Al-Azhar International Medical Journal

Volume 5 | Issue 4 Article 20

4-30-2024

Needlescopic Inguinal Hernia Inversion and Snaring in Female Children: A Prospective Study

Ahmad Gamal
Pediatric Surgery, Al-Azhar University Hospitals, Cairo, Egypt, ahmad.gamal12395@gmail.com

Refaat Badawy
Pediatric Surgery, Al-Azhar University Hospitals, Cairo, Egypt

Mohamed ElSayed
Pediatric Surgery, Al-Azhar University Hospitals, Cairo, Egypt

How to Cite This Article

Gamal, Ahmad; Badawy, Refaat; and ElSayed, Mohamed (2024) "Needlescopic Inguinal Hernia Inversion and Snaring in Female Children: A Prospective Study," *Al-Azhar International Medical Journal*: Vol. 5: Iss. 4, Article 20.
DOI: https://doi.org/10.58675/2682-339X.2364

ORIGINAL ARTICLE

Needlescopic Inguinal Hernia Inversion and Snaring in Female Children: A Prospective Study

Ahmad Gamal *, Refaat Badawy, Mohamed ElSayed

Department of Pediatric Surgery, Al-Azhar University Hospitals, Cairo, Egypt

Abstract

Background : ***Using one instrument with a 2mm width was sufficient to invert the hernia sac in females with little trauma to the abdominal wall, hence excellent cosmoses. We introduce a new maneuver for congenital inguinal hernia (CIH) repair in female children using a 1.6-mm suture grasping device (SGD), a Snaring loop (SL), and an Epidural needle. We call this method telescopic inguinal hernia inversion and snaring in females of the pediatric age group.***

Patients and methods : ***This study was carried out prospectively in the period from October 2022 to October 2023 on a total of fifty patients with hernia of the canal of Nuck who underwent telescopic inguinal hernia inversion and snaring under general endotracheal anesthesia. Abdominal and Inguinal ultrasound (US) was done on all patients to confirm the presence of the hernia sac and its size. All hernias were repaired using one SGD and one SL. The epidural needle was our tool to evaluate the diameter of the internal inguinal ring (IIR) laparoscopically. Period of the follow-up started from 1 week and lasted up to 6 months.***

Results : ***Fifty patients, together with 60 hernia defects, comprised the material of this study with a mean age equaled 5.88 ± 2.7 years. IIR size ranged from 4 to 14 mm, with a mean of equaled 0.7 ± 0.29. The mean operative time was 26.78 ± 0.83 min in bilateral and 18.44 ± 2.22 min in unilateral cases. All operations were done without needing to convert to open operations or major intraoperative complications, and the period of follow-up ranged from 1 week to 6 months. Unnoticeable wound marks were reported in all patients, and no symptoms or signs were suggested of recurrence.***

Conclusion : ***Needlescopic inguinal hernia inversion and snaring in females of the pediatric age group are feasible, simple, effective, and safe. This maneuver can be carried out in a short amount of time by almost all pediatric surgeons with standard laparoscopic handling, with the benefits of no recurrence or visible scars.***

Keywords: Female inguinal hernia repair ; Inversion and snaring ; Needlescopy ; Suture grasping device ; Minimally invasive surgery .

1. Introduction

The origin of "hernia" comes from the Greek term "hernios" meaning offshoot or budding.[1] Congenital inguinal hernia (CIH) results from incomplete obliteration of the processus vaginalis in the period of fetal and newborn growth.[2] Repair of the inguinal defect is being performed very commonly in pediatric surgery. It is done by open herniotomy in the inguinal region with ligation of the sac as proximal as possible (gold standard).[3] El Gohary first introduced the management of inguinal hernia in girls by laparoscopy in 1997.[4] In the recent era, laparoscopic inguinal hernia repair (LIHR) has advanced rapidly from using three ports to two ports, and now laparoscopic surgery with a single incision is so common. Together with decreased surgical time and postoperative pain, it has the advantage of delivering wonderful and more desired cosmoses .[5] One of the disadvantages of conventional laparoscopy is the bad cosmetic appearance of visible scars, although they are still tinier than those of open repairs .[6] This has brought us to using needlescopy.

