

# Single-incision laparoscopic closure of inguinal hernia in female children: a simplified technique

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**How to cite this article:** Helal AA. Single incision laparoscopic closure of inguinal hernia in female children: a simplified technique. *Mini-invasive Surg* 2017;1:89-94.



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## ABSTRACT

**Aim:** Single-incision laparoscopic hernia repair (SILHR) is a popular technique, especially in female children, as it reduces the number of incisions while achieving a better cosmetic outcome. However, intracorporeal suturing and knotting remains a major obstacle during SILHR and it requires a relatively long learning curve. Conversely, extracorporeal suturing and knotting is straightforward, though it has several drawbacks. The purpose of this report is to describe a simple technique for SILHR in female children. **Methods:** Between May 2014 and December 2016, 100 girls with 120 hernias of the Canal of Nuck (34 with right-side inguinal hernia, 46 with left-side hernia, and 20 with bilateral hernia) underwent SILHR. The opened internal inguinal ring was closed using a complete purse string suture fashioned by epidural needle with intracorporeal knot tying. The main outcomes were feasibility, operative time, complications and cosmetic outcome. **Results:** The mean age was  $2.0 \pm 2.2$  years, and the mean operative time was  $8.0 \pm 2.2$  min for unilateral hernia repair and  $16.0 \pm 4.3$  min for bilateral cases. All cases were completed laparoscopically without intraoperative complications. During follow-up, there were no recurrences and umbilical scars were almost invisible. **Conclusion:** This simplified technique is feasible, quick, achieves better cosmetic results in female children, and avoids the drawbacks of extracorporeal knotting.

### Article history:

Received: 20-12-2016  
Accepted: 05-04-2017  
Published: 30-06-2017

### Key words:

Single incision,  
intracorporeal knotting,  
laparoscopic hernia repair,  
simplified technique,  
female hernia



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## INTRODUCTION

Over recent years, a variety of techniques have been used for laparoscopic inguinal hernia repair in children, involving both extra- and intracorporeal suturing and knotting.<sup>[1,2]</sup> Single-incision laparoscopic hernia repair (SILHR) is an excellent and increasingly popular technique for children, and is supported by a number of publications describing its feasibility, efficacy, and outstanding cosmetic results.<sup>[3-6]</sup>

However, intracorporeal suture tying and knotting remains one of the most difficult and complicated step for most pediatric surgeons during SILHR, and remains the main causative factor for increased operative time. It is possible that the apparent cause for this obvious problem is that the instruments used for SILHR lie almost parallel to each other without triangulation (this triangulation creates an environment in which instruments can be moved comfortably during conventional laparoscopic surgery), thus making intracorporeal suture tying and knotting a very challenging task.<sup>[7-10]</sup>

During SILHR, many pediatric surgeons prefer extracorporeal suture ligation with subcutaneous knotting, under laparoscopic guidance. However, some authors have reported that this approach may be associated with some drawbacks, such as stitch sinus, infection, granuloma, puckering or dimpling of the skin and entrapment of the abdominal wall muscles with the suture, which may result in later loosening of the suture with an increased recurrence rate.<sup>[11-15]</sup>

Here, we introduce a simplified technique for SILHR in female children. This technique entails the use of gauge-18 epidural needles (EN) to fashion a complete purse string suture around the internal inguinal ring (IIR), accompanied by intracorporeal knotting using extracorporeal self-sliding clinch knot. We have named this as the "Helal technique". Our purpose here, is to demonstrate the feasibility, safety and efficacy of this new surgical technique.

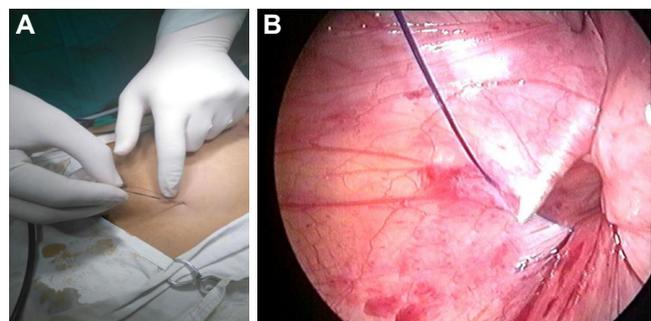
## METHODS

This prospective study was conducted and followed-up at the Pediatric Surgery Department, Al-Azhar University Hospitals, Cairo, Egypt, between May 2014 and December 2016. A total of 120 inguinal hernias were repaired with SILHR in 100 female children. Inclusion criteria included female gender and unilateral or bilateral inguinal hernia. Exclusion criteria included recurrent hernia, hernia in morbid obese female child, complicated hernia (e.g. incarcerated ovary), and children who could not tolerate pneumoperitoneum

