Skipping the cord during laparoscopic percutaneous internal ring suturing in children, is it reasonable?

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Abstract

Background As a minimally invasive procedure, laparoscopic inguinal hernia repair in children was introduced. Percutaneous internal ring suturing (PIRS) is a popular technique. The main concern is that the spermatic cord will be trapped and/or the vasculature of the testes will be damaged in boys. This can be avoided by performing a careful dissection or by skipping the peritoneum over the cord and/or the vessels. The aim of the study was to compare the incidence of recurrence or complication (e.g. hydrocele) in children with skipped peritoneum on the cord and/or vessels compared to those without skipped peritoneum during laparoscopic PIRS repair.

Methods The charts of children who underwent laparoscopic PIRS repair for inguinal hernia between 2017 and 2021 were analyzed. Complications and recurrence were assessed. The video recordings were viewed, and data on skipping (group 1) or not skipping (group 2) the peritoneum on vas deferens was recorded. The rates of recurrence and complications were compared between groups.

Results There were 101 boys with a total of 125 inguinal hernias in the study. There were 45 right-sided hernias, 32 had left-sided hernias, and 24 had bilateral hernias. According to the video investigation, there were 63 hernias in group 1 and 62 hernias in group 2. In each group, there were two recurrences (3% for both groups). There were no other postoperative complications.

Conclusions To avoid spermatic cord or vessel damage, skipping the cord appears to be an acceptable path that does not appear to increase recurrence or complication rates while also ensuring the safety of spermatic structures.

Keywords Children · Inguinal hernia · Spermatic cord · Laparoscopy

Abbreviations

PIRS Percutaneous internal ring suturing
IH Inguinal hernia
OR Open repair

Introduction

One of the most common surgical conditions in children is inguinal hernia (IH). Despite the fact that conventional open repair (OR) is the standard surgical method, laparoscopic repair has emerged as an equally safe and effective method over the last years [1, 2]. A feared concern with the OR is the possibility of complications due to unavoidable manipulation of the vas deferens and testicular vessels during hernia sac dissection, as well as the main concern of recurrence [2]. Although the risk of injury to these structures remains, it has been reported to be extremely rare with almost all different laparoscopic approaches [2, 3].

Schier's description of laparoscopic IH repair in children evolved in many ways [1]. Currently, the percutaneous internal ring suturing (PIRS) method described by Patkowski et al. is one of the most widely used laparoscopic IH repair methods in the world [4].
Even though the PIRS method prevents hernia sac dissection, entrapment of the vas deferens and vessels remains a risk that must be considered. Although some studies reported normal testicular blood flow and volume after laparoscopic PIRS repair in children, there is a paucity of data in the literature on spermatic cord position and function following percutaneous IH repair techniques [5–7]. Given that evaluating the function of spermatic cord after IH repair regarding fertility is difficult, the lack of publications is better understood. Individual intraoperative findings also make performing a standard operation almost any time difficult, especially in newborns and infants. Dissecting the peritoneum on the spermatic cord and vessels in some children may be extremely difficult because peritoneal folds and inflamed peritoneum may shadow the edges of the vas deferens and the angle of the vas at the level of the inguinal ring vary.

PIRS was the technique of choice for IH repair in the authors’ practice. In some cases, authors choose to skip the peritoneum over the vas deferens and/or the vessels, contrary to the original description of the method. The aim of this study was to compare the incidence of recurrence and postoperative complication following hernia repair with skipped peritoneum over the vas and/or vessels compared to those children without skipped peritoneum during laparoscopic PIRS repair.

Materials and methods

The research was intended to be a retrospective video analysis study. Videos of children who underwent laparoscopic inguinal hernia repair between 2017 and 2021, were evaluated retrospectively. This study was reviewed by Ankara University’s ethics committee under the number 2021000301, and ethics committee approval was obtained. The analysis did not include any videos of girls. Furthermore, children whose parents and/or themselves did not consent to be included in the study, as well as children with recurrent inguinal hernia, were excluded from the study (Fig. 1). All of the videos were blindly evaluated by two surgeons, and suspicious cases were reevaluated by a third surgeon. The video recordings were viewed, and data on skipping (group 1) or not skipping (group 2) the peritoneum on vas deferens was recorded.