In this study, we aim to use the telescopic technique with some modifications for the management of inguinal defects in girls and assess its safety, feasibility, intraoperative time, rate of recurrence, and cosmetic appearance.

Accepted 14 April 2024.
Available online 30 April 2024

* Corresponding author at: Pediatric Surgery, Al-Azhar University Hospitals, Cairo, Egypt.
E-mail address: ahmad.gamal12395@gmail.com (A. Gamal).

https://doi.org/10.58675/2682-339X.2364

2. Patients and methods

This study was fashioned prospectively at the Pediatric Surgery Department in Hospitals of Al-Azhar University (Al-Hussein and Sayed Galal University Hospitals) Cairo, Egypt. It was conducted in the period ranging from October 2022 to October 2023. The Institutional Review Board (IRB) of Al-Azhar University accepted this study, and the patient's caregivers signed a well-understood written consent.

Patients below 6 months, recurrent or complicated cases (irreducible or incarcerated bowel or ovary), and a diameter of an internal ring of inguinal canal more than 1.5 cm known by preoperative ultrasonography (US) were dropped out from the study as dealing with these cases may entail suturing of IIR or repair of the arch of the inguinal musculature. Routine preoperative chemistry was done with inguinal (US) to assess the diameter of IIR in all patients. All patients underwent our new manoeuvre (telescopic inguinal hernia inversion and snaring using one SGD and SL with accurate confirmation of the diameter of IIR by using an Epidural needle).

2.1.Operative instruments

Instruments for this procedure included A 5-mm cannula for a telescope of 30°, Suture Grasping Device (SGD) [Company of Mediflex in 250 Gibbs Road, Islandia, NYC 11,749, United States] (Fig. 1A), Snare loop (SL) [Boston Scientific Company, 2546 First street of Propark, El Coyol A., Costa Rica] (Fig. 1B) and an Epidural needle (Fig. 1C).

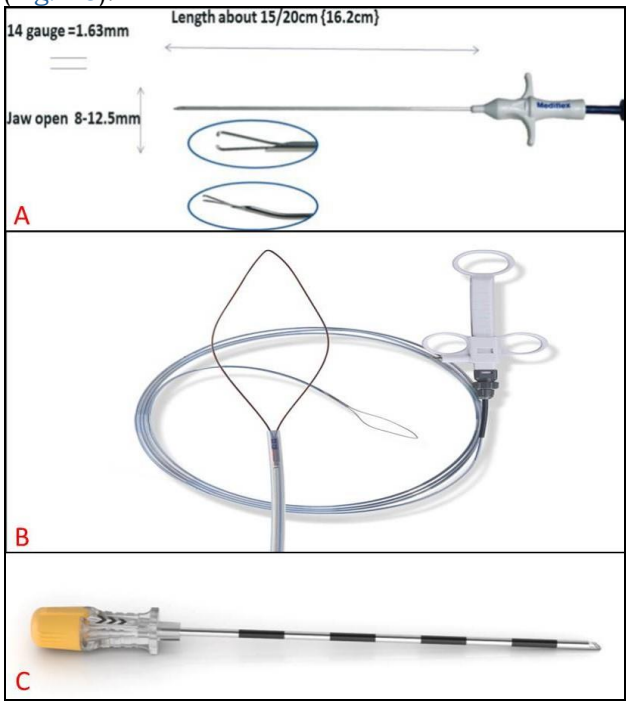

Figure 1. (A) showing features of the SGD (Mediflex needle) which is originally used as a device to do facial closure at port sites and we modified its use to catch the hernia sac. (B) showing the snare loop which is originally used in endoscopies to catch endoluminal polyps and we modified its use to encircle and excise the sac of hernia. (c) showing the epidural needle which is originally used in procedure that involves injecting medication into the space around spinal nerves to provide pain relief, we modified it me measurement on IIR diameter.

