

Laparoscopic Inguinal Hernia Repair in Infancy and Childhood: A Randomized Controlled Study of Two Different Techniques

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Abstract: Background: Inguinal hernia repair is one of the most frequently performed surgical procedures in infants and young children. Laparoscopic hernia repair in infancy and childhood is still debatable. There are many techniques available for laparoscopic hernia repair in pediatrics. **Purpose:** to compare laparoscopic intracorporeal purse-string suture ligation of the hernia defect leaving the sac intact versus disconnection of the hernia sac with intracorporeal suture of proximal part. **Patients and Methods:** A prospective controlled randomized study of laparoscopic repair of congenital inguinal hernia [CIH] was conducted over ninety patients at the Pediatric Surgery Department, Al-Azhar University Hospitals, Cairo, over a period of 2 years from April 2014 to April 2016. They were randomized into two equal groups: **Group I** (n = 45) received Intracorporeal purse string suture ligation of the hernia sac in at IIR leaving the sac intact; and **Group II** (n = 45) received disconnection of the hernia sac with intracorporeal suture of proximal part at IIR. **Inclusion criteria:** Bilateral CIH, unilateral CIH with questionable other side, cases of CIH associated with umbilical hernia and parental request. **Exclusion criteria:** Recurrent cases, complicated cases, hernia of canal of Nuck in females, inguinal hernia with undescended testis, parental refusal. The main outcome measurements were; operative time, hospital stay, postoperative hydrocele formation, recurrence rate, and cosmetic results. **Results:** This study included 90 patients with 94 hernia defects. Their age ranged from 6 months to 3 years. There were no significant differences regarding the demographic data of the groups. All cases were completed successfully without conversion. There were no statistically significant difference between groups regarding intraoperative complications and hospital stay. There were statistically significant difference in the operative time and post-operative complications between the studied groups. **Conclusions:** Laparoscopic inguinal hernia repair by disconnection of the hernia sac at the IIR with peritoneal closure is safe and feasible method. It has a lower recurrence rate than the purse string suturing leaving the sac intact.

[Yasser Ashour, Mohamed Abd-Alrazek and Rafik Shalaby. **Laparoscopic Inguinal Hernia Repair in Infancy and Childhood: A Randomized Controlled Study of Two Different Techniques.** *Nat Sci* 2017;15(2):35-41]. ISSN 1545-0740 (print); ISSN 2375-7167 (online). <http://www.sciencepub.net/nature>. 7. doi:[10.7537/marsnsj150217.07](https://doi.org/10.7537/marsnsj150217.07).

Key words: Laparoscopic hernia repair; Purse string suture; intracorporeal sutures, disconnection of the hernia sac, inguinal hernia.

1. Introduction:

Congenital inguinal hernia is a common pediatric surgical disease, with a peak incidence during the first 3 months of life. It is traditionally treated by open approach with high ligation of the hernia sac (gold standard). However, Laparoscopy is gaining popularity nowadays and indeed, it has an established role in the management of pediatric inguinal hernia and it is fast becoming the gold standard.^(1,2)

Initially, laparoscopy was used to examine the contralateral groin, either through the opened processus vaginalis during open unilateral herniotomy, or through a remotely placed port.⁽³⁾ However; recently, many centers routinely perform laparoscopic hernia repair in children and there have been numerous reports describing various laparoscopic techniques. Reported advantages of laparoscopic hernia repair include; excellent visual exposure, minimal dissection, less complications, comparable

recurrence rates, and improved cosmetic results compared with the traditional open approach.^(4, 5, 6)

The recurrence rate of laparoscopic hernia repair is about 4%, which is mostly due to technical factors of early-phase and lack of surgical experience in the beginning of the training curve. However, the none transection of the hernia sac in most cases of laparoscopic hernia repair may be the important factor for recurrence and postoperative hydrocele formation.⁽⁷⁾

Becmeur et al. and **Tsai** et al. described a technique in which they resected the processus vaginalis and then close the inguinal ring and they claimed that they have excellent results with 0%–1.2% recurrence.^(8, 9) **Riquelme M.** et al describe a technique based on the theory that [CIH] is due to a patent processus vaginalis, and therefore, the procedure should be to entirely resect it, with or without closure of the internal ring. This allows the peritoneal scar tissue to close the area of the ring.

