



## Laparoscopic Hernia Repair in Infancy and Childhood; Evaluation of Two Different Techniques

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**Background/Purpose:** There are many techniques available for laparoscopic hernia repair in infancy and childhood. The objective of this study is to compare two different laparoscopic techniques as regards operative time, recurrence rate, hydrocele formation and post operative cosmetic results.

**Materials & Methods:** A prospective randomized controlled study was carried out in the Pediatric Surgery Unit of Al-Azhar University Hospitals, over three years period. One-hundred and fifty patients with congenital inguinal hernia were randomized into two equals groups; (n = 75). Group A was subjected to purse-string suture around the internal inguinal ring (IIR) using two needle holders (TNH). Group B was subjected to laparoscopic hernia repair of inguinal hernia by Reverdin Needle (RN). Inclusion criteria included; bilateral inguinal hernia, recurrent hernia, hernia in obese child, incarcerated hernia and hernia on ipsilateral with questionable contralateral side. Exclusion criteria included; unilateral inguinal hernia, and hernia with undescended testicles. The main outcome measurements were; operative time, hospital stay, postoperative hydrocele formation, recurrence rate, and cosmetic results.

**Results:** There were no significant differences as regard age, sex and mode of presentation between both groups. All cases were completed successfully without conversion. There were significant statistical differences in the operative time between the studied groups, while there were no significant statistical differences in the hospital stay, post operative hydrocele formation and recurrence rate. The cosmetic result is excellent in group B.

**Conclusion:** Laparoscopic hernia repair by RN is an effective line of hernia repair in infancy and childhood. It resulted in marked reduction of operative time and excellent cosmetic results with low recurrence.

**Index Word:** Laparoscopic, Reverdin Needle, Purse-string, Intracorporeal sutures.

### INTRODUCTION

Inguinal hernia repair is one of the most frequently performed surgical procedures in infants and young children<sup>1</sup>. 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<sup>2</sup>. 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<sup>3,4,5</sup>. The most commonly used techniques are the use of two needle holders (TNH) to close the internal inguinal ring (IIR) by either purse string or Z-shaped suture and the

insertion of purse string suture from outside subcutaneously under laparoscopic guidance by different methods (Prasad's curved stainless steel awl, Endoneedle, Reverdin needle (RN) or conventional needle with needle holder and subcutaneous endoscopically assisted ligation of the internal ring (SEAL) <sup>5,6,7,8</sup>. We hypothesized that Laparoscopic hernia repair using RN is a rapid and safe technique for the repair of congenital hernia in infancy and childhood with less recurrence rate. So, we conducted this prospective randomized study to compare RN technique with TNH technique for repair of congenital inguinal hernia in infancy and childhood as regards operative time, hospital stay, postoperative hydrocele formation, recurrence rate, and cosmetic results.

## PATIENTS AND METHODS

This prospective randomized clinical trial was conducted between January 2005 and January 2008 in the Pediatric Surgery Unit at Al-Azhar University Hospitals, Cairo, Egypt. Ethical committee of our hospital approved the study protocol. Criteria for enrollment in this study included; bilateral inguinal hernia, recurrent hernia, hernia in obese child, incarcerated hernia and ipsilateral hernia with questionable contralateral side (Fig. 1 A , 2 A). Exclusion criteria included; unilateral inguinal hernia, and hernia with undescended testicles. The main outcome measurements were; operative time (calculated after induction of pneumoperitoneum), hospital stay, postoperative hydrocele formation, recurrence rate, and cosmetic results. One-hundred and fifty patients with different types of congenital inguinal hernia were randomized into two equal groups (no=75) by a random-number table sequence after a written informed parental consent was obtained. The allocations were contained in opaque sequentially numbered sealed envelopes. All children were subjected to full history taking, thorough clinical examination, and routine laboratory investigations (CBC, BT, CT, FBS, Liver and Renal Profile). They received one dose of preoperative antibiotic prophylaxis in the form of Ceftriaxone 50 mg/kg in the morning of surgery. Group A was subjected to intracorporeal insertion of purse-string suture around the IIR using TNH, while group B was subjected to laparoscopic hernia repair by RN (Fig. 3 A and B) under laparoscopic guidance.

### *Description of the two techniques:*

In both groups, after induction of general endotracheal 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. Laparoscopy was used for initial visualization of the pelvis and internal inguinal rings on both sides. **In group A**, the laparoscopic hernia repair was done according to the technique described by Scheir <sup>9</sup>. Two 3-mm. accessory ports were inserted at the lateral borders of the rectus muscle at the level of the umbilicus. Non absorbable 3-0 Prolene suture was used in all patients after its shortening to 8 cm. length. The needle and thread were passed into the abdomen directly through the abdominal wall. Two 3-mm. needle holders were used for stitching the wide IIR with intracorporeal knot tying. The stitches included the peritoneum and the underlying muscular tissue lateral to the spermatic cord. The contralateral IIR was closed if its diameter is more than 2-mm.