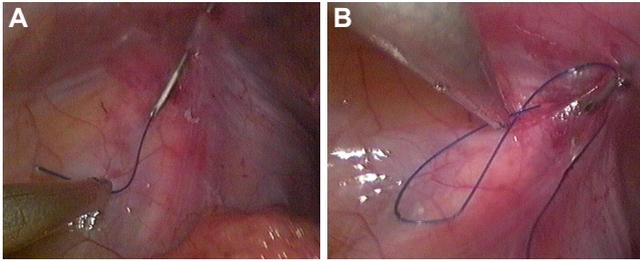
(e.g. those with congenital heart disease). All children were subjected to full history taking, thorough clinical examination, and routine preoperative investigations (complete blood count, bleeding time, clotting time, and liver and renal profiles). All cases were performed by the author and his team. The primary outcome measurements included feasibility of the procedure, operative time, complications and cosmetic outcome. The secondary outcome measurements included parent satisfaction with the cosmetic results.

## Operative steps

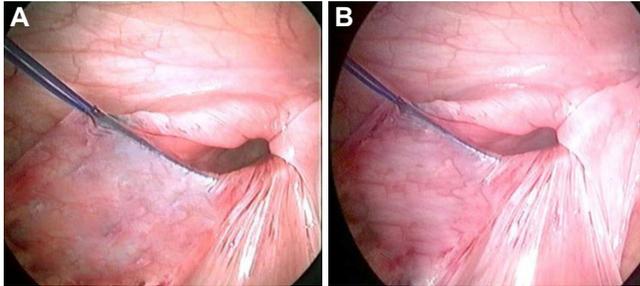
1. The patient was placed in a supine Trendelenburg's position with tilting to the opposite side of the hernia.
2. A longitudinal trans-umbilical incision (0.5-0.9 mm) was made with elevation of the skin flaps.
3. A camera port was inserted for the telescope (5 mm, 30 degree) and a 3-mm laparoscopic needle holder was inserted through a separate facial incision within the same umbilical skin incision.
4. A pneumo-peritoneum was created and pressure was adjusted according to age (from 8 to 10 mmHg).
5. The pelvis, adnexa and both IIRs were carefully inspected. If a contralateral patent processus vaginalis was identified, it was repaired.
6. An EN (gauge-18) was threaded with a 3/0 prolene suture and introduced percutaneous at the level of the IIR [Figure 1A].
7. The EN was manipulated extraperitoneally around the margin of the IIR starting at 3 o'clock meridian (on both sides). It was then advanced along the lower margin of the IIR beneath the peritoneum to breach the peritoneum at 9 o'clock meridian on the margin of the IIR [Figure 1B].



**Figure 1:** (A) An epidural needle (EN) threaded with a 3/0 prolene suture was percutaneously introduced into the extra-peritoneal cavity by direct puncture of the anterior abdominal wall; (B) the EN was then advanced in an extraperitoneal direction to complete a purse string around the internal inguinal rings



**Figure 2:** (A and B) Both ends of the thread was picked out from the epidural needle using a trans-umbilical laparoscopic needle holder and pulled outside of the abdomen



**Figure 3:** (A and B) Complete extra-peritoneal purse string around the internal inguinal ring

8. The end of the thread was picked out from the EN using a trans-umbilical laparoscopic needle holder, and pulled outside of the abdomen [Figure 2A]. The thread was held outside of the abdomen and the needle holder was reintroduced.

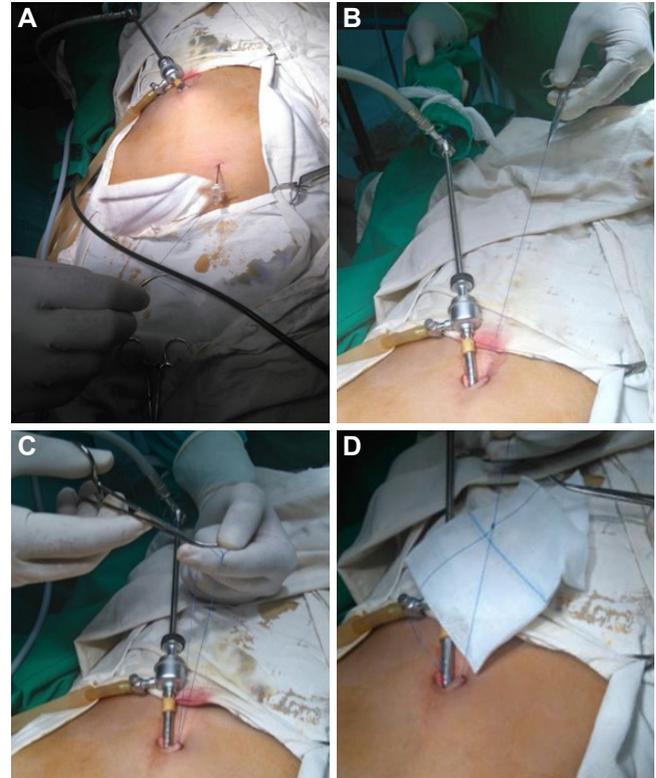
9. The EN was withdrawn backwards to the starting point at 3 o'clock meridian, and then advanced along the upper margin of the IIR beneath the peritoneum to come out from the same peritoneal puncture at 9 o'clock meridian, where the other end of the thread was picked out of EN by the needle holder and also pulled outside of the abdomen [Figures 2B and 3].