Also, this scarring occurs in the extent of the inguinal canal where the dissection took place, therefore causing the same peritoneal scarring and sealing of the inguinal floor with complete resolution of the problem⁽¹⁰⁾.

However, a few studies address the superiority of technique over the others and to date there is no controlled randomized study to compare laparoscopic hernia repair with disconnection of the hernia sac and closure of the peritoneum at IIR versus insertion of purse string and ligation of the sac in continuity. That is why we are conducted this controlled randomized study to evaluate these different laparoscopic techniques for [CIH] repair to address any value of disconnection of the hernia sac on the outcome as recurrence, hydrocele and testicular atrophy⁽¹¹⁾.

Patients and Methods:

This prospective controlled randomized study of laparoscopic repair of congenital inguinal hernia [CIH] was conducted on ninety male infants and children at the Pediatric Surgery Unit, Al-Azhar University Hospitals, Cairo, over a period of 2 years from April 2014 to April 2016. The protocol was discussed and approved for clinical study by the Ethical Research Committee of Al-Azhar University and a written informed parental consent was obtained. All patients were randomized into two equal groups by a random-number table sequence. The allocations were contained in opaque sequentially numbered sealed envelopes: **Group I** (n = 45) received Intracorporeal purse string suture ligation of the hernia sac at IIR leaving the sac intact; and **Group II** (n = 45) received disconnection of the hernia sac with intracorporeal suture of proximal part at IIR.

Inclusion criteria:

Male patients only, bilateral CIH, unilateral CIH with questionable other side, cases of CIH associated with umbilical hernia and parental request. **Exclusion criteria:** Recurrent cases, complicated cases, hernia of canal of Nuck in females, inguinal hernia with undescended testis, parental refusal, contraindications for laparoscopy as major lower abdominal surgery. The main outcome measurements were; operative time (calculated after induction of pneumoperitoneum), hospital stay, postoperative hydrocele formation, recurrence rate, and cosmetic results. All children were subject to full history taking, thorough clinical examination, and routine laboratory investigations (CBC, BT, CT, FBS, Liver and Renal Profile), Preoperative ultrasound to confirm the diagnosis and to measure the diameter of IIR. All patients received one dose of preoperative antibiotic prophylaxis in the form of Ceftriaxone 50 mg/kg in the morning of surgery.

Description of the technique:

Group I: Intracorporeal purse-string suture ligation of the hernia defect leaving the sac intact at IIR.

Group II: Disconnection of the hernia sac with intracorporeal suture of proximal part at IIR. In both groups, after induction of general endotracheal tube anesthesia, the patient was placed supine in Trendelenburg's position. Insertion of the main umbilical port by open method was done, then pneumoperitoneum was created to a pressure of 8-12 mmHg. Two 3-mm ports, for working instruments, were inserted vision at the lateral border of both recti at the level of the umbilicus. Laparoscopy [5-mm thirty-degree telescope] was used for initial visualization of the pelvis and IIR on both sides. In Group I, Laparoscopic purse-string suture of hernia sac at IIR leaving the distal sac intact using 3 – 0 non-absorbable suture. Two 3-mm. needle holders were used for intracorporeal insertion of purse string suture around the opened IIR with intracorporeal knot tying. The spermatic vessels and vas deferens are well visualized and protected during the suture. The stitch included the peritoneum only along the lower margin of IIR while it included the peritoneum and the underlying fascia transversalis along the upper margin of IIR. In Group II, The peritoneum is incised lateral to IIR and disconnected circumferentially by careful sharp dissection and to protect the vas and vessels, the peritoneum at IIR was sharply incised circumferentially. This was achieved by lifting the peritoneum between the vas and vessels and making a small nick. This opening was gently widened, and the vas and vessels were swept away under direct vision. To ensure that the vaginalis process was completely sectioned, we pulled on it. The distal part of the sac is partially resected or dropped in the inguinal canal and the peritoneum closed by a nonabsorbable suture. No electrocautery was used in the immediate vicinity of the vas and vessels. Then the proximal part of the disconnected peritoneum was sutured intracorporeally using non-absorbable prolene 3-0 suture. The suture needle was introduced into the peritoneal cavity by directly puncturing the lower abdominal wall. In both groups, supra-umbilical incision was closed with polyglycolic acid 3-0 suture after deflation of the abdomen and steri-strip was applied on 3-mm port sites. Postoperative pain was managed by NSAIDs. The first dose of analgesic was given as a suppository on the operating table itself after recovery from anesthesia. Then paracetamol was given orally. The patient was considered fit to be sent home if he remained pain-free or in mild pain for 4 hours continuously and had accepted an oral feed.