The children’s demographics, including age and weight, hernia side, operation duration, intraoperative complications and events, and postoperative complication and recurrence rates, were examined. The main focus was on postoperative recurrence rates. Operative times were not compared due to the possibility of confusion caused by the fact that in some bilateral cases, the cord is skipped on one side but not on the other. Figures 2 and 3 display different stages of two procedures. Also, Fig. 4 shows an illustration of skipping the peritoneum over the vas deferens and Fig. 5 shows the dissection over the cord as in original PIRS procedure.

The research was carried out in accordance with the Helsinki Declaration. Each child’s legal guardians provided written informed consent, and the Ethical Committee approved the procedure.

Surgical method

In all patients, the IH repair was performed uniformly. The PIRS procedure was performed on all of the children. The peritoneum on these structures was skipped in children where anatomical topography of the spermatic cord and vessels did not allow the surgeon to easily dissect the overlying peritoneum due to reasons such as inflamed and thin peritoneum. Due to a lack of experience with this method, hydrodissection was not performed in any of the cases. Cauterization was also avoided due to the possibility of thermal injury. The decision to skip (Fig. 2a, b, c) or not skip this area (Fig. 3a, b) was made solely by the surgeons and had no objective criteria.

All of the children were referred to the outpatient clinic in the first, sixth, and first year after surgery. They were then instructed to return in case of complications.

Statistical analysis

The Student’s t test was used to compare normally distributed variables. To compare non-normally distributed variables, the Mann–Whitney U test was used. The Pearson Chi-square test was used to compare categorical variables between the two groups. Statistical significance was defined as a p<0.05 value.

Results

The study has 101 boys enrolled, with 125 IH repairs. 45 of the children had right-sided IH, 32 had left-sided IH, and 24 had bilateral IH. The children’s average weight was
4 kg (IR: 4.00). Table 1 displays demographic information as well as data on outcomes. There were nine intraoperative complications, three in group 1 and six in group 2. All of these complications were iliac hematomas caused by iliac vessel puncture. None required further treatment. All of these accidental punctures occurred in the first year.

![Fig. 2](image1.png) Right indirect inguinal hernia. a Peritoneum over vas deferens was skipped. b The loop was sent into the peritoneal cavity. c Last view after repair

![Fig. 3](image2.png) Right indirect inguinal hernia. a The loop which contains all the peritoneum was sent into the peritoneal cavity. b Last view after repair

![Fig. 4](image3.png) Illustration of skipping the cord

![Fig. 5](image4.png) Illustration of not skipping the cord
of the study. Within a similar follow-up period, the recurrence rate was similar in both groups (3% vs 3%, 2 patients in each group). Recurrence rates did not differ significantly between groups \((p = 0.98)\). When the operation times were analyzed after the bilateral cases were excluded it was observed that the times were shorter in group 1 \((p < 0.05)\) (There were 33 repairs in group 1 and 44 children in group 2). The mean of group 1 was 25 min \((19–31 \text{ min})\) and the mean of group 2 was 29 min \((24–41 \text{ min})\). The laparoscopic PIRS technique was used to treat all recurrences. Complication rates were also statistically similar. Among a total of nine complications; six were in group 2 and three in group 1 \((p > 0.05)\).

One boy who had recurrence in Group 2 had an extra-peritoneal hematoma that resolved without incident, while the perioperative process was uneventful, and no obvious cause for recurrence was identified in the other three boys. Table 2 provides detailed information on recurred cases. Boys with recurrent disease had lower weight means \((3.4\text{kgs in recurrent vs 8 kgs in non recurrent group}; \ p = 0.045)\) and younger \((2.2 \text{ months in recurrent vs 21.7 months in non-recurrent group}; \ p = 0.013)\).

