop, introduced through the contralateral working port, to ligate the inverted sac, thus achieving high ligation without the use of needles or knotting (8).

This technique was applied only in females with congenital inguinal hernia as the cord structures cannot be identified from the tie in males (8).

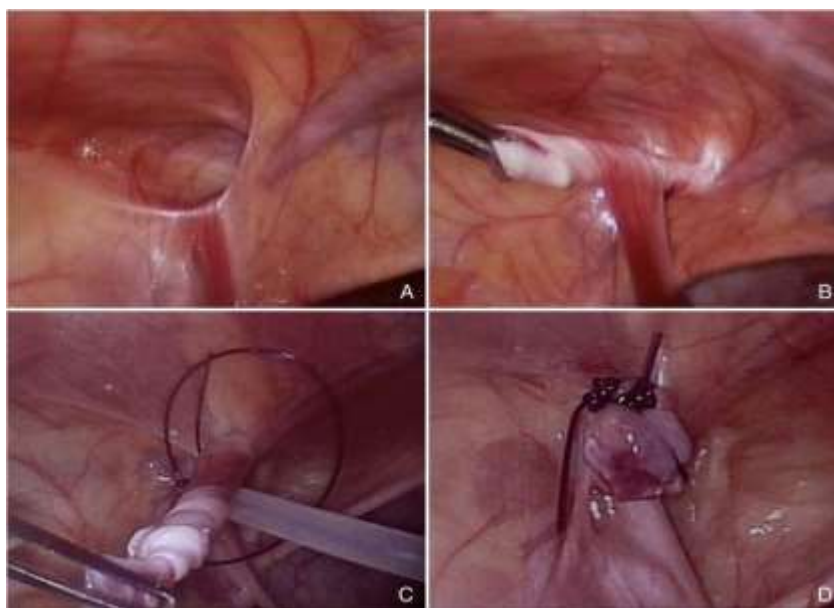


Figure 1. Laparoscopic inversion ligation

2. Laparoscopic inversion ligation:

- (a) Identification of hernia.
- (b) Inversion of peritoneum.
- (c) Twisting and double ligation of sac.
- (d) Excision of sac.

3. Suturing of the internal ring:

It ensures the ligation of the neck of the PPV, without its division. It involves intracorporeal placement of interrupted or continuous sutures, including only the peritoneum or, at times, some underlying muscular tissue as well (5).

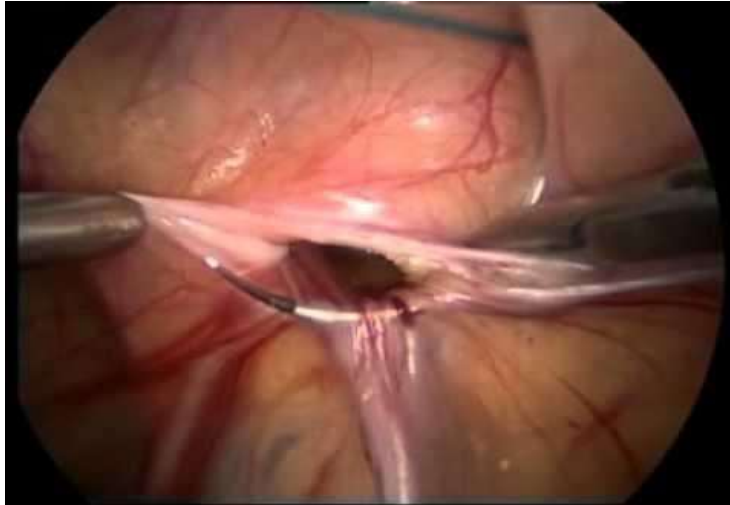


Figure 2. Intracorporeal suturing of the internal inguinal ring. (9).

4. Purse string suture with skipping vas and vessels:

This technique use intracorporeal purse string suture around the internal ring, skipping the vas deferens & spermatic vessels (8).

When using the standard three port technique with intracorporeal knot tying or the two port technique with an assistant port for intraabdominal suturing, the hernial orifice is closed with an N-shaped or purse string suture, which may leave gaps in the

peritoneum. These gaps may reduce the formation of peritoneal adhesions to keep the gap closed, and the recurrence may occur if the knots gradually loosen (8).