2.2.Sites of port and needles

Point A: A vertical umbilical stab wound for the introduction of a 5-mm 30-degree visual port. Point B: A stab of the 11-blade scalpel in the midline [Midway between pubis and umbilicus] for Snare loop. Point C: A similar stab at the corresponding point of Mc-Burney (point LC in left and RC in right-sided hernia) as shown in (Fig. 2).

Figure 2. showing sites of ports and needles in bilateral inguinal hernia; Point A: A vertical umbilical stab wound for introduction of 5-mm 30-degree visual port. Point B: A stab of 11-balde scalpel in the midline [Midway between pubis and umbilicus] for Snare loop. Point C: A similar stab at the corresponding point of Mc-Burney (point LC in left and RC in right-sided hernia).

2.3.Operative details

The patient was put in a prone position, with her abdomen exposed. General endotracheal tube anaesthesia was accomplished. The abdomen was thoroughly prepared with povidone-iodine (Betadine) from the nipple to the midthigh. On induction of anaesthesia, an intravenous antibiotic was given preoperatively using a dosage of 50 mg/kg body weight of 3rd generation cephalosporin.

During cases of either unilateral or bilateral hernias, the surgeon stays on the patient's hernia side while the cameraman stays at the head of the table. The tower of the laparoscope is placed at the patient's feet. The open approach (Hasson

technique) was used for the insertion of the umbilical port (Point A). Pneumoperitoneum was achieved with a Co2 flow rate ranging from 1.5 to 2.5 L/min and an intra-abdominal pressure from 8 to 12 mmHg, according to the weight and age of the patient. The pelvic peritoneal cavity was examined thoroughly to ensure the presence of the inguinal defect and exclude contralateral or other hernias or pathologies. The operating table was then put in a slightly head-down position and tilted a little bit to the opposite side of the hernia. The epidural needle is introduced into the pelvic peritoneal cavity through the corresponding surface point of the internal ring; this allows measuring the IIR meticulously as every mark equals 1cm, as shown in (Fig. 3A). Two-mm incision (point B) located at Midway between umbilicus and symphysis pubis for the Snare Loop (SL). A 1.6-mm puncture using an 11-blade scalpel located at 2 cm above the corresponding point of Mc-Burney (point C) for the Suture Grasping Device (SGD).

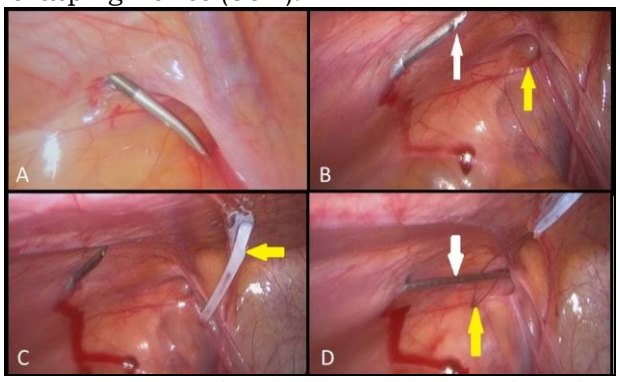

Figure 3. (A) showing intromission of Epidural needle to measure the IIR (every mark is 1 cm). (B) Showing intromission of Suture Grasping Device [SGD] (white arrow) and a unilateral hernia defect (yellow arrow). (c) Showing intromission of the snare Loop (yellow arrow). (D) Showing passage of the SGD (white arrow) through the Snare loop (yellow arrow).