### Discussion

The current study, which included a retrospective analysis of surgical videos from 125 PIRS procedures, suggests that skipping the peritoneum over the spermatic cord or vessels during the PIRS procedure may be an alternative option that does not increase the recurrence rate when peritoneal dissection appears challenging.

The vas deferens and testicular vessels are the most vulnerable structures surrounding the inguinal canal. Surgeons’ primary concern when performing IH repair, regardless of method, is the safety of these structures. Manipulation of vas and vessels while dissecting the hernia sac during open repair of IH in boys poses a risk of injury to these structures. Driven by this concern, pediatric surgeons have worked hard to develop new techniques that require less interaction with these delicate structures. The main principle of PIRS is purse string closure of the internal inguinal ring, which is one of the most commonly used laparoscopic methods today. However, including the peritoneum over the vas and vessels in the purse string while avoiding injury to them is a critical and difficult step of the procedure. As a result, the authors propose that avoiding the peritoneum in favor of the vas

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**Table 1** Demographic data and patient outcomes

|                      | GROUP 1 (skipping the peritoneum on vas deferens) | GROUP 2 (Not skipping the peritoneum on vas deferens) | \( P \) value |
|----------------------|-------------------------------------------------|-------------------------------------------------|--------------|
| Median age (months)  | 4.00 (IR: 4.00)                                 | 4.00 (IR: 4.50)                                 | \( p > 0.05 \) |
| Median weight (kg)   | 5.00 (IR: 15.00)                                | 7.00 (IR: 8.25)                                 | \( p > 0.05 \) |
| Side (bilateral hernias separated as right and left) | R 33  | L 30  | R 36  | L 26  | – |
| Intraoperative complication | 3 (4.7%) | 6 (9.6%) | \( p > 0.05 \) |
| Recurrence           | 2 (3%)                                          | 2 (3%)                                          | \( p > 0.05 \) |
| Mean operative time (minutes) | 25 (19–31) | 29 (24–41) | \( p < 0.05 \) |
| Follow-up            | 18 months (6–36)                                | 19 months (7–36)                                | \( p > 0.05 \) |

Bold values indicates statistically significant \( p < 0.05 \)

**Table 2** Characteristics of recurrent cases

| Case | Group | Age  | Side | Intraoperative complication | Postoperative complication | Duration of recurrence | Additional findings in the first laparoscopy | Recurrence pattern | Additional findings in the second laparoscopy |
|------|-------|------|------|-------------------------------|--------------------------|----------------------|----------------------------------------------|-------------------|-----------------------------------------------|
| 1    | 1     | 43 days | Left | None                          | None                     | Postoperative 10th month | None                                         | Totally opened inguinal ring | None                                           |
| 2    | 1     | 3 months | Left | None                          | None                     | Postoperative 3rd month | None                                         | Partly opened inguinal ring (Lower part)     | None                                           |
| 3    | 2     | 2 months | Left | Iliac hematoma                | None                     | Postoperative 3rd day   | None                                         | Totally opened inguinal ring | None                                           |
| 4    | 2     | 45 days | Right | None                          | None                     | Postoperative first month | None                                         | Totally opened inguinal ring | None                                           |
deferens and—occasionally—vessels may be a safe option. Although there is no strong evidence to support routine peritoneum skipping at this site, our initial experience suggests that skipping the cord is safe and does not jeopardize the success of the repair when the surgeon is unable to perform a total and perfect purse string knot. The main concern with performing an incomplete purse string knot is the theoretical risk of higher recurrence rate, but to the best of our knowledge, no study has specifically evaluated this issue.

Although the initial results of the laparoscopic PIRS method showed slightly higher recurrence rates than the open procedure, recurrence rates have decreased with increasing experience and have recently become comparable [8]. Using absorbable sutures, insufficient experience with laparoscopic repair, and male gender may be potential risk factors associated with higher recurrence rates of laparoscopic IH repair in children [9, 10]. On the other hand, it is a well-known pitfall that IH repair in younger children (especially newborns) has a higher rate of recurrence [9]. The recurrences in the current study were all males, as expected from the literature, and the oldest child was 3 months old. Each group had two recurrences, with 63 and 62 children, respectively, and the recurrence rates in groups 1 and 2 were not significantly different (p > 0.05). The study’s overall recurrence rate was 3.2% (4/125), which was consistent with the literature. It is worth noting that all recurrences occurred in young infants, implying that IH repair may be challenging.