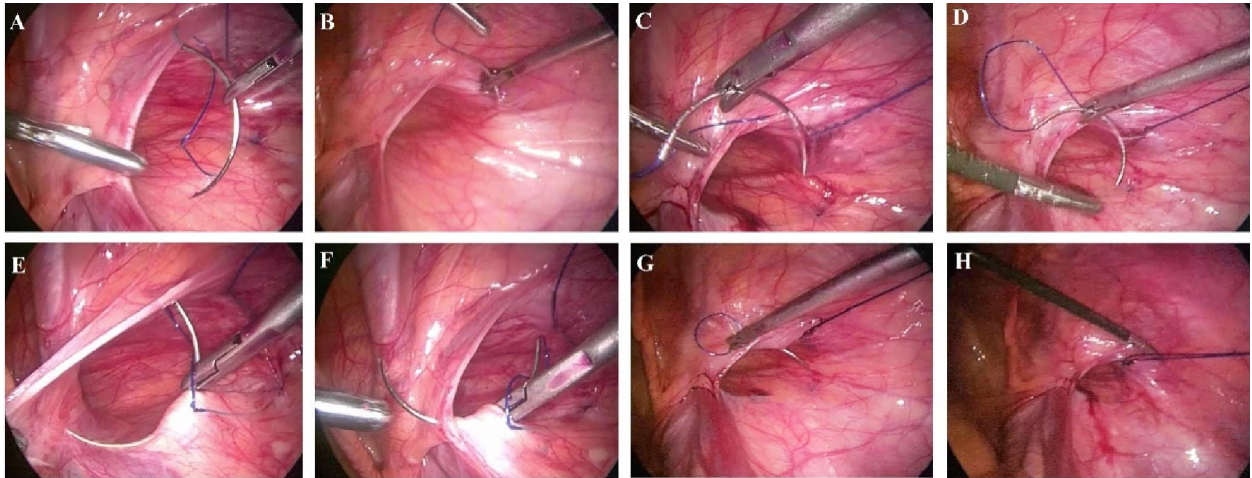


Fig. 1 showing the steps of intracorporeal purse string leaving the hernia sac intact. Needle is passing around the lower margin of IIR [A-F]. Needle is passing along upper margin with complete encirclements of IIR [G-H].

