

Comparison of Single Port and Three Port Laparoscopic Technique of Inguinal Hernia Repair in Children

Fayaz ur Rahman

Department of Pediatrics Surgery, Khyber Teaching Hospital, Peshawar.

Abstract

Background: Laparoscopic repair of inguinal hernia has been commonly practiced nowadays, however an extensive debate exist regarding the different techniques and the numbers of port used for its repair.

Objective: To share our institutional experience and to compare the outcome of two different laparoscopic techniques of inguinal hernia repair in children.

Study design, settings and duration: A prospective randomized controlled trial was conducted at pediatric surgery unit, Khyber Teaching Hospital, Peshawar from July 2015 to January 2017.

Subjects and Methods: The children aged below 16 years with a diagnosis of reducible inguinal hernia (IH) were randomly assigned into 2 groups of repair of inguinal hernia, single port laparoscopic needle assisted repair (LNAR) and three port technique of purse string around deep inguinal ring (PSDIR). Demographic and clinical data was collected and analyzed using SPSS 20.

Results: A total of 205 laparoscopic repair of inguinal hernia done on 153 patients by the same group of surgeon in same unit. 83 patients underwent single port LNAR with 5 patients having bilateral inguinal hernia and 22 contralateral patent processus vaginalis (CPPV). Seventy patients underwent three port technique of PSDIR having 7 cases with bilateral IH and 18 CPPV. Age ranges from 0 to 16 years with a mean age for single port LNAR 3.6 ± 3.21 years and three ports PSDIR 4.69 ± 3.08 years. Mean weight for single port LNAR 10.5 ± 5.24 kg and PSDIR 12.33 ± 7.47 kg. Mean operating time for unilateral LNAR 10 ± 2.91 min and PSDIR 25.68 ± 3.55 min while bilateral LNAR 16 ± 3.88 min and PSDIR 40 ± 5.59 min. Length of hospital stay (LOHS) for LNAR 30 ± 4.50 hours and PSDIR 38.57 ± 6.15 hours. Analgesia doses for Unilateral LNAR 4.56 ± 1.15 and PSDIR 7.51 ± 1.57 while analgesia for Bilateral LNAR 7.0 ± 1.26 and PSDIR 10.6 ± 1.84 . PSDIR has high postoperative complications of recurrence, hydrocele and poor parents satisfaction score.

Conclusion: Our results support single port LNAR of inguinal hernia using spinal needle as safe, reliable and effective technique with a high parents satisfaction as compared to three port technique.

Key words: Inguinal hernia, purse string, laparoscopy, needle assisted repair.

Introduction

Inguinal Hernia (IH) is common in pediatric age group and its incidence range from 0.8% to 4.4%.^{1,2} IH repair is one of the most common

elective surgeries in pediatric population.³⁻⁶ Open repair of inguinal hernia with high ligation was adopted for inguinal hernia treatment and was practiced for decades before the introduction of minimal invasive surgery. Laparoscopic management of inguinal hernia was widely adapted to meet the expedition for limiting pain and better cosmesis. It also reduces stay in hospital, minimal dissection, operative time, early return to normal activity and high parents satisfaction.^{7,8} Many new laparoscopic techniques started in recent years and continue to evolve. These techniques can be divided into intraperitoneal and extraperitoneal repair of inguinal hernia.^{7,9,10} We can also briefly classify the technique on the basis of trocar, one to three trocar. Increase in number of trocar and instruments mean high operative time and more visible scar.¹¹ Single trocar technique is nowadays

Corresponding Author:

Fayaz ur Rahman

Department of Pediatrics Surgery,
Khyber Teaching Hospital Peshawar.
Email: fayaz621@gmail.com

Received: 21 January 2018, **Accepted:** 20 December 2018,
Published: 27 December 2018

Authors Contribution

FR conceptualized the project, performed literature search, statistical analysis, data collection, drafting, revision and writing of manuscript.