**In group B**, RN was used (Marten Medizin-Technik, D-78501 Tuttlingen, Germany) to close internal inguinal ring. One 2-mm Maryland was passed through a port inserted at the lateral border of the rectus muscle at the level of the umbilicus for both unilateral and bilateral hernias. A snip incision of the skin was done 2-cm lateral to the IIR for insertion of the RN. A 3/0 Prolene suture was mounted into the hollow of the needle. The needle was introduced into the abdominal cavity and was manipulated to pass through the upper half of the internal ring incorporating peritoneum and transversalis fascia (from lateral to medial on the right side and from medial to lateral on the left side) piercing the peritoneum just in front the inferior epigastric vessels. Then hollow of RN was opened and the thread was pulled out by the Maryland. The RN was withdrawn without the thread after closure of its hollow to start another suture through the lower half of the internal ring starting from the first insertion of the thread. The RN pierces the peritoneum just lateral and medial to the spermatic vessels, then lateral and medial to vas to pick the free end of the thread again into its hollow. The needle with the thread was withdrawn to the first suture completing a purse string suture which is tightened by extracorporeal knot tie and pushed inside the abdomen by knot pusher around the IIR. In cases of incarcerated hernia, the small bowel was pulled back from the inguinal canal without great difficulty and inspected at the same time for signs of

ischemia and the hernial defect was closed by either technique.

**Statistical analysis:** Data were analyzed using the SPSS software package version 12. For continuous variables, data were expressed as mean  $\pm$  SD and comparison between the two groups was carried out using two-sided *t*-test. Categorical variables were expressed as frequency number and percent and comparison between these variables was carried out using  $\chi^2$  tests. P values  $< 0.05$  was used as an indicator of statistically significant difference between studied groups.

## RESULTS

One hundred and fifty children with congenital inguinal hernia were operated upon laparoscopically. They were 120 males and 30 females. The median age was 61.56 month (rang = 2-96 month). table (1).

There is no significant difference as regard age, sex, mode of presentation between the two groups, table (1). All operations were done by the first author and all procedures were completed laparoscopically without any conversion in both groups. In group A, the mean duration of surgery was 21.9  $\pm$ 7.2 minutes for bilateral cases, 12.8  $\pm$ 4.5 minutes for unilateral recurrent cases. While the operative time for unilateral hernia in obese patient and incarcerated hernia was 14.3  $\pm$ 3.6 minutes and 16.2  $\pm$ 6.3 minutes respectively. The operative time in group B was as follows; bilateral hernia: 11.4  $\pm$ 2.7 minutes, recurrent

unilateral hernia: 7.6  $\pm$ 3.5 minutes. While the operative time for unilateral hernia in obese patient and incarcerated hernia were 9.8  $\pm$ 5.1 minutes and 9.2  $\pm$ 4.6 minutes respectively. There was significant statistical difference between the two groups as regard operative time table (2). No intraoperative complications were reported in this study. 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 on the same day of admission to be seen after 7 days, 2 weeks, 6 months, and one year later. The mean hospital stay was 3.23  $\pm$  5 hours with no significant difference between both groups. Three cases developed post operative hydrocele in the early postoperative follow up in group A, while in group B, postoperative hydrocele was reported in two cases, table (3). However; all cases responded well to conservative management.

Over a mean follow-up period of 24 months, recurrence rate was 4% in group A, while in group B recurrence rate was 1.3% table (3). All cases of recurrence were subjected again to successful laparoscopic hernia repair. RN proved cosmetically more appealing (one 3-mm and one 2-mm versus three 3-mm scars). That is why postoperative excellent cosmetic results were more in group B than group A. (Fig. 1, B). In all cases of incarcerated hernia, the reduced small bowel was seen clearly and there were no signs of ischemia. At a follow-up examination more than 6 months later, there were practically no visible scars in group B. At one-year follow up, all patients were available for check-up.

**Table 1. Demographic data of the studied group (age, sex and presentations)**

Group	Group A		Group B		Total No.	P
	No.	%	No.	%		
<b>Sex</b>						
Male	52	52.5	47	47.5	99	0.49
Female	23	45.1	28	54.9	51	
<b>Age in month</b>						
1-12	27	62.8	16	37.2	43	0.27
12-24	21	44.7	26	55.3	47	
25-36	12	44.4	15	55.6	27	
>36	15	45.5	18	54.5	33	
<b>Presentation</b>						
Unilateral	28	45.2	34	54.8	62	0.09
Bilateral	16	45.7	19	45.3	35	
Recurrent	11	47.8	12	52.2	23	
Bilateral incarcerated	3	37.5	5	62.5	8	
Unilateral incarcerated	17	77.3	5	22.7	22	

