

Case Series

Modified “keyhole” technique for preservation of the uterine round ligament during transabdominal preperitoneal with groin hernias: a case series of 9 patients

Lihua Zhao¹, Qianpeng Huang², Hongbo Liu^{2*}

¹Nursing department, Handan Central Hospital, Handan Hebei, China

²Department of General Surgery, Handan Central Hospital, Handan Hebei, China

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*Correspondence:

Dr. Hongbo Liu,

E-mail: peng881223@126.com

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ABSTRACT

The "keyhole" technique, utilized in laparoscopic transabdominal preperitoneal (TAPP) hernia repair, sacrifices the integrity of the mesh, which is critical for preventing hernia recurrence. We present a series of 9 female patients with inguinal hernias who underwent TAPP using a modified "keyhole" technique at our hospital between January 2022 and June 2025. The modified technique involved precise mesh positioning using a dual-mesh configuration, with the two mesh pieces straddling the round ligament from above and below, and the openings closed with sutures to restore mesh integrity. The mean operative time was 46.8 ± 8.9 min, and the mean estimated blood loss was 7.7 ± 2.8 ml. No postoperative complications were observed, and all patients reported satisfactory recovery. At a mean follow-up of 12 months, no recurrence, mesh infection, or chronic pain was documented. This modified "Keyhole" technique appears to be a feasible and effective approach for female patients with inguinal hernias, offering favorable short-term outcomes while preserving the round ligament and maintaining mesh integrity. Our series suggests that this technique may reduce the risk of recurrence associated with conventional Keyhole repair, though long-term follow-up in larger cohorts is warranted.

Keywords: Modified “keyhole” technique, TAPP, Inguinal hernia, Round ligament of the uterus, Laparoscopic repair

INTRODUCTION

The unique characteristics of female reproductive tract embryogenesis, coupled with the distinct anatomy of the inguinal region, account for a significantly lower incidence of inguinal hernias in women compared to men.¹ Consequently, inguinal hernias are relatively uncommon in clinical practice among female patients, with an incidence rate of approximately 0.3%, and the relevant literature remains scarce.² Current international guidelines advocate for the use of laparoscopic mesh repair as the preferred approach for primary inguinal hernias in this patient population.³ The round ligament of the uterus originates from the uterine cornu, just anterior

and inferior to the fallopian tube. Extending through the bilateral inguinal canals to the labia majora and mons pubis, it plays a pivotal role in maintaining the uterus's position within the pelvis.⁴ However, its intricate anatomy and close adhesion to the peritoneum often complicate complete dissection during laparoscopic procedures, thereby potentially influencing surgical outcomes. To date, no consensus has been reached regarding the optimal management strategy for the round ligament during laparoscopic inguinal hernia repair.⁵

The "Keyhole" technique, employed during laparoscopic transabdominal preperitoneal (TAPP) repair, allows for preservation of the round ligament.⁶ Nevertheless, a

primary drawback is that it necessitates cutting the mesh, thereby compromising its structural integrity and potentially increasing the risk of hernia recurrence—a concern well-documented in the context of parastomal hernia repair.⁷ The present study reports on the clinical outcomes of nine female patients with inguinal hernia who underwent a modified "Keyhole" procedure at our institution

CASE SERIES

Patient presentation

We retrospectively reviewed the clinicopathological data of 9 female patients who underwent a modified "Keyhole" procedure during TAPP at our center between January 2022 and June 2025. All patients were successfully followed up. The evaluated parameters included demographic and clinical characteristics, such as age, body mass index, and hernia features (side and type), as well as perioperative data, including operative time, estimated blood loss, visual analog scale pain score on postoperative day one, length of hospital stay, and any documented complications. Chronic pelvic pain was defined as persistent pain in the pelvic region lasting more than three months, while genital prolapse was identified by the downward displacement of the uterus, the uterovaginal junction, or the vaginal walls.⁸ This study was approved by the Ethics Committee of Handan Central Hospital, and all enrolled patients provided written informed consent.

Surgical procedure

Abdominal port placement and preperitoneal dissection were performed following a standardized protocol.⁹ A 10-mm transverse incision was made above the umbilical ring, and a Veress needle was inserted to establish a pneumoperitoneum with carbon dioxide, which was maintained at a pressure of 12 mmHg. A 10-mm trocar was then placed to introduce the laparoscope for initial exploration. Under direct laparoscopic visualization, an additional 5-mm and a 10-mm trocar were inserted at the lateral border of the rectus abdominis muscle on each side. An incision was made in the peritoneum approximately 2 cm above the internal inguinal ring, and the peritoneum was retracted to facilitate preperitoneal insufflation for entry into the Retzius space. The inferior epigastric vessels were then identified. When dissecting the Bogros space, the preperitoneal fascia was carefully preserved to avoid nerve exposure and the hernia sac was reduced using traction.¹⁰