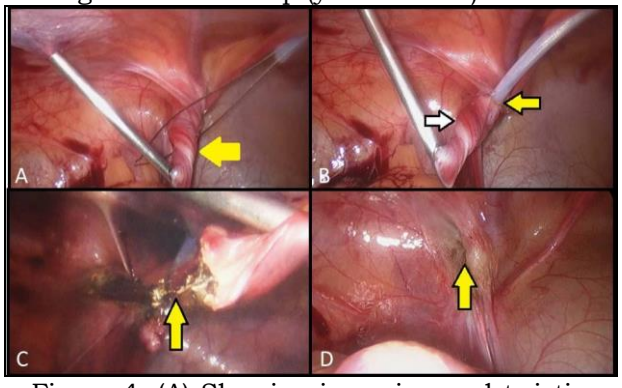

Figure 4. (A) Showing inversion and twisting of the hernia sac (yellow arrow). (B) Showing closure and tightening of the snare loop (yellow arrow) over the inverted and twisted hernia sac (white arrow). (C) Showing closure and tightening of the snare loop (yellow arrow) over the inverted and twisted hernia sac (white arrow). (D) Showing post-snaring view of the internal inguinal opening (yellow arrow).

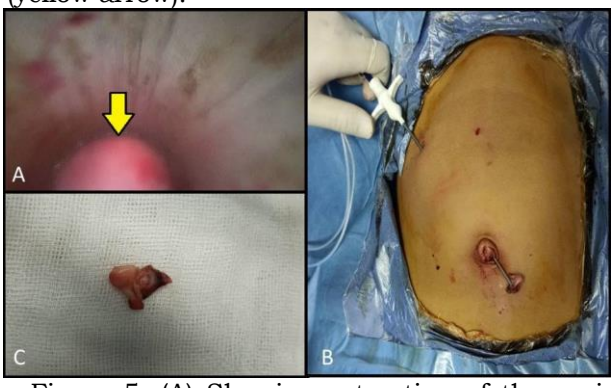

Figure 5. (A) Showing extraction of the excised hernia sac through the umbilical port (yellow arrow). (B) Showing extraction of the sac through umbilicus. (C) Showing snared sac after extraction of it through the umbilicus.

The Snare loop entered through (Point B) and SGD through (point C). (Fig. 3B) shows an intraperitoneal picture of SGD, and (Fig. 3C) shows an intraperitoneal picture of the Snare loop. The SGD is passed via the snare loop (Fig. 3D) to catch the fundus of the sac of the hernia. Then, the fundus of the hernia is inverted, followed by stepwise sustained twisting with traction on the round ligament till complete inversion of the sac occurs (Fig. 4A). At this point, the SL is tightly closed (Fig. 4B), and the current of diathermy is applied to it leading to detachment of the sac of the hernia at its proper neck (Fig. 4C). The excised sac (caught by SGD) is extracted via the visual port (Fig. 5). Relooking in the pelvis is done to make sure that the IIR is sealed successfully (Fig. 4D). Deflation of the peritoneal cavity is done, the iatrogenic umbilical fascial defect is repaired using a 3/0 absorbable suture, and the umbilical skin is closed using a 4/0 subcuticular absorbable suture.

2.4.Postoperative management and Follow-up

All patients were shifted to the regular word after complete recovery and observed for vital signs every 2 hours; intravenous fluids (IV) were reduced as oral intake increased. Antibiotics for surgical site prevention in the form of a single dosage of Cefazolin, 25 mg/kg per body weight, were given in all cases. If the patient was allergic to penicillin, Clindamycin in a dose of 10 mg/kg of body weight was given as the first alternative antibiotic. Analgesics using acetaminophen every 4-6 hours in a dose of 15 mg/kg when needed. All patients started a regular diet two hours after the operation and were sent home on the night of the same day. All patients are regularly seen after discharge in one week, one month, three months, and 6 months in our outpatient department (OPD) of hospitals of Al-Azhar University Cairo, Egypt. They are reviewed in OPD to evaluate and assess them

for wound healing, recurrence, patient and parent satisfaction, and cosmoses.