*The table shows that there is no significant difference between the studied groups as regard age, sex and presentations*

**Table 2. Distribution of the studied patients according to operative time**

Group	Group A	Group B	P value
	Mean ± SD	Mean ± SD	
Unilateral recurrent	12.8 ± 4.5	7.6 ± 3.5	5.6 E-40
Hernia in obese patients	14.3 ± 3.6	9.2 ± 4.6	2.2 E-6
Incarcerated hernia	16.2 ± 6.3	9.8 ± 5.1	3.1 E-23
Bilateral	21.9 ± 7.2	11.4 ± 2.7	7.8 E-42

*The table shows that there is a highly significant difference between the studied groups as regard operative time*

**Table 3. Distribution of the studied patients according to post operative complications**

Group	Group A		Group B		$\chi^2$	P
	No.	%	No.	%		
Hydrocele	3	4	2	2.7	0.21	0.65
Recurrence	3	4	1	1.3	0.26	0.61

*The table shows that there is no significant difference between the studied groups as regard occurrence of hydrocele and recurrence rate.*



Fig. 1 A: Bilateral huge hernia



Fig. 1 B: Bilateral huge hernia Post-operative



Fig. 2 A: Recurrent Rt. inguinal hernia



Fig. 2 B: Recurrent Rt. inguinal hernia post-operative

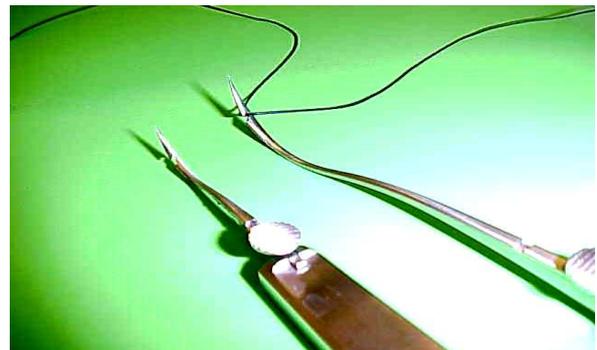


Fig. 3 A & B: Reverdin needle



## DISCUSSION

In children, the standard surgical treatment of inguinal hernia is limited to ligation of the hernial sac at the internal inguinal ring without narrowing the ring<sup>3</sup>. The internal ring normally is reached by dissecting the hernial sac 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 cord, vas deferens, hematoma, wound infection, iatrogenic cryptorchidism, testicular atrophy, and recurrence of hernia<sup>7,9,10</sup>.

The rationale of laparoscopic hernia surgery is to approach inguinal hernias in children from within, leaving the outer abdominal wall intact<sup>3,8</sup>. The laparoscopic approach is rapidly gaining popularity with more and more studies validating its feasibility, safety, and efficacy. The oldest, most widely practiced laparoscopic technique is the three-port technique<sup>4,11,9</sup>. Further technical refinements have led to the emergence of newer techniques, such as subcutaneous SEAL and Endoneedle, Prasad technique and others for closure of IIR. However some of these new techniques are associated with high recurrence rate and development of granuloma, infection and skin puckering at the site of the subcutaneously placed knot<sup>7,8,12</sup>.

Advantages of endoscopic repairs include the ability to evaluate the contralateral side, avoidance of access trauma to the vas deferens and gonadal vessels, iatrogenic cryptorchidism and decreased operative time especially in recurrent and obese cases<sup>11</sup>.

In our unit of Pediatric Surgery Al-Azhar University Hospitals, congenital inguinal hernia is traditionally treated by open herniotomy. Recently, we started to do laparoscopic hernia repair in selected cases. These cases include; bilateral inguinal hernia, ipsilateral hernia with questionable contralateral side, recurrent inguinal hernia, incarcerated inguinal hernia, and inguinal hernia in obese child. We still believe that laparoscopic hernia repair in unilateral cases is not worthy. We previously introduced a new simplified technique for repair of congenital inguinal hernia by RN<sup>6</sup>. Also we use the standard TNH laparoscopic hernia repair described by Scheir<sup>9</sup>. We hypothesized that laparoscopic hernia repair by RN is a rapid and safe technique for the repair of inguinal hernia in infancy and childhood with less recurrence rate. So, we conducted this randomized study to compare RN technique with TNH technique for repair of congenital inguinal hernia in infancy and childhood

Our results showed that laparoscopic hernia repair by RN resulted in marked reduction of operative time, reduced the risk of injury of the vas and testicular vessels and the cosmetic results were excellent with low recurrence rate<sup>6,13</sup>.

In our series the operative time is less than that reported in the literature as we use an easy simple and rapid technique for repair of inguinal hernia i.e RN. Extracorporeal knotting, on the other hand, can be done with far greater ease, in a very short time. Therefore, it is not surprising that RN technique takes less time than TNH technique. This observation is true for all the techniques involving extracorporeal knotting as reported by others<sup>6,7,8,14</sup>.