The purse string suture includes the peritoneum and the underlying fascia lateral to the spermatic cord. Before the knot was tied, the hernia sac was compressed to expel any gas. The peritoneum was completely closed, and the airtightness was confirmed by the absence of hernia sac enlargement when the intraperitoneal pressure was increased (8).

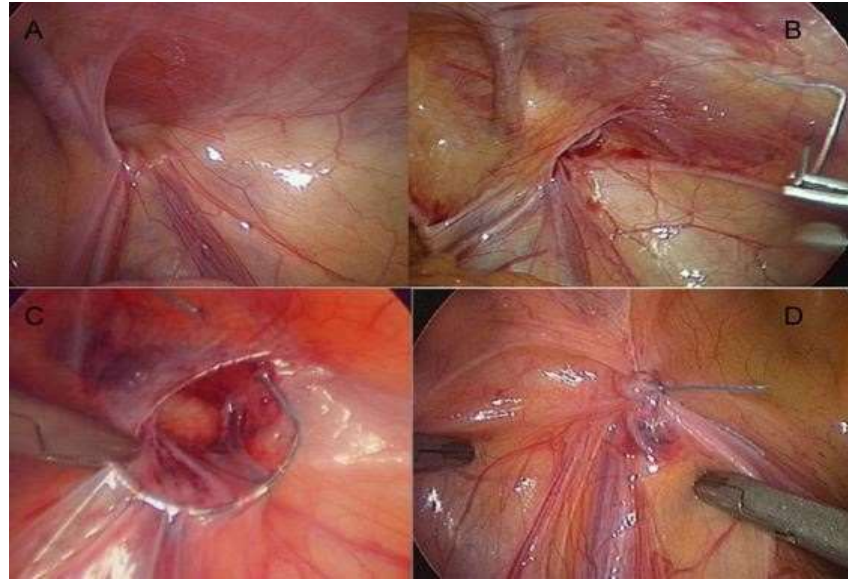


Figure 3. Purse string suture. (8)

5. Flip-Flap technique:

This technique involves raising a peritoneal flap by dissection and detaching the anterior and lateral hemi circumference of the sac, flipping it over medially to cover the hernial site and anchoring it with an intracorporeally placed suture (10).

This forms a one-way peritoneal valve that prevents abdominal contents from entering the sac while selectively allowing fluid from the distal sac to enter the general peritoneal cavity, thereby preventing postoperative hydrocele formation (10).

Satisfactory results have been noticed by Hassan et al. in a comparative study of this

flip-flap technique with the conventional open technique (11).

6. Disconnection of the sac and peritoneal ligation:

It involves detachment of the sac with suture obliteration, by laparoscopic division of the PPV at the level of the internal ring followed by its suture intracorporeally (12).

With three ports and nonabsorbable sutures employed. In this technique, the hernia sac is resected and closed with a purse-string suture at the level of the internal inguinal ring. Becmeur et al. recorded no recurrence with this method. This was done in an attempt to reduce the recurrence (13).

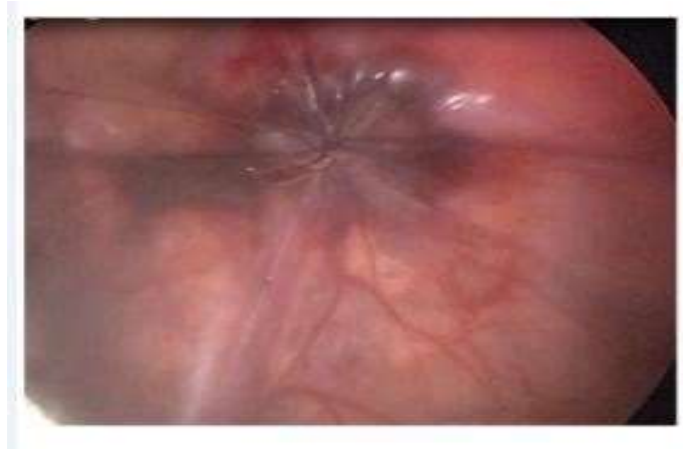


Figure 4. Peritoneal closure after hernial sac disconnection. (8).