more commonly adopted which is extremely minimal invasive with best outcome and comparable complication to three port technique. Research has been done globally to know the feasibility and outcome of laparoscopic inguinal hernia repair. Inguinal hernia can be repaired with a different laparoscopic techniques and multiplicity of reports exist to know that which technique is superior to the other. The current study was conducted to clarify the dominance of one laparoscopic hernia repair technique over the other. Two different laparoscopic hernia repair techniques were compared, single port Laparoscopic Needle Assisted Repair (LNAR) versus three port technique of PSDIR, regarding demographics, preoperative laterality, operative time, length of hospital stay, analgesia requirement and postoperative complications.

Materials and Methods

Prospective randomized control trial was conducted in pediatric surgery unit of the Khyber teaching hospital, Peshawar from July 2015 to January 2017. Patients with diagnosis reducible inguinal hernia and age up to 16 years were included in the study. Irreducible hernia and previously operated cases of inguinal hernia were excluded from the study. This study included 153 patients with diagnosis of inguinal hernia (IH) who underwent laparoscopic repair. Two types of laparoscopic repair were performed by the same group of surgeon in a single centre, single port LNAR and three ports PSDIR. The purpose of this study was to share of experience and to know the outcome of two different laparoscopic techniques of hernia repair in the pediatric population. Patient data were analyzed regarding surgical approach (single port/three ports), age, gender, weight, laterality, operating time, length of hospital stay, analgesia requirements, postoperative complications and parents/care giver satisfaction. Operative time starts from the 1st incision to the last stitch. Length of hospital stay (LOHS) was calculated from the time of admission till the time of discharge from hospital. Postoperative complications include recurrence, hydrocele, testicular atrophy, wound infection. Postoperative complications were recorded in the follow up period. For both procedures, age ranges from 0 to 16 years. For all patients, follow up period was 7 months, having 4 visits with different interval. Patients who lost follow up were inquired through telephone. All patients were discharged on the same day after recovery. One hundred ten single port LNAR were performed on 83 patients and 95 three ports PSDIR were performed on 70 patients. Contralateral detected PPV were repaired in same

general anesthesia. All procedure was done under general endotracheal anesthesia. NG tube passed and urinary catheterization done in all patients who underwent LNAR.

Small supraumbilical incision of 3mm was made and 3mm port fashioned with a closed vareese needle technique. Intraabdominal pressure ranges from 6 to 12 mm Hg, depending on the age of the patient. 0 degree telescope of 3mm was used to inspect the deep inguinal ring and contraetral ring as well for detection of CPPV. Spinal needle of 20G was used with a 2-0 non-absorbable suture to make a loop through needle. Spinal needle was then introduced through a proposed site on the internal ring under direct vision and slowly advanced toward the medial border of the ring above the testicular vessels. A loop is made inside the peritoneal cavity and the needle is slowly withdrawn. Spinal needle again reintroduced through the same site and advanced on the medial border of the internal ring inside the previously made loop. Suture end pushed into the needle for a sufficient length and the loop was pulled out bringing the suture outside and completely encircling the deep ring. Suture ligated in subcutaneously. Intra abdominal pressure was lower down before ligation and pressure increased after ligation to ensure the air tight closure.

Three millimeter port fashioned through a small supraumbilical insion with a closed vareese needle technique. Intraabdominal pressure kept between 6mm Hg to 12 mm Hg depending on age. 0 degree 3 mm telescope introduced through this port. Further 3mm, two ports fashioned in the lateral border of the rectus sheath. Seventeen millimeter curved needle of the 3-0 or 4-0 absorbable suture introduced through abdominal wall and held in position by laparoscopic needle holder. Purse string taken around the deep inguinal ring by taking small bites of peritoneum. Intracorporeal knot taken and the defect closed. Before taking knot, pressure applied to the scrotum to evacuate the retained air inside the sac.