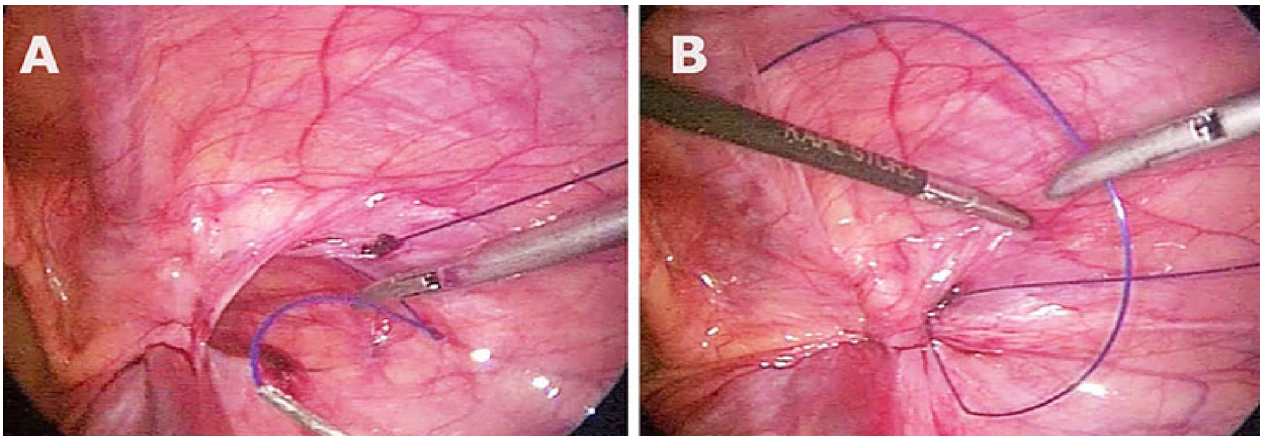


Fig. 2 showing complete encirclement of the hernia sac without skip area and tightening of the suture around IIR.

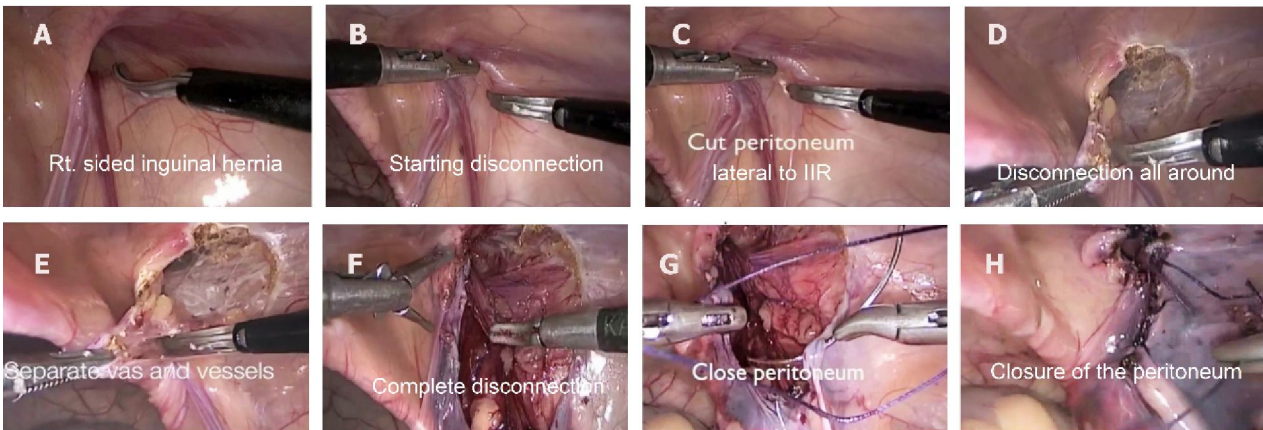


Fig. 3 showing the steps of disconnection of the hernia sac intact. Fig.3, A- Showing right-sided inguinal hernia. Fig.3, B-D Showing steps of disconnection of the sac. Fig.3, E Showing blunt separation of the vas and testicular vessels. Fig.3, G-H Closure of the proximal peritoneum at IIR