7. Disconnection of the sac, no ligation just resection:

Here, the hernia sac is resected at the level of the internal inguinal ring and allowed to close spontaneously. This novel technique has been reported in the literature with preliminary results showing satisfactory outcome and no recurrence. In Riquelme's series, a purse string closure of

the ring was done for >10 mm the size of the deep ring. It is logical for the critics to believe that leaving the peritoneum unsutured may invite more recurrences in infants due to a suboptimal sealing mechanism of the conjoint muscle. The method uses three ports and no sutures are employed (8).

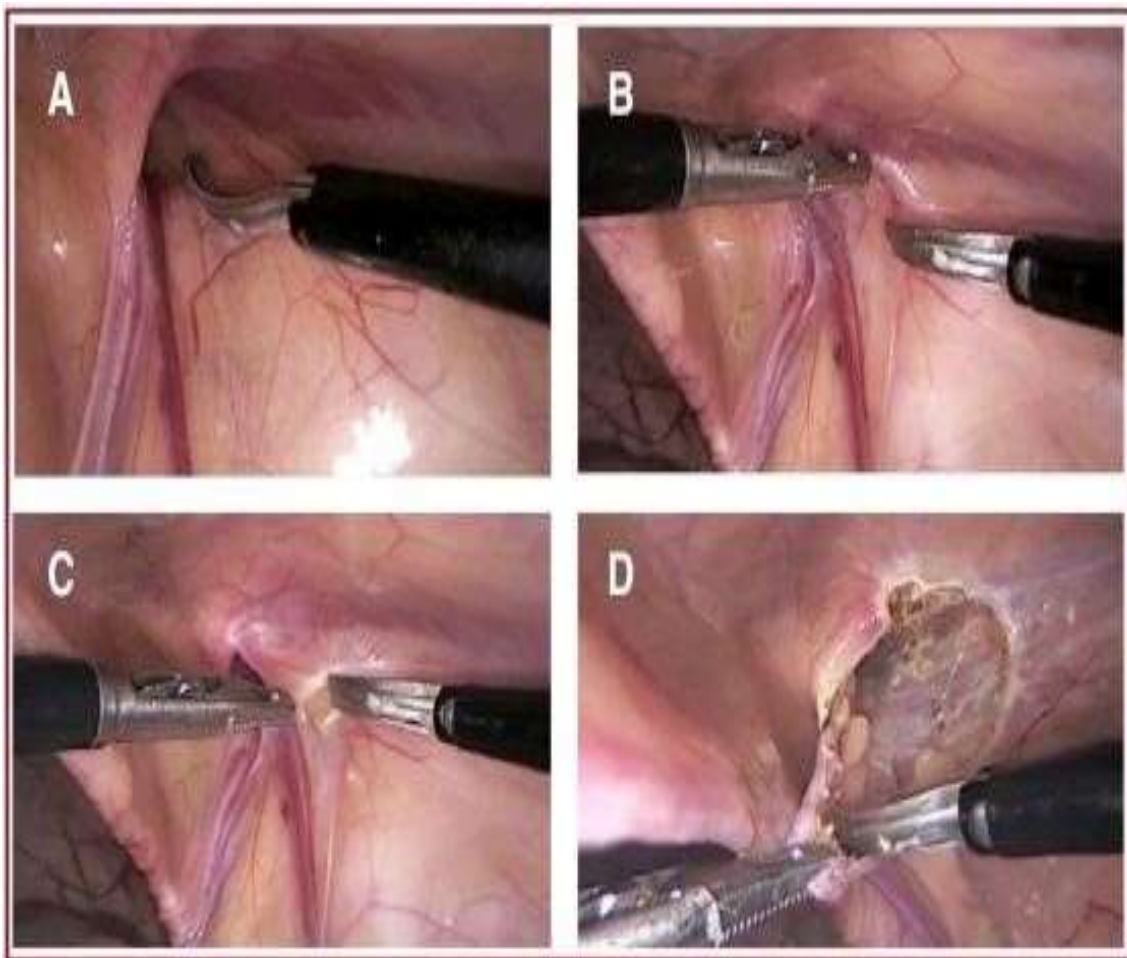


Figure 5. Resection of the sac without ligation.