The collected data were revised, tabulated, coded and fed in computer having statistical analysis program SPSS-20. Data was presented and analysis was carried out. Statistical significance was accepted at a value $p < 0.05$. Mean and SD for numerical data like age, weight, frequency and percentage for categorical data like age, weight and gender distribution. Chi-square test (χ^2) used for categorical data like age, weight and gender distribution (Comparison between two groups). Student t-test was used for numerical data like operative time, length of hospital stay, analgesia dose given (comparison between two groups).

Parents/ Care giver satisfaction questionnaire			
Questions to asked on 1 st follow up visit	0=Not satisfied	1= satisfied	2=Very satisfied
1. Satisfaction with the recovery time:			
2. Satisfaction with the post-op mobilization:			
3. Satisfaction with rapid return to normal activity:			
4. Satisfaction with wound appearance:			
5. Satisfaction with scar appearance:			
6. Satisfaction with cost of surgery:			
7. If given the choice, would you do the surgery the same way that it was done?	No	Yes	Sure

Results

A total of 205 laparoscopic repair of inguinal hernia done on 153 patients. Eighty three patients underwent single port LNAR with 5 patients having bilateral inguinal hernia and 22 CPPV. Seventy patients underwent three port technique of purse string around DIR having 7 cases with bilateral IH and 18 CPPV.

For both laparoscopic technique age ranges from 0 to 16 years with a mean age for single port LNAR 3.6 years \pm 3.21 and three port PSDIR 4.69 years \pm 3.08 ($p = 0.005$, $X^2 = 10.49$), and thus age difference is statistically significant. Age distribution for single port LNAR and three ports PSDIR is shown in Table-1.

Table 1: Demographic data of patients with single port and three ports technique repair.

	Single Port LNAR (N=83) N (%)	Three Ports PSDIR (N=70) N (%)	p value
Age			
< 1yr	28 (34)	14 (20)	0.005
1- 5 yr	34 (41)	24 (34)	
>5yrs	21 (25)	32 (46)	
Weight			
< 5kg	16 (19)	15 (21)	0.89
5 - 10kg	32 (39)	25 (36)	
> 10kg	35 (42)	30 (43)	
Gender			
Male	67 (81)	58 (83)	0.000
Female	16 (19)	12 (17)	
Laterality (pre-op)			
Unilateral	78 (94)	63 (90)	0.297
Bilateral	05 (6)	07 (10)	

Maximum number of patients having weight below 10 kg. Mean weight of patient with single port LNAR 10.5kg \pm 5.24 and PSDIR 12.33kg \pm 7.47 (p

$= 0.89$, $X^2 = 0.23$). Weight and gender distribution for single port LNAR and three ports PSDIR is shown in Table-1.

Preoperatively unilateral IH was found in 94% of Single port LNAR group and 90% of three port PSDIR group while bilateral IH was found in 6% of single port LNAR and 10% of three ports PSDIR group. CPPV detected in 27.1% (22 out of 81) of the single port LNAR group while 28.1% (18 out of 64) of three ports PSDIR group (Table-1).

Operative time of both laparoscopic approaches was compared for unilateral as well as bilateral repair. Operating time for single port LNAR was significantly shorter as compared to three ports PSDIR in both unilateral and bilateral IH repair. In unilateral single port LNAR 10 \pm 2.91 min and three ports PSDIR 25.68 \pm 3.55 min ($p = 0.001$, $t = 24.39$) and bilateral single port LNAR 16 \pm 3.88 min and three ports PSDIR 40 \pm 5.59 min ($p = 0.001$, $t = 17.85$) (Table-2).

Mean length of hospital stay (LOHS) for single port LNAR was significantly low as compared to three ports PSDIR, single port LNAR 30 \pm 4.50 hours and three ports PSDIR 38.57 \pm 6.15 hours ($p = 0.001$, $t = 9.8$) (Table-2).