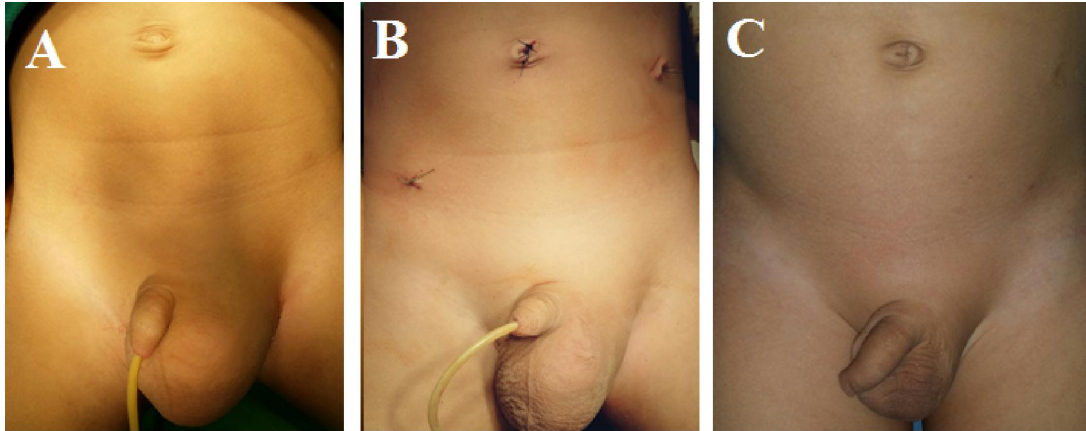


Fig.4-A left-sided inguinal hernia Fig.4-B. Laparoscopic hernia repair by ligation [Group I] Fig.4-C Late post-operative follow up showing nearly invisible scar.

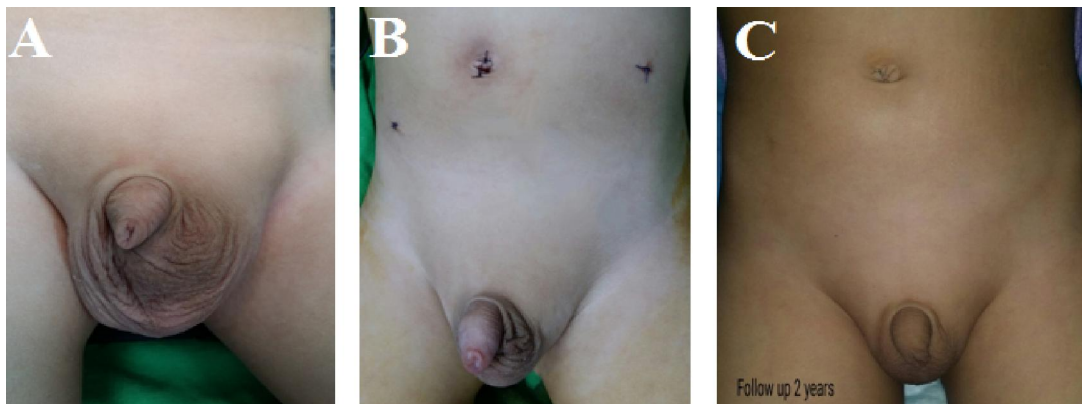


Fig.5-A left-sided inguinal hernia Fig.5-B. Laparoscopic hernia repair by Disconnection [Group II] Fig.5-C Late post-operative follow up showing nearly invisible scar.

Statistical analysis: Data were analyzed using Statistical Program for Social Science (SPSS) version 20.0. Quantitative data were expressed as mean \pm standard deviation (SD). Qualitative data were expressed as frequency and percentage. The following tests were done: Independent-samples t-test of significance was used when comparing between two means. Chi-square (X²) test of significance was used in order to compare proportions between two qualitative parameters. Probability (P-value): P-value <0.05 was considered significant, P-value <0.001 was considered as highly significant, P-value >0.05 was considered insignificant.

3. Results

This study was conducted on ninety male patients with 94 hernia defects at the Pediatric Surgery Department, Al-Azhar University Hospitals, Cairo. Ninety male patients were divided into 2 groups: Group I included 45 patients with 48 hernia defects, mean age \pm SD was 25.02 ± 8.36 months [range 8-36 months]. Group II included 45 patients with 46 hernia defects. The demographic data of all patients is shown

in table 1. There were no significant differences in the age and mode of presentation between the studied groups (Table 1).