The round ligament of the uterus was then elevated and meticulously dissected to create adequate space between it and the "triangle of doom," thereby establishing a clear operative field between the Retzius and Bogros spaces, enabling complete coverage of the myopectineal orifice. For patients with a defect smaller than 3 cm in diameter, the internal ring was left unrepaired after sac reduction;

for those with a defect of 3 cm or larger, the internal ring was routinely closed using 3-0 absorbable sutures. In our approach, the peritoneum was typically separated from the round ligament for approximately 2 cm (Figure 1A), which differs from the complete circumferential dissection of the round ligament used in the conventional "Keyhole" technique. Our modified "Keyhole" procedure involves positioning two opened mesh pieces within the preperitoneal space such that they straddle the round ligament from above and below, with the openings of the two mesh pieces facing opposite directions, aiming to restore the integrity of the hernia repair (Figures 1B, 1C). Both mesh pieces were then secured to the round ligament with sutures—a second key distinction from the conventional technique. The openings of the two mesh pieces were closed using 3-0 Prolene sutures to restore the structural integrity of the mesh. Typically, both mesh pieces were obtained by cutting a single 15 × 15 cm mesh to minimize material waste. Finally, the peritoneal layer was meticulously closed using a running absorbable suture (Figure 1D). Carbon dioxide gas accumulated in the preperitoneal space was then aspirated to promote mesh adherence and stabilization.

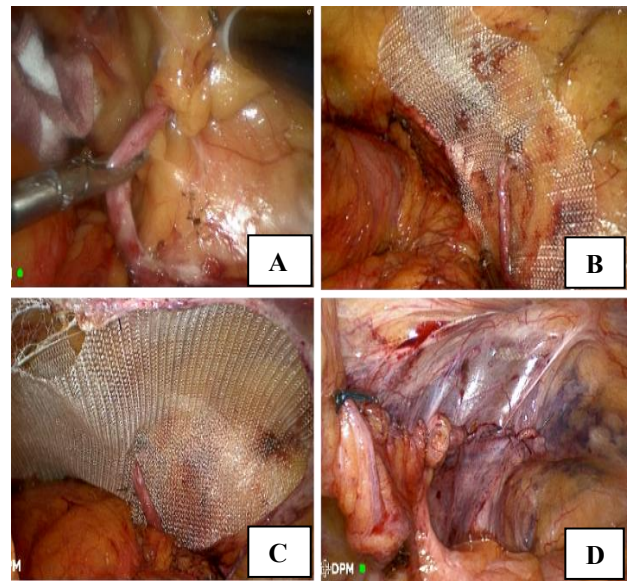


Figure 1: The modified "keyhole" technique to preserve the URL in TAPP. (A) Separation part of the URL after separation of Retzius space and Bogros space; (B) placement of the primary mesh patch; (C) placement of the secondary mesh patch to cover the hernia defect comprehensively; (D) closure of peritoneum flap.

Clinical outcomes

A total of 9 female patients with 9 groin hernias were included in this study. The mean age was 47.22±9.24 with a mean BMI of 23.08±2.36. Hernia location was 4 cases on the left, 5 cases on the right. There were 7 indirect hernias, 7 direct hernias. The hernias included 3 Type I (<1.5 cm) hernias, 4 Type II (1.5-3.0 cm) hernias,

2 Type III (>3.0 cm) hernias. Preservation of the round ligament was adopted for all the 9 patients with the modified “keyhole” technique, and there was no conversion to other procedures. The mean operative time was 46.78±8.91 min. The mean estimated blood loss was 7.67±2.83 ml. The mean VAS on POD1 was 2.00±0.66 and the mean length of postoperative hospitalization duration was 1.81±0.68 days. There was no postoperative complications in all the cases. There was no recurrence or incisional or mesh infection during a mean follow-up of 12 months (1-27 months). No patient suffered from dyspareunia (Table 1).

Table 1. Clinical characteristics and perioperative data of patients

Perioperative data	N
Patients/Hernias	9/9
Age (years)	47.22±9.24
BMI (kg/m²)	23.08±2.36
Hernia location	
Left	4
Right	5
Bilateral	0
Hernia classification	
Indirect hernia	7
Direct hernia	2
Hernia type	
Type I (<1.5 cm)	3
Type II (1.5-3.0 cm)	4
Type III (>3.0 cm)	2
Operative time (minutes)	46.78±8.91
Blood loss (ml)	7.67±2.83
Concomitant injury	0
VAS on POD1	2.00±0.66
Postoperative hospitalization duration (days)	1.81±0.68
Follow-up time (months)	12.00±9.17
Postoperative complications	
Seroma	0
Haematoma	0
Recurrence	0
Uterine prolapse	0
Mesh infection	0
Foreign body sensation	0
Chronic groin pain	0
Dyspareunia	0

DISCUSSION

In the present study, we described a modified “Keyhole” technique for laparoscopic TAPP repair in female patients. This technique offers several advantages. First, it preserves the round ligament without requiring complete circumferential dissection, which is technically demanding and may increase operative time. Second, by using a dual-mesh configuration, we restored the mechanical integrity of the repair, addressing a major

concern associated with conventional Keyhole technique - mesh fenestration and potential hernia recurrence. Third, the technique is cost-effective because it uses a single mesh cut into two pieces, minimizing material waste.