Analgesia doses given according to weight of the patient and number of doses recorded for both procedures. Analgesia requirement was significantly lower in single port LNAR group as compared to three ports PSDIR. We compared the analgesia doses for both approaches in unilateral and bilateral cases. In unilateral single port LNAR 4.56 \pm 1.15 doses and three ports PSDIR 7.51 \pm 1.57 doses ($p = 0.001$, $t = 10.84$). In bilateral single port LNAR 7 \pm 1.27 doses and three ports PSDIR 10.16 \pm 1.84 doses ($p = 0.001$, $t = 6.80$) (Table-2).

Table 2: Operative time, length of hospital stay, analgesia requirements for LHR & OHR.

	Single Port LNAR	Three Ports PSDIR	p value
Operative time			
Unilateral	10 min \pm 2.91	25.68 min \pm 3.55	0.000
Bilateral	16 min \pm 3.88	40 min \pm 5.59	0.000
LOHS	30 hours \pm 4.50	38.57 hours \pm 6.15	0.001
Analgesia requirements			
Unilateral	4.56 doses \pm 1.15	7.51 doses \pm 1.57	0.001
Bilateral	7 doses \pm 1.27	10.16 doses \pm 1.84	0.001

Postoperative complications (wound infection, recurrence, hydrocele, testicular atrophy) compared between the 2 groups. The recurrence rate was high in three ports PSDIR as compared to single port LNAR because of more technically demanding intracorporeal suturing. Recurrence in single port LNAR 1.8% (2 out of 110) while in three ports PSDIR 4.2% (4 out of 95). Hydrocele occurred

in less than 1% patients treated by single port LNAR while in 3.1% of three ports PSDIR group. The single port LNAR group has no case of wound infection and testicular atrophy while in three ports PSDIR has 1.4% (1 out of 70) wound infection rate (Table-3).

Table 3: Postoperative complications.

	Single Port LNAR N (%)	Three Ports PSDIR N (%)
Recurrence	2/110 (1.8)	4/95 (4.2)
Hydrocele	1/110 (0.9)	3/95 (3.1)
Testicular atrophy	0/110 (0)	0/95 (0)
Wound infection	0/83 (0)	1/70 (1.4)

Parents/care giver satisfaction score calculated with a questionnaire, which contains 7 questions and each question has 3 options. Max score 14. Patients with single port LNAR have high scores than three ports PSDIR (single port 12.33 \pm 1.19 and three ports 11.02 \pm 1.47, $p=0.001$, $t=7.06$).

Discussion

Laparoscopic repair of inguinal hernia has gained popularity and many new techniques have been developed. Development of these new laparoscopic techniques has given birth to new controversy between different techniques. Laparoscopic repair of inguinal hernia can be performed with single and three ports technique. Three ports technique led the way to repair inguinal hernia laparoscopically, but recently single port procedure is gaining more attention.

The operating time decreases with experience and vary between different surgeons. Published data showed significantly high operating time for three ports purse string technique which is endorsed by current study as well.¹² The single port technique requires low working port and less instruments as compared to three ports technique, which leads to low operating time as well.¹³ Three ports technique requires high level of intracorporeal suturing skills, which can be acquired with experience. In a current study high operating time for three ports technique was mainly due to early series of laparoscopic experience.

Pain is one of the important measures of surgical outcome, which can be measured by analgesia doses given to patients after surgery. Less ports placement and lower operative time will result in lower level of analgesia requirement. Single port technique is reported to have less analgesia requirement.¹⁴ In current study mean analgesia

requirement of single port technique is low as compared to three port technique.

Three port technique has the disadvantage of the high recurrence rate with a reported recurrence of 0.4% to 4%. High rate of recurrence is related to large skip areas, retained CO₂ in the hernia sac and tension suturing. Recurrence can be decreased by minimizing skip areas in purse string, evacuation of gas from hernia sac before applying the knot and applying secured knot. The current study shows a recurrence rate of 4.2% in three ports technique. Such high recurring alarms paediatric surgeons about its safety and reliability. Reported recurrence rate of single port extracorporeal suturing is 0.35% to 1.5%.¹⁵ The current study shows a recurrence rate of 1.8%, which is mainly due to initial learning curve. Single port technique was adopted and has gained attraction quickly. This technique has a short learning curve and does not require high skills of internal suturing.