All cases were completed successfully without conversion. There were statistically significant difference between groups according operative time, In Group I, the mean duration for surgery was 20.42 ± 1.78 min, ranged between (17-25)min for unilateral cases, and 43.67 ± 1.15 min, ranged between (43-45) min for bilateral cases, while in Group II it was 24.68 ± 2.58 min, ranged between (19-30) min for unilateral cases, and 47.00 ± 0.00 min, ranged between (47-47)min for bilateral cases. There were statistically significant differences between groups regarding hydrocele formation. In Group I, Post-operative hydrocele developed in 12 case (24.5%) which was resolved spontaneously within 2 months, on the other hand in Group II only 4 cases (8.9%) developed hydrocele which resolved spontaneously.

There were significant statistical differences in the recurrence rate between the studied groups, six cases (12.2 %) in Group I developed recurrence during the follow up period while no recurrence was reported

in Group II (Table 2). All patients have had minimal postoperative discomfort and resumed normal activities later on the same day of surgery. They passed uneventful postoperative recoveries and

discharged home on the evening of the same day of surgery to be seen after 7 days, 2 weeks, 6 months, and one year later. The scar is excellent and nearly invisible in both groups. [Fig-4 C, 5 C]

Table 1. Demographic data of the studied group.

Age (Months)	Group I		Group II		t-test	p-value
Mean \pm SD	25.02 \pm 8.36		25.27 \pm 7.04		0.023	0.881
Range	8-36		10-36			
Side of Hernia	No.	%	No.	%	Chi-square test	
Right	31	63.3%	25	55.6%	1.175	0.278
Left	11	22.4%	19	42.2%	2.458	0.117
Bilateral	7	14.3%	1	2.2%	2.995	0.054
Total	49	100.0%	45	100.0%	-	-

The table shows that there is no significant difference of the demographic data between the studied groups.

Table 2. Distribution of the studied patients according to operative time and post-operative complications.

Operative time (min)	Group I		Group II		t-test	p-value
Unilateral Hernia	Mean \pm SD	20.42 \pm 1.78	24.68 \pm 2.58		3.203	<0.001
	Range	17-25	19-30			
Bilateral Hernia	Mean \pm SD	43.67 \pm 1.15	47.00 \pm 0.00		3.333	0.036
	Range	43-45	47-47			
Hydrocele formation	No.	%	No.	%	Chi-square test	
Yes	12	24.5%	4	8.9%	6.042	0.024*
No	37	75.5%	41	91.1%	6.042	0.024*
Total	49	100.0%	45	100.0%	-	-
Recurrence	No.	%	No.	%	x2	p-value
Yes	6	12.2%	0	0.0%	5.886	0.015*
No	43	87.8%	45	100%	5.886	0.015*
Total	49	100.0%	45	100.0%	-	-

The table shows that there is a **significant difference** between the studied groups as regard operative time and post-operative complication.

4. Discussion:

The standard surgical treatment for inguinal hernia, in children, is limited to ligation of the hernia sac at the IIR without narrowing the ring.⁽¹²⁾ The IIR normally is reached by dissecting the herniasac from the cord structures. Open inguinal hernia repair is an excellent method of repair in the pediatric population. However, it has the potential risk of injury of the spermatic vessels and vas deferens, hematoma formation, wound infection, iatrogenic ascending testis in small number of cases, testicular atrophy, and recurrence of hernia.⁽¹³⁾

The advantage for laparoscopy in inguinal hernia repair is to approach inguinal hernias in children from the site of origin leaving the outer anterior abdominal wall intact. The laparoscopic approach is rapidly gaining popularity with more and more studies validating its feasibility, safety, and efficacy.⁽¹²⁾ A variety of laparoscopic techniques have been introduced in the past two decades such as the Z-type

suture, W-type suture, flip-flap techniques, subcutaneous endoscopically assisted ligation of IIR. etc.^(14, 15, 16, 17)

The oldest, most widely practiced laparoscopic technique is intracorporeal suturing of the IIR using 3-ports.^(18, 12) Further, technical refinements have led to the emergence of newer techniques, such as subcutaneous SEAL and percutaneously Endo-needle, Prasad technique, and others for closure of IIR. However, some of these new techniques are associated with a high recurrence rate and development of granuloma, infection, and skin puckering at the site of a subcutaneously placed knot.^(13, 19, 20)

However, these methods are technically similar in that herniotomy, which is a vital step of conventional herniorrhaphy, is not performed. Most previous laparoscopic techniques focused on the ligation of the internal ring leaving the sac intact without herniotomy; some of them focused on the ideal method of complete ligation of the internal ring.