10. The suture was tied using a self-sliding extracorporeal clinch knot, as described by Weston,<sup>[16]</sup> and this was reinforced with single instrument intracorporeal knot tying, as described by Ismail and Shalaby [Figures 4 and 5A].<sup>[13]</sup>

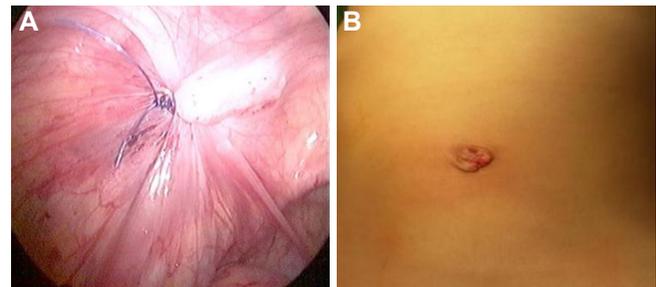
11. Finally, the umbilical incision was closed [Figure 5B].

**RESULTS**

One hundred female children with 120 inguinal hernias



**Figure 4:** (A and B) The end of the thread was pulled out through the trans-umbilical incision; (C and D) the self sliding extracorporeal clinch knot was tied



**Figure 5:** (A) Complete closure of the internal inguinal ring with intra-corporeal knotting; (B) finally the umbilicus was closed leaving an almost invisible scar

underwent SILHR. Demographic, preoperative, intraoperative, and postoperative data were collected and analyzed. The mean age was  $2.0 \pm 2.2$  years (range 6 months to 7 years). The demographic data of all patients are shown in Table 1. All cases were completed laparoscopically. The mean operative time was  $8.0 \pm 2.3$  min for unilateral cases and  $16.0 \pm 4.3$  min for bilateral cases. All patients achieved full recovery

**Table 1: Patient demographic data**

No. of patients	Gender	Age		Clinical presentation		Operative presentation	Complications	
		Mean	Range	Left inguinal hernia	Right inguinal hernia	Bilateral inguinal hernia	Intraoperative	Postoperative
100 (100%)	Female	$2 \pm 2.2$ years	6 months -7 years	46 (46%)	34 (34%)	20 (of clinically left)	Nil	Nil

without intraoperative or postoperative complications. There was no recurrence. All children returned home on the same day. The mean hospital stay was  $7.79 \pm 1.28$  h (range 5-19 h). All parents were satisfied with the cosmetic outcome with an almost invisible scar. The mean postoperative follow-up period was 12 months (range 8-24 months).

## DISCUSSION

In 2015, we published a paper describing a novel technique for the repair of inguinal hernia in female children using a single laparoscopic instrument (needle holder).<sup>[12]</sup> However, we observed that the entry for this single instrument required a separate port in the abdominal wall, plus the camera port. As a consequence, this particular technique was not cosmetically optimal for a female child. Moreover, closure of opened IIR using a single laparoscopic instrument technique requires special laparoscopic skills to manipulate the needle easily around the IIR, and to develop the back-hand movement skills, with protection of the inferior epigastric vessels. Consequently, this technique requires a long learning curve.

Therefore, we continued our research in order to identify a single-incision access technique, which was more feasible for children and required a relatively short learning curve. This research culminated in the novel technique described in this paper. From the author's point of view, there is no doubt that this new technique represents a simpler procedure with a relatively short learning curve. Moreover, the new technique achieves better cosmetic outcomes in female children.