There were no major intraoperative complications that required additional intervention in 125 IH repairs. There were nine bleedings, all caused by an accidental iliac vein puncture, and they all resolved spontaneously. The rates of intraoperative complications were also comparable across groups, despite a slight increase in group 2 that did not reach statistical significance (p > 0.05). These punctures occurred in the first year of the study so the authors think that it may be a result of the new adoption of a new method. Also, when the complications were reviewed it was observed that the punctures in group 1 occurred during the dissection right after the vas deferens (n = 1) and at the end of the second suture (n = 2). In group 2, the accidental punctures were observed either during peritoneum dissection over the vas deferens (n = 4) or at the end of the second suture as it was in the first group (n = 2). The authors may speculate that the authors’ insistence on achieving a complete purse string suture may be responsible for the slight increase in complications. Skipping the peritoneum, on the other hand, may be safer to avoid complications such as accidental puncture of iliac and spermatic vessels or injury to the vas. Regarding the comparison of operative times of two groups, insisting on not skipping the cord over the vas deferens may lead to lengthen the operation time as it was found in the current study. The mean operative time in group 2 was significantly longer than group 1 (25 min vs 29 min, p > 0.05).

Although spermatic cord injury is uncommon in IH repair, it is possible that this low incidence is due to unreported or undiagnosed injuries [11]. Despite the surgeons’ belief that they did not harm the spermatic cord, pathological examination of hernia sac specimens revealed sections of vas deferens in 0.05% of the cases [12]. In addition to major trauma, minor and microvascular trauma caused by tissue handling and dissection can have disastrous consequences, as demonstrated in animal studies [13]. Although the PIRS repair has a theoretical advantage over the open approach in terms of cord injury, it is still unclear whether the spermatic cord or vessels are injured by accidental punctures while dissecting the overlying peritoneum. And, while some studies have shown that testicular blood flow is unaffected after PIRS repair, demonstrating the patency and health of the vas deferens in children is nearly impossible, and relevant literature data is insufficient. In their well-designed study, Celebi et al. and Parelkar et al. claimed that laparoscopic IH surgery has no effect on testicular blood flow [6, 7]. Xu et al. conducted one of the first studies on the effect of the PIRS procedure on the vas deferens, and they concluded that the orientation of the vas deferens does not change after the procedure [14]. To the best of our knowledge, there is no study that evaluates the functional integrity and welfare of the vas deferens after the procedure. Furthermore, a study on the fertility of boys after PIRS repair does not exist because the method is still relatively new, and even if one side is completely injured, the paternity rate is not affected if the other side is intact. However, we are aware that this is a significant and well-documented complication of open IH repair [15]. Even though the tissue handling and dissection of vas deferens and vessels in PIRS repair is significantly less than in open hernia repair, it is not zero, and it may be a risk factor for infertility as well. Given these complications, it may be reasonable to avoid engaging the vas deferens and simply skip the peritoneum over it. The worst-case scenario would be recurrent IH, and our research indicates that the recurrence rate is not increased in this modified method when compared to the original.

The current study, a retrospective video analysis, found that skipping the peritoneum over the vas deferens and testicular vessels during laparoscopic PIRS repair did not increase recurrence rates in a short follow-up period. The greatest limitations of this study are the lack of objective criteria for deciding whether or not to skip the peritoneum on the vas deferens and the bias it caused. Other major limitations include the study’s retrospective nature, a small number of patients to report a certain conclusion, a short length of follow-up, and the evaluation of only one method of IH repair. However, the authors suggest that the findings
of this study may encourage future randomized controlled trials on this topic.

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