3. Results

A set of 52 female children with 62 inguinal hernia defects were the material of our study, and their ages varied from 6 months to 12 years. Thirty-one patients (59.6%) presented with right-sided hernia of the canal of Nuck, fourteen (27.0%) patients presented with left-sided hernia of the canal of Nuck, seven (13.4%) patients presented with bilateral hernia of the canal of Nuck. On laparoscopy, there were three patients with contralateral hernia on the right side and no patients with contralateral hernia on the left side—two patients with two hernia defects on the Rt. The side had a diameter of IR equal to or more than 1.5 cm. Accordingly, these patients underwent disconnection and then closure of the defect by nonabsorbable sutures, and these patients were not included in the study. The remaining 50 cases, with 60 hernia defects, comprised the material of this study. Table 1 illustrates the demographic information of these patients.

Table 1. Showing demographic and clinical information according to number of cases.

Preoperative parameters		*Study Group*
		No. = 50
Age in years	Mean ± SD	5.88 ± 2.7
	Range	0.9 – 10
Chronic disease	No	0 (0%)
Anesthesia	General	50 (100%)
Contralateral hernia	Right side	3 (6%)
	Left side	0 (0%)
Side in relation to no. of pt.		29 (58%)
	Right side	14 (28%)
	Left side	7(14%)
	Both sides	
Side in relation to no. of hernia		No.=60
	Right side	39 (65%)
	Left side	21 (35%)

The time of operation it was varied from 15 to 30 minutes (mean =20.186 ± 0.74) for all patients regardless of the laterality. In unilateral cases, the time of operation it was varied from 15 to 22 minutes (mean = 18.44 ± 2.22). For bilateral hernias, the time of operation it was varied from 24 to 30 minutes (mean =26.78 ± 0.83). As shown in Table 2.

Table 2. Showing operative data and complications in relation to number of patients.

Operative data		
Time of operation Unilateral	Mean ± SD	18.44 ± 2.22
	Range	15 – 22
Time of operation Bilateral	Mean ± SD	26.78 ± 0.83
	Range	24 – 30
Size of IIR (mm)	Mean± SD	0.7 ± 0.29
	Range	0.4- 1.4
Intraoperative complications		
Type	Yes / No	No. of patients and percentage 50 (100%)
Conversion to conventional Lap	No	0 (0%)
Conversion to Open	No	0 (0%)
Bleeding	No	0 (0%)
Another instrument	No	0 (0%)

All cases were finished telescopically without needing to convert to open or to conventional laparoscopic technique or adding any further instrument rather than SGD and the snare loop. No major intraoperative complications occurred, as shown in Table 2.

Table 3. Showing hospital stays and postoperative complications regarding recurrence, infection, and cosmoses and hydrocele formation according to number of patients.

Hospital stay		
Days		No. of patients %
The same day		50 (100.0%)
The second day		0 (0.0%)
Postoperative complications		
Complications	No. of patients	%
Port site Infection		
1 week	No 48	96%
	Yes 2	4%
Hydrocele formation		
1 week to 6 months	No 50	100.0%
Recurrence		
1 week to 6 months	No 50	100.0%
Cosmoses		
1 week to 6 months	good 2	4%
	v. good 11	22%
	Exce. 37	74.0%

Table 4. Showing methods of follow up.

Methods of Follow up	1 week		1 month		3 months		6 months	
	No.	%	No.	%	No.	%	No.	%
Physical	50	100.0%	42	84%	30	60%	10	20%
Virtual	0	0.0%	8	16%	20	40%	25	50%
Lost follow up	0	0.0%	0	0.0%	0	0.0%	15	30%

All patients are sent home on the same day of operation. On follow-up, two cases had port site infection (4%) that was managed conservatively. No recurrence or hydrocele formation was noted with excellent Cosmoses in 37 cases (74%), according to caregivers. Hospital stay and post-operative complications are shown in Table 3. All patients came to us in 1 week after the operation, 42 of them came to us after 1 month (84%), 8 cases used a virtual method for contact with us (16%), and 15 cases lost communication with us after 6 months (30%). Methods of follow-up are shown in Table 4.