Hydrocele is one of the complication of laparoscopic inguinal hernia repair with a reported incidence of 2.7% for single port LNAR and 4% for three port PSDIR. This can be explained by leaving a small gap while closing the internal ring and not excising the sac.^{16,17} In our study, hydrocele was recorded in 3.1% of three port PSDIR and 0.9% in single port LNAR. Laparoscopic repair of inguinal hernia has been reported to have no effect on testicular perfusion and size.¹⁸ Our study not a single case of testicular atrophy recorded during the follow up period. Wound infection rate was extremely low in laparoscopic inguinal hernia repair in children. The reported incidence of wound infection ranges from 0 to 1%.¹⁹ Recorded wound infection rate in current study was zero percent.

Laparoscopic approach to inguinal hernia has the beauty of detection of contralateral PPV and reported incidence from 23% to 43%.^{20,21} Manual examination has no role in the detection of CPPV. Laparoscopic repair of hernia provide an excellent opportunity to inspect contralateral PPV and to repair it in the same setting.⁷ In the current study CPPV detection ranged from 27% to 28% in both single and three ports techniques.

Satisfaction is an important measure of outcome in paediatric population. Parents satisfaction is very important for any surgery. Laparoscopic surgery has reported to have a high level of parents satisfaction score.^{22,23} To know the level of satisfaction, we designed a questionnaire. Parents/care giver satisfaction was higher in single port LNAR than three port PSDIR.

In our study, we found the single port technique to have shorter operative time, length of hospital stay, analgesia requirement and minimum

complications as compare to three port technique. Parents/care giver satisfaction score was higher for single port technique. On the basis of this comparative study between two laparoscopic techniques of inguinal hernia repair, we recommend the superiority of single port LNAR using spinal needle over the three port PSDIR.

Conflict of interest: None declared.