8. Single instrument intracorporeal knot tying:

Longitudinal transumbilical skin incision was done for insertion of the umbilical port and a 3-mm Maryland forceps. RN was used for insertion of a purse string suture with a

single instrument intracorporeal suture tie around the internal inguinal ring. The purse string knot airtightness was stress-tested by raising the intraperitoneal CO₂ pressure to 16–24 mm Hg for about 30 seconds (8).

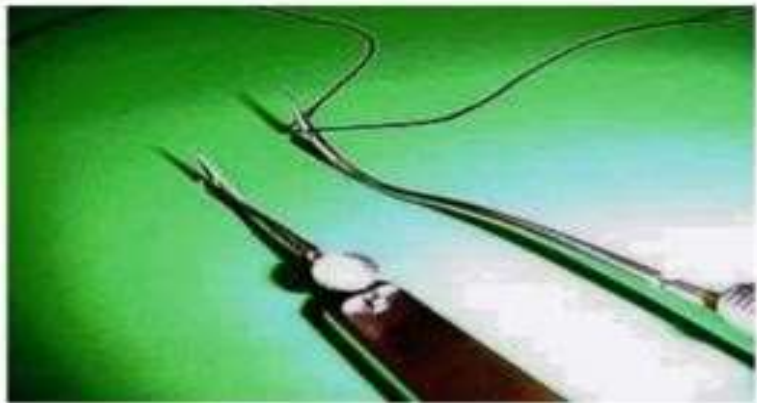


Figure 6. Reverdin needle.

9. Muscular arch repair:

In these techniques a repair of the muscular arch is tried by approximation of muscle arch with pectineal ligament (14).

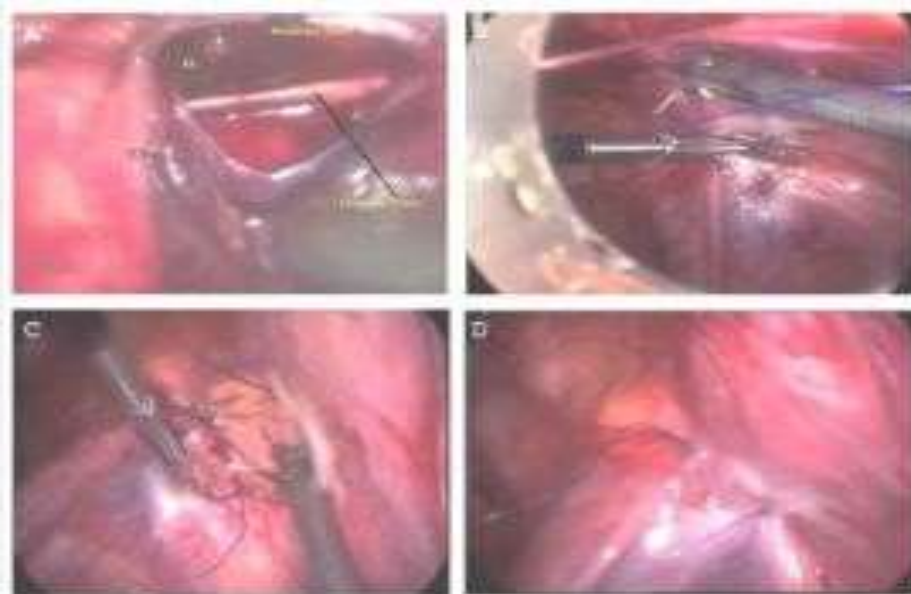


Figure 7. Laparoscopic Muscular Arch Repair. (8).

B. Extra peritoneal approaches:

1. Subcutaneous endoscopically assisted ligation (SEAL)

The internal inguinal ring is looped under endoscopic control using a 1/0 or 2/0 absorbable suture swaged on a large needle

(36–40 mm, curved round body) introduced percutaneously using a strong conventional needle holder. Skipping the vas and vessels and directed to the skin, suture is tied extra corporeally, in females the round ligament could be anchored in the suture (15).