4. Discussion

The conventional method of repair of congenital inguinal hernia in girls (hernia of the canal of Nuck) is through open herniotomy.[3] It is a very good treatment method for the pediatric age group. Unfortunately, it holds the possible hazard of tubal or ovarian trauma, which may affect fertility.[7] Laparoscopy is rapidly becoming popular, with more and more papers proving its accessibility, efficacy, and safety.[8] The pros of the laparoscopic technique include perfect visual examination of the peritoneal cavity, the ability to operate on the IIR from inside, having no skin wounds or scars, evaluation of the other side of the inguinal canal, minimal tissue damage and decreased time of operation especially in obesity and recurrence.[9] However, learning laparoscopic techniques takes a relatively long time and a high rate of recurrence.[10] One of the important benefits of LIHR is to suspect androgen insensitivity syndrome and other dysgenic malformations. These conditions occur more frequently in inguinal hernias, especially in bilateral cases, and therefore, careful inspection of the female genital system (the uterus, fallopian tubes, and ovaries) is another advantage .[11] Lipskar et al. in 2010 reported 2 cases out of 173 female children (one patient with a right hemiuterus without a uterus on the other side and a rudimentary left Fallopian tube and the other patient with the left Fallopian tube not reaching the uterus) and followed up .[12] In our series, we did not observe any cases of disorders of sexual development. In 1997, El-Gohary was the first surgeon who described laparoscopic inguinal hernia ligation after inversion in females of the pediatric age group. In his original description of the technique, he used three 5-mm ports for the inversion of the sac of the hernia, and a tie of preformed endo loop is placed around the base of the inverted inguinal sac. El-Gohary reported that there were no complications in 28 cases, 11% contralateral patent processus vaginalis, and 1 recurrent case .[4] In 2007, Zallen and Glick reported that they did an inguinal hernia ligation after inversion using laparoscopy in 37 cases. In their report, they used one 5-mm cannula and two 3-mm stab wounds. They reported no complications or recurrent cases in their series .[7] On the other hand, Lipskar et al., in 2010, reported 173 patients who underwent laparoscopic inguinal hernia ligation after inversion in female children using 5-mm and two 2.7-mm instruments; there were 2 recurrent cases (0.83%). Both recurrent cases were repaired by conventional open operation.[10] Contrary to Guner et al. in 2010, which had 2 cases of recurrence in their series using the laparoscopic technique of repair of CIH utilizing the technique of sac inversion, which could be related to incomplete excision of the sacs .[13] During the revolutionary era of LIHR, many surgeons reported improved outcomes after the application of the cautery to the hernia sac at IIR, therefore exhibiting peritoneal fibrosis and decreasing rates of recurrence .[14] In 2016, Novotny et al. used the Burnia technique in which they took advantage of Maryland graspers for cauterization after inversion of the entire hernia sac in 67 female patients with 80 inguinal hernia defects and reported no recurrent cases on a period of follow-up reached 25 months .[13] On the contrary, St-Louis et al. in 2018 studied outcomes of thermal trauma to hernia sacs by monopolar cauterization of the anterolateral part of the IIR in 94 female children and 178 male children and a 3% rate of recurrence was noted. A conclusion of no relation between the intentional peritoneal thermal trauma and reduced rate of recurrence was reported .[15] Using thermal cautery with no complete detachment of the hernia sac, leading to the ignoring of a large part of the peritoneal layer at