References

1. Shalaby R, Abd Alrazek M, Elsaied A, Helal A, Mahfouz M, Ismail M, et al. Fifteen years experience with laparoscopic inguinal hernia repair in infants and children. *J Laparoendosc Adv Surg Tech* 2018; 28(1): 101-5.
2. Esposito C, St. Peter SD, Escolino M, Juang D, Settini A, Holcomb GW. Laparoscopic versus open inguinal hernia repair in pediatric patients: a systematic review. *J Laparoendosc Adv Surg Tech* 2014; 24(11): 811-8.
3. Esposito C, Turial S, Escolino M, Giurin I, Alicchio F, Enders J, et al. Laparoscopic inguinal hernia repair in premature babies weighing 3 kg or less. *Pediatr Surg Int* 2012; 28(10): 989-92.
4. Choi W, Hall NJ, Garriboli M, Ron O, Curry JI, Cross K, et al. Outcomes following laparoscopic inguinal hernia repair in infants compared with older children. *Pediatr Surg Int* 2012; 28(12): 1165-9.
5. Thomas DT, Göcmen KB, Tulgar S, Boga I. Percutaneous internal ring suturing is a safe and effective method for the minimal invasive treatment of pediatric inguinal hernia: experience with 250 cases. *J Pediatr Surg* 2016; 51(8): 1330-5.
6. Wang KS. Assessment and management of inguinal hernia in infants. *Pediatrics* 2012; 130(4): 768-73.
7. Niyogi A, Tahim AS, Sherwood WJ, De Caluwe D, Madden NP, Abel RM, et al. A comparative study examining open inguinal herniotomy with and without hernioscopy to laparoscopic inguinal hernia repair in a pediatric population. *Pediatr Surg Int* 2010; 26(4): 387-92.
8. Saha M. Laparoscopic Extracorporeal Ligation of the Internal Inguinal Ring by a Spinal Needle: a Simple Method of Hernia Repair in Children. *Ind J Surg* 2016; 78(2): 85-9.
9. Choi W, Hall NJ, Carriboli M, Ron O, Curry JI, Cross K. Outcomes following laparoscopic inguinal hernia repair in infants compared with older children. *Pediatr Surg Int* 2012; 28: 1165-9.
10. Oak S, Parelkar S, Agarwal P, Sailukar M, Gera P, Pathak R, et al. Laparoscopic surgery of inguinal hernia in children-experience with 110 repairs. *Ind J Surg* 2004; 66(2): 70.
11. Molina VME, Sanchez AA, Aguilar CR. Laparoscopic assisted percutaneous treatment of inguinal hernia in infants. *Cirugia Pediatrica: Organo* 2012; 25(1): 4-8.
12. Korkmaz M, Güvenç BH. Comparison of Single-Port Percutaneous Extraperitoneal Repair and Three-Port Mini-Laparoscopic Repair for Pediatric Inguinal Hernia. *J Laparoendosc Adv Surg Tech* 2018; 28(3): 337-42.
13. Timberlake MD, Herbst KW, Rasmussen S, Corbett ST. Laparoscopic percutaneous inguinal hernia repair in children: review of technique and comparison with open surgery. *J Pediatr Urol* 2015; 11(5): 262.
14. Bharathi RS, Dabas AK, Arora M, Baskaran V. Laparoscopic ligation of internal ring-three ports versus single-port technique: are working ports necessary? *J Laparoendosc Adv Surg Tech* 2008; 18(6): 891-4.
15. Lee DY, Baik YH, Kwak BS, Oh MG, Choi WY. 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? *J Hernias Abdom Wall Surg* 2015; 19(4): 607-10.
16. Shalaby R, Essa AG, Yehya AA, Ibrahim R, Hassan E, Shams AE, et al. Laparoscopic Hernia Repair in Infancy and Childhood; Evaluation of Two Different Techniques. *Annals Pediatr Surg* 2010; 6(1): 6-13.
17. Wheeler AA, Matz ST, Schmidt S, Pimpalwar A. Laparoscopic inguinal hernia repair in children with transperitoneal division of the hernia sac and proximal purse string closure of peritoneum: our modified new approach. *Eur J Pediatr Surg* 2011; 21(6): 381-5.
18. Parelkar SV, Oak S, Bachani MK, Sanghvi B, Prakash A, Patil R, et al. Laparoscopic repair of pediatric inguinal hernia--is vascularity of the testis at risk? A study of 125 testes. *J Pediatr Surg* 2011; 46(9): 1813-6.
19. Chinnaswamy P, Malladi V, Jani KV, Parthasarathi R, Shetty RA, Kavalakat AJ, et al. Laparoscopic Inguinal Hernia Repair in Children. *JLS* 2005; 9(4): 393-8.
20. Saad S, Mansson J, Saad A, Goldfarb MA. Ten-year review of groin laparoscopy in 1001 pediatric patients with clinical unilateral inguinal hernia: an improved technique with transhernia multiple-channel scope. *J Pediatr Surg* 2011; 46(5): 1011-4.
21. Zhu LL, Xu WJ, Liu JB, Huang X, Lv ZB. Comparison of laparoscopic hernia repair and open herniotomy in children: a retrospective cohort study. *Hernia* 2017; 21(3): 417-23.
22. Rehman IU, Rahman FU, Imran M, Rehman ZU, Amin H, Akhtar W, et al. Laparoscopic Needle assisted repair of inguinal hernia using spinal needle. *J Med Sci* 2018; 26(2): 105-8.
23. Rahman FU, Rahman ZU, Akhtar W, Rahman IU, Imran M. Laparoscopic appendectomy in pediatric population: a single center experience. *J Postgr Med Inst* 2018; 32(2): 201-5.