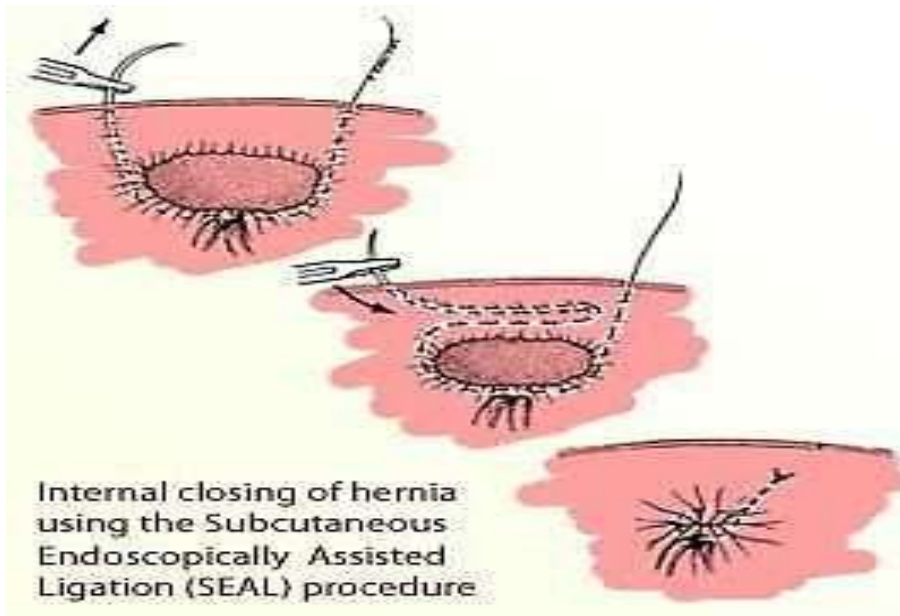


Figure 8. subcutaneous endoscopically assisted ligation (SEAL).

2. Needlescopic hernia repair:

Reverdin needle (RN) is a surgical needle with an eye that can be opened and closed with a slide. It essentially modifies

the delivery of the suture material, creating an extracorporeal knot tying. It markedly reduces both operative time and technical difficulty (16).

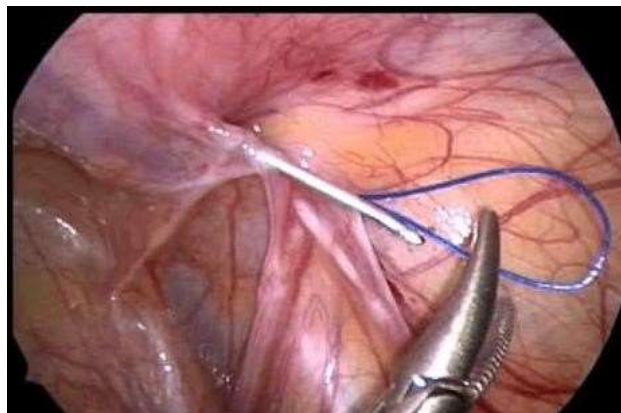


Figure 9. Needlescopic hernia repair. (8).

3. Percutaneous internal ring suturing (PIRS):

This technique (similar to SEAL) has been used to loop the internal ring

extraperitoneally under laparoscopic guidance. In PIRS, an 18-gauge epidural needle with a 3/0 non-absorbable suture in its barrel replaces the swaged needle (17).

A hollow needle with suture material inside is passed percutaneously under the peritoneum of each half of the internal ring. It allows extracorporeal knot-tying by catching a loop of the suture material and pulling it to the surface. Some intraoperative and postoperative complications were reported. Recurrence was three cases out of 106 children (8).



Figure 10. Percutaneous internal ring suturing using epidural needle (PIRS).