Compared with previously described techniques for preserving the round ligament, such as the longitudinal peritoneal incision, complete dissection, and conventional Keyhole technique,¹¹⁻¹³ our modified approach balances the goals of anatomical preservation, technical feasibility, and mesh integrity. A recent study by Chinese investigators proposed round ligament reconstruction, which requires transection and re-anastomosis of the ligament.¹⁴ While innovative, that technique significantly increases surgical complexity and potentially damages the ligament's vascular supply. Our technique avoids transection altogether, thereby preserving the ligament's native anatomy and function.

Our results compare favorably with those reported in the literature. The mean operative time in our series (46.8 min) is comparable to that reported by Lu et al in a large cohort of female patients undergoing TAPP, who documented a range of 40-60 min, suggesting that our modified technique does not substantially prolong the procedure despite the additional mesh manipulation.¹² Regarding chronic pain, which has been reported to occur in 5-10% of female patients after laparoscopic inguinal hernia repair the absence of such cases in our series is noteworthy.^{2,4} This finding may be attributed to the preservation of the round ligament, as division of this structure has been associated with higher rates of chronic pelvic pain in several studies.^{2,5} Zhong et al in their meta-analysis, reported that preservation of the round ligament was associated with significantly lower rates of chronic pain compared with division (6.1% vs. 0.6% for pelvic pain, and 3.0% vs. 0% for genital prolapse), findings that align with our observation of zero complications related to ligament division.² With respect to recurrence, the conventional Keyhole technique for parastomal hernia repair has been associated with recurrence rates as high as 30–40% in some series, primarily due to mesh fenestration and the resultant loss of structural integrity.^{6,7} Although our follow-up duration is insufficient to draw definitive conclusions, the absence of recurrence at 12 months, together with the absence of mesh infection or migration, provides preliminary evidence that the dual-mesh reinforcement strategy may effectively address this limitation. These findings support the hypothesis that restoring mesh integrity through our modified approach could translate into improved long-term outcomes, a question that merits further investigation in larger cohorts with extended follow-up.

The absence of postoperative complications in our cohort warrants discussion. Seroma formation, which occurs in 5-15% of cases after laparoscopic hernia repair, was not observed in our patients.¹⁰ This may be related to the

relatively small defect sizes in our cohort (most were Type I or II) and the routine aspiration of carbon dioxide gas from the preperitoneal space before peritoneal closure, which promotes mesh adherence and reduces dead space. The low morbidity profile supports the safety of this modified approach, at least in the short term.

Several technical points deserve emphasis. First, we recommend selective dissection of only 2-3 cm of the round ligament, which is sufficient for adequate exposure. Second, the "lifting" maneuver-elevating the round ligament together with the overlying peritoneum-facilitates safe entry into the preperitoneal space. Third, orienting the primary mesh opening inferolaterally helps avoid interference from the round ligament and peritoneum during suturing, simplifying the procedure. From an economic perspective, our dual-mesh technique uses a single 15×15 cm mesh, which is cut into primary (15×10 cm) and auxiliary (15×5 cm) pieces. This approach avoids the waste associated with using two separate mesh products.

This study has several limitations. The small sample size and retrospective design are the most obvious. Lack of a control group prevents direct comparison with conventional techniques. Additionally, the follow-up period was relatively short (mean 12 months), and long-term outcomes, including recurrence rates and effects on fertility or uterine prolapse, remain to be determined. Larger, prospective, multicenter studies with extended follow-up are needed to validate our findings.

CONCLUSION

In conclusion, the modified "Keyhole" technique for TAPP repair in female patients with inguinal hernias is feasible and effective, with favorable short-term outcomes. This technique preserves the uterine round ligament while maintaining the mechanical integrity of the mesh repair, addressing a key limitation of the conventional Keyhole approach. Our findings suggest that this modification may reduce the risk of recurrence and chronic pain, though these observations require confirmation in larger studies with longer follow-up. The technique is technically straightforward, cost-effective, and can be readily adopted by surgeons familiar with laparoscopic hernia repair. Further, prospective comparative studies are needed to establish the superiority of this approach over existing techniques.

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