Takehara et al believe that the high recurrence rate and postoperative hydrocele formation of these laparoscopic techniques are mostly due to not performing herniotomy and ligation of the IIR leaving the sac intact without herniotomy.⁽²¹⁾

Laparoscopic hernia repair in children is known to take longer operative time than open herniotomy. Many reports showed that it ranged from 25 to 74 minutes^(16, 12). However, the operative time is reduced gradually with advancing the learning curve. In the current study, the operating time, in group I was 20.42±1.78 minutes for unilateral case and 43.67±1.15 minutes for bilateral case, in group II it was 24.68±2.58 minutes for unilateral case and 47.00±0.00 minutes for bilateral case. There was significant difference regarding the operating time between the 2 groups. In the study of **Tam et al.** who did laparoscopic hernia repair using the hook method in 433 children the mean operating time was 23.8 minutes⁽²²⁾.

In **Montupet, and Esposito** series they had significantly shorter operative time than the current study,⁽²³⁾ However in the work of **Tsai** who implemented the same technique as group II they showed significantly longer time than the current study⁽²⁴⁾.

Post-operative complications: Early follow up was done within 2 weeks after the procedure. In group I, postoperative hydrocele developed in **12 cases** (24.5%) but resolved conservatively without surgical intervention within 3 weeks. In group II postoperative hydrocele appeared in 4 cases (8.9%) and also spontaneously resolved. Post-operative hydrocele and hematoma are acceptable complications after laparoscopic hernia repair as they resolve spontaneously. **Shalaby et al**⁽²⁵⁾ reported that 4% of their cases developed scrotal hydrocele and were treated conservatively without surgery.⁽²⁵⁾ In the study of **Tam et al.** postoperative hydrocele also was reported (1%) and was treated non surgically.⁽²⁶⁾ In another series of **Shalaby et al.** there were 4 reported hydroceles (0.57%), one required percutaneous aspiration, and the others responded well to conservative treatment.⁽²⁵⁾

Recurrence rate after LHR in many series is from 0.7% to 4.5%.^(25, 27, 23, 22) In the current study recurrence of hernia on the same side was reported in six case (12.2%) in group I after 24 months follow up, no recurrence was reported in group B. Regarding post-operative recurrence, purse string suturing after hernia sac disconnection showed that it is more effective and safe than purse string suturing alone leaving the sac intact.

Becmeur performed the disconnection of hernia sac in 82 patients. After 6 months follow up no recurrences were reported in his study.⁽⁸⁾ In another

series of **García-Hernández et al.** who performed the same repair as **Riquelme**⁽¹⁰⁾ by resection the hernia sac without ligation. One patient had scrotal hematoma, which was drained through the scrotum. There were only 2 recurrences (0.53%), which were secondary to incomplete disconnection of the hernia sac and appeared in the first week after surgery.⁽²⁸⁾

Finally, the current study showed that disconnection of the hernia sac at the IIR is an important step in preventing both post-operative recurrence and hydrocele formation. These results are comparable to different series that performed disconnection of the hernia sac.⁽²⁹⁾

Conclusion:

Laparoscopic inguinal hernia repair using disconnection of the hernia sac at IIR with closure of peritoneum mimic what happen with conventional open herniotomy is safe and feasible technique. It resulted in both low recurrence rate and low hydrocele formation with no added risk of injury to the vas and vessels- It should be the standard treatment of inguinal hernia in infants and children as it mimics open herniotomy with the added advantage of laparoscopic magnification that avoids injury of the vas and testicular vessels.

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