Over recent years, laparoscopic inguinal hernia repair for children has progressively developed from conventional laparoscopic surgery with 2 working instruments (with or without ports) and a camera port, to become single laparoscopic instrument repair with a camera port. Most recent studies have described and supported the feasibility and safety of pediatric single-port and single-incision pediatric laparoscopic hernia repair.<sup>[12,17-19]</sup>

However, there is still debate over which laparoscopic technique is the most appropriate and beneficial for pediatric hernia repair. Becmeur *et al.*<sup>[20]</sup> concluded that pediatric inguinal hernia must be treated in the same manner as that carried out for open surgery; this is achieved with complete separation of the sac at the IIR, and suturing of the peritoneum at the IIR. Giseke *et al.*<sup>[21]</sup> further reported that laparoscopic hernia repair in children should be a reproduction of the open inguinal approach with dissection of the sac at the IIR. In 2015, Lee *et al.*<sup>[22]</sup> reappraised one critical concern in their

publication entitled "A purse-string suture at the level of internal inguinal ring, taking only the peritoneum leaving the distal sac: is it enough for inguinal hernia in pediatric patients?" These authors concluded that laparoscopic purse-string suture of the hernia sac at the IIR, taking only the peritoneum and leaving the distal sac intact, is a safe, effective, and reliable course of treatment for pediatric inguinal hernia.

At the moment, SILHR appears to be taking the upper hand as a very important development in minimal access surgery, with most pediatric surgeons tending to use the simple and rapid percutaneous extraperitoneal closure of opened IIR with subcutaneous suture knotting. However, the major concern of percutaneous closure is the unavoidable inclusion of tissues between the skin and the hernia sac, including nerves and muscles, which may result in unnoticed injury and may be reflected by a subsequent increase in postoperative morbidity.<sup>[23-26]</sup> Moreover, the subcutaneous sutures may cause stitch sinus, infection, granuloma, puckering or dimpling of the skin; or it may cut through the muscles with subsequent loosening of the suture around the IIR, thus resulting in the recurrence of hernia.<sup>[27-29]</sup> Therefore, from the author's point of view, one of the major advantages of our new technique, is that the knot was sutured and tied using an extracorporeal clinch knot with an intracorporeal knotting. Thus, we avoided subcutaneous placement of the suture and associated complications.

Yang *et al.*<sup>[29]</sup> reported that the rate of recurrence following laparoscopic inguinal hernia repair in children was still a matter of controversy. Shalaby *et al.*<sup>[30]</sup> published a description of 150 patients treated with SILHR, and reported one case of recurrence and three cases of hydrocele. It appears that the cause of recurrence may have been related to a weak point (the superficial purse) in the area above the vas and vessels. Helal<sup>[12]</sup> published an investigation of a further series of 60 girls with 68 hernias, treated by laparoscopic single instrument closure of inguinal hernia, and reported only one case of recurrence (1.47%). Furthermore, Helal<sup>[12]</sup> explained that this recurrence may have occurred due to skip areas around the IIR during his learning curve.

In the present study of SILHR, we observed no recurrence during the postoperative follow up (up until the time of writing). We believe that this is because we used an EN to easily fashion a complete, secure and tight purse string suture around the IIR with intracorporeal knotting (i.e. no abdominal wall muscles were included within the knot) without any skip areas (no vas or vessels need to be protected in female children). Furthermore, we performed SILHR after gaining significant prior experience in performing different laparoscopic

procedures for inguinal hernia repair.

One of the major limitations of SILHR is that the instruments lie almost parallel to each other without triangulation (unlike conventional laparoscopic surgery).<sup>[16]</sup> In our new technique, the percutaneous insertion of a complete purse string suture using EN is a straightforward procedure for female children (no vas or vessels need to be protected) with easy retrieval of thread from the EN. Moreover, withdrawal of the thread from the same facial opening of the needle holder entry acts as a guide for reinsertion of the needle holder and avoids trial and error during blind re-entry. Furthermore, the use of a laparoscopic needle holder allows us to stretch the peritoneum in front of the EN and thus avoid the presence of any skip areas. The use of a self-sliding clinch knot avoids the need for a tie pusher, unlike many other extracorporeal knots.<sup>[16]</sup> One well-known disadvantage of laparoscopic knot tying is the reduced sensation of the tension applied to the tissues and the knot. Tightening of the knot in our technique, using a self-sliding extracorporeal clinch knot, and its reinforcement with a laparoscopic single instrument tie, preserves tactile sensation and allows for accurate adjustment of the tension applied to the tissues, thus ensuring the firm and secure closure of the IIR.<sup>[11,12,16,19,20,30,31]</sup>

In conclusion, this simplified technique is feasible, only requires a short operative time, does not lead to recurrence, and yields better cosmetic outcomes in female children. In addition, this technique extends the benefits of single-incision endosurgery and avoids the drawbacks of extracorporeal knotting.

### Author's contributions

A.A. Helal contributed solely to this paper.

### Financial support and sponsorship

None.

### Conflicts of interest

We have no conflicts of interest and no financial disclosures.

### Patient consent

Written informed consent was obtained from parents.

### Ethics approval

The study protocol was approved by the ethical committee of our hospital.

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