References

1. Marte, A., Caldamone, A. A., & Aguiar, L. M. (2021). The history of the pediatric inguinal hernia repair. *Journal of Pediatric Urology*, 17(4), 485-491 .
2. Juang, D., Fraser, J. D. and Holcomb 3rd, G. W. (2016) ‘The laparoscopic approach for repair of indirect inguinal hernias in infants and children’, *Translational pediatrics*, 5(4), pp. 222–226. doi: 10.21037/tp.2016.10.03.
3. Svetanoff, W. J., & Oyetunji, T. A. (2022). Inguinal Hernia. In *Fundamentals of Pediatric Surgery* (pp. 781-787). Cham: Springer International Publishing.
4. Rajbhandari, N., Karki, B., Guglielmetti, L. C., & Vuille-dit-Bille, R. N. (2021). Establishment of single-port, laparoscopic, pediatric hernia repair in a developing country. *Journal of Laparoendoscopic & Advanced Surgical Techniques*, 31(1), 124-129.
5. Morini, F., Dreuning, K. M. A., Janssen Lok, M. J. H., Wester, T., Derikx, J. P. M., Friedmacher, F., Miyake, H., Zhu, H., Pio, L., Lacher, M., Sgró, S., Zani, A., Eaton, S., van Heurn, L. W. E. and Pierro, A. (2021) ‘Surgical Management of Pediatric Inguinal Hernia: A Systematic Review and Guideline from the European Pediatric Surgeons’ Association Evidence and Guideline Committee’, *European Journal of Pediatric Surgery*, 32(03), pp. 219–232. doi: 10.1055/s-0040-1721420.
6. Vishnu, R. K. (2020). Comparative study on Inguinodynia in Lichtenstein (OPEN) Versus Tapp (Laprosopic) Hernioplasty in Mohan Kumaramangalam Medical College Hospital, Salem (Doctoral dissertation, Government Mohan Kumaramangalam Medical College, Salem).
7. Pogorelić, Z., Huskić, D., Čohadžić, T., Jukić, M. and Šušnjar, T. (2021) ‘Learning curve for laparoscopic repair of pediatric inguinal hernia using percutaneous internal ring suturing’, *Children*, 8(4), p. 294
8. Bin Nour, S. M., Rozeik, A. E., Alekrashy, M., & El-Taher, A. K. (2023). Laparoscopic techniques for congenital inguinal hernia repair. *Journal of Pharmaceutical Negative Results*, 14(3).

9. Wang, D., Yang, P., Yang, L., Jin, S., Yang, P., Chen, Q., & Tang, X. (2021). Comparison of laparoscopic percutaneous extraperitoneal closure and laparoscopic intracorporeal suture in pediatric hernia repair. *Journal of Pediatric Surgery*, 56(10), 1894-1899 .
10. Garzi, A., Prestipino, M., Calabrò, E., Di Crescenzo, R. M., & Rubino, M. S. (2020). Laparoscopic repair of paediatric indirect inguinal hernia: modified flip flap technique. *Translational Medicine@UniSa*, 22, 33.
11. Kantor, N., Travis, N., Wayne, C., & Nasr, A. (2019). Laparoscopic versus open inguinal hernia repair in children: which is the true goldstandard? A systematic review and meta-analysis. *Pediatric surgery international*, 35(9), 1013-1026.
12. Elbatarny, A. M., Khairallah, M. G., Elsayed, M. M., & Hashish, A. (2020). Laparoscopic Repair of Pediatric Inguinal Hernia :Disconnection of the Hernial Sac versus Disconnection and Peritoneal Closure. *Journal of Laparoendoscopic & Advanced Surgical Techniques*, 30(8), 927-934 .
13. Alshammari, D., Sica, M., Talon, I., Kauffmann, I., Moog, R., Becmeur, F., & Schneider, A. (2020). Our laparoscopic surgical technique and experience in treating pediatric inguinal hernia over the past decade. *Journal of Indian Association of Pediatric Surgeons*, 25(1), 28.
14. Lee, S. R., & Park, P. J. (2019). Laparoscopic reoperation for pediatric recurrent inguinal hernia after previous laparoscopic repair. *Hernia*, 23, 663-669.
15. Muncie, C., Cockrell, H., Whitlock, R., Morris, M., & Sawaya, D. (2019). The ideal candidate for subcutaneous endoscopically assisted ligation (SEAL) of the internal ring for pediatric inguinal hernia repair. *The American Surgeon*, 85(11), 1262-12.64
16. Shalaby, R., Negm, M., El-Sawaf, M., Elsaied, A., Shehata, S., Hamed, A., ... & Radwan, A. B. (2022). Needleoscopic disconnection and peritoneal closure for pediatric inguinal hernia repair: a novel technique. *Surgical Laparoscopy Endoscopy & Percutaneous Techniques*, 32(2), 272-278.
17. Thomas, D. T., Göcmen, K. B., Tulgar, S., & Boga, I. (2016). Percutaneous internal ring suturing is a safe and effective method for the minimal invasive treatment of pediatric inguinal hernia: experience with 250 cases. *Journal of Pediatric Surgery*, 51(8), 1330-1335