the IIR, may be attributed to a cause of recurrence. Snaring after inversion of the inguinal hernia sac gives a smaller raw patch for thermal cautery around its neck, resulting in the addition of the advantages of sac excision and peritoneal thermal trauma to decrease recurrence. This concept matches with the recent reports that reached no recurrence .[16] On the other hand, Shehata et al., in 2012, operated on 56 cases (42 male and 14 female children) with 12 patients who came at the age of one year with a unilateral inguinal hernia that was treated and followed up for 18 months. All patients underwent laparoscopic inguinal hernia repair without sac ligation. They excluded premature patients, patients with age less than 6 months, patients with complicated hernias (irreducible or recurrent hernias), and patients with IIR diameter more than 2 cm. They reported a zero recurrence rate in their 20.5-month period of follow-up .[16] Similarly, in 2010, Riquelme et al. did a laparoscopic inguinal herniotomy without sac ligation (just resection). They operated on 91 cases (76 boys and 15 girls); they completely resected the PPV and the peritoneal fold of the IIR. In their study, suturing was done only in the patients with an IIR wider than 1 cm. There were no recurrent cases during their period of follow-up .[17] Snaring is routinely used in colonic polypectomy, which is applied around the neck using the local current of coagulation without perforation of the colonic wall .[18] In 2020, Shalaby and Negm performed laparoscopic snaring after inversion on 37 female patients with 55 inguinal hernias with the closure of the peritoneal at IIR. They reported no recurrent cases on 10 months of follow-up. They used a polypectomy snaring loop through an extra 5mm port .[16] In our series, we used the polypectomy snaring loop through a separated, very small stab wound using its original electrical insulating sheath. In 2021, Shalaby et al. operated on 53 girls with 74 hernias using two 1.6-mm suture grasping devices (SGD) and a polypectomy snare. They did inversion and snaring herniotomy without closure of the peritoneal defect. There was no recurrence on 24-month follow-up .[6]. In our prospective study, we did not recognize any recurrence in 50 girls with 60 hernias during the period of follow-up of 6 months. The absence of recurrent cases in our study can be related to many points, including meticulous case selection for our modified manoeuvre with IIR less than a diameter of 15 mm. Complete excision of the inguinal sac with peritoneal disconnection, and peritoneal thermal trauma that leads to peritoneal fibrosis and more lasting peritoneal closure. In 2003, Chock et al. reported that the 2-mm instruments, despite having a good cosmetic appearance, are costly, fragile, flexible, and with weak and short jaws, making their far-reaching application limited.[6] On the other hand, SGD (1.6 mm in diameter) has a reasonable length, an intense shaft, an ergonomic handle, and a wide jaw with a secure tissue grasp. That is why we used it to replace the weak 2 mm instruments for telescopic hernia inversion and snaring in girls. In our cases, we were able to use only one SGD during the whole operation, while the other authors used 2 SGDs .[19] In our series, all patients had excellent cosmetic results (almost scarless abdomen in 2 months postoperative follow-up). That is attributed to small 1.6-mm stabs for SGDs, which make minimal or no visible wound marks, and vertical trans-umbilical incision for the visual port, which is almost concealed and leaves no mark.

5. *Conclusion*

Telescopic inguinal hernia inversion and snaring is a feasible, easy, secure, and effective manoeuvre for the repair of congenital inguinal hernia in females of the pediatric age group. It has the advantage of diagnosis and treatment of contralateral PPV at the same time, discovering androgen insensitivity syndrome and other dysgenic malformations. This operation is a direct manoeuvre that can be done in a short time by most pediatric surgeons with standard laparoscopic handling with no recurrence and invisible scars.

Disclosure

The authors have no financial interest to declare in relation to the content of this article.

Authorship

All authors have a substantial contribution to the article

Funding

No Funds : Yes

Conflicts of interest

There are no conflicts of interest.

References

1. Agarwal D, Sinyard RD 3rd, Ott L, Reinhorn M. Primary Tissue Repair for Inguinal Hernias: The Shouldice Repair Technique and Patient Selection. Surg Clin North Am. 2023;103(5):859-873.
2. Brainwood M, Beirne G, Fenech M. Persistence of the processus vaginalis and its related disorders. Australas J Ultrasound Med. 2020;23(1):22-29.
3. Wang K, Cai J, Lu YC, et al. A Faster and Simpler Operation Method for Laparoscopic Inguinal Hernia Repair in Children. J Laparoendosc Adv Surg Tech A. 2020;30(6):706-711.