In this study, all cases with incarceration of inguinal hernia were treated successfully. Insufflations seem to widen the internal ring, and anesthesia helps to pull the bowel loops back into the abdominal cavity. The reduced bowel can be seen clearly for signs of ischemia<sup>6,8</sup>.

Montupet and Esposito (1999) used purse string suture to close the internal inguinal ring for small hernias and non-absorbable suture to close larger hernia (4 to 5 mm in diameter). They had recurrence in 4.4% of cases. Schier (1998) used 2-mm instruments without a trocar for intraabdominal suturing of the open inguinal rings in 25 girls by the placement of two Z-sutures with good results<sup>15,16</sup>.

Open herniorrhaphy in children has been reported to have recurrence rates of 0.8–3.8% and postoperative contralateral hernia rates of 5.6–30%<sup>17</sup>. While in laparoscopic hernia repair it is ranged from 0.7 % to 4.5%<sup>3,13,18,19</sup>. In the present study, recurrence rate was 1.3 % in group B at one-year follow up, while in group A the recurrence rate was 4 %. This is comparable with others in both groups<sup>8,9,14</sup>. For children with recurrences, laparoscopic approach is recommended and it is our policy to do all recurrent hernias by laparoscopy either using RN or TNH technique<sup>7,9,10</sup>.

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<sup>3,16,20,18</sup>. However, the operative time is reduced gradually with the development of the training curve. It is well documented that the limiting step in laparoscopic hernia repair is the intracorporeal suturing of the internal inguinal ring<sup>2,3</sup>. Even the most experienced surgeons in this technique report a median operating time of 20 minutes. This owes to the requirement of a high degree of hand-to-eye coordination both for placing the suture and for

knotting laparoscopically. In our study the operative time is less than that reported in literature as we started laparoscopic hernia repair in our unit after gaining good experiences in different laparoscopic procedures. However, the reported operative time in RN group is significantly decreased in comparison with that of TNH group.

Innovative techniques have been described recently for use in pediatric laparoscopic inguinal hernia surgery. Endo and Ukiyama<sup>12</sup> introduced the Endoneedle designed specifically for laparoscopic extraperitoneal closure of the patent processus vaginalis. Lee and Liang<sup>3</sup> performed micro-laparoscopic high ligation in 450 patients with good results. They reported no complications of the surgery and a remarkably low recurrence rate (0.88%). Prasad used a stainless steel curved awl and a 1.7-mm telescope to safely perform needlescopic inguinal herniorrhaphy. We previously used RN for closure of IIR in 150 patients successfully with excellent cosmetic results without any recurrence<sup>8</sup>. Chan et al 2004 introduced saline injection and needle sign to reduce recurrence rate in his series<sup>19</sup>.

Bharathi et al used TNH technique in 67 repairs and 146 repairs were performed using SEAL technique. They stated that SEAL resulted in marked reduction of operative time than TNH technique (unilateral, 15 versus 25 minutes) bilateral, 25 versus 40 minutes)<sup>14</sup>. They added that avoiding the vas deferens and gonadal vessels during SEAL repair in males may leave a small gap at the internal ring as well as leaving the hernia sac in situ, which has the potential to contribute to a higher incidence of recurrence in male patients. They believe that ligation of the internal ring leads to scarring and obliteration of the space distally. This would explain the relatively low incidence of postoperative hydrocele. In their series, only seven patients were noted to have hydrocele on follow-up. Only one patient required a second operation for a postoperative hydrocele. Fluid accumulating in the distal sac postoperatively often reabsorbs spontaneously and does not necessitate additional intervention<sup>14</sup>.

Several piercing of the peritoneum by RN around the neck of the sac may add fixation of the suture at this level which prevent migration of the suture distally initiating recurrence. It may result into creation of adhesions of the sac preventing hydrocele formation. This may explain the high incidence of recurrence in the series Ozgediz 2007 and Bharathi 2008 which apply the subcutaneous suture around the internal ring without piercing the peritoneum<sup>8,14</sup>. However

Chan et al 2004 reported a very low recurrence (1%) after refinement of the his technique by using TNH and injecting saline around the vas and vessels and using the needle sign to avoid damage to the testicular vessel and vas. They claimed that presence of a complete ring around IIR prevent recurrence<sup>19</sup>. Prasad et al reported no recurrence in his early small series of 8 cases. We previously reported no recurrence in our series<sup>6,7</sup>.

## CONCLUSION

The results of our study confirmed the safety and efficacy of laparoscopic hernia repair with RN in the treatment of inguinal hernia in infancy and childhood. It resulted in marked reduction of operative time, less recurrence, less hydrocele formation and excellent cosmetic results.

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