4. Kantor N, Travis N, Wayne C, Nasr A. Laparoscopic versus open inguinal hernia repair in children: which is the true gold-standard? A systematic review and meta-analysis. Pediatr Surg Int. 2019;35(9):1013-1026.
5. Shalaby R, Ismail M, Shehata S, et al. Shalaby technique for efficient single incision laparoscopic pediatric inguinal hernia repair. J Pediatr Surg. 2015;50(11):1995-2000.
6. Shalaby R, Elsawaf M, Mohamad Y, Daboos M, Othman A-S, Abdelhafez M, et al. Needlescopic inversion and snaring for inguinal hernia repair in girls using 1.6-mm instruments. Journal of Pediatric Endoscopic Surgery. 2021;3(3):167-173.
7. Feng S, Zhao L, Liao Z, Chen X. Open Versus Laparoscopic Inguinal Herniotomy in Children: A Systematic Review and Meta-Analysis Focusing on Postoperative Complications. Surg Laparosc Endosc Percutan Tech. 2015;25(4):275-280.
8. Ozgediz D, Roayaie K, Lee H, et al. Subcutaneous endoscopically assisted ligation (SEAL) of the internal ring for repair of inguinal hernias in children: report of a new technique and early results. Surg Endosc. 2007;21(8):1327-1331.
9. Dreuning K, Maat S, Twisk J, van Heurn E, Derikx J. Laparoscopic versus open pediatric inguinal hernia repair: state-of-the-art comparison and future perspectives from a meta-analysis. Surg Endosc. 2019;33(10):3177-3191.
10. Esposito C, Escolino M, Turrà F, et al. Current concepts in the management of inguinal hernia and hydrocele in pediatric patients in laparoscopic era. Semin Pediatr Surg. 2016;25(4):232-240.
11. Lipskar AM, Soffer SZ, Glick RD, Rosen NG, Levitt MA, Hong AR. Laparoscopic inguinal hernia inversion and ligation in female children: a review of 173 consecutive cases at a single institution. J Pediatr Surg. 2010;45(6):1370-1374.
12. Esposito C, St Peter SD, Escolino M, Juang D, Settimi A, Holcomb GW 3rd. Laparoscopic versus open inguinal hernia repair in pediatric patients: a systematic review. J Laparoendosc Adv Surg Tech A. 2014;24(11):811-818.
13. Novotny NM, Puentes MC, Leopold R, Ortega M, Godoy-Lenz J. The Burnia: Laparoscopic Sutureless Inguinal Hernia Repair in Girls. J Laparoendosc Adv Surg Tech A. 2017;27(4):430-433.
14. Ostlie DJ, Ponsky TA. Technical options of the laparoscopic pediatric inguinal hernia repair. J Laparoendosc Adv Surg Tech A. 2014;24(3):194-198.
15. St-Louis E, Chabot A, Stagg H, Baird R. Experience with peritoneal thermal injury during subcutaneous endoscopically assisted ligation for pediatric inguinal hernia. J Pediatr Surg. 2018;53(5):968-972.
16. Shalaby R, Negm MA. Laparoscopic snaring of hernia sac for inguinal hernia in girls: a preliminary study. Acta Sci Paediatr. 2020;3(3):48-52.
17. Abdulhai S, Glenn IC, Ponsky TA. Inguinal Hernia. Clin Perinatol. 2017;44(4):865-877.
18. Chen YN, Chang LC, Chang CY, et al. Comparison of cold and hot snaring polypectomy for small colorectal polyps: study protocol for a randomized controlled trial. Trials. 2018;19(1):361.
19. Chang LC, Chang CY, Chen CY, et al. Cold Versus Hot Snare Polypectomy for Small Colorectal Polyps : A Pragmatic Randomized Controlled Trial. Ann Intern Med. 2023;176(3):311-319.