

Laparoscopic Totally Extra-peritoneal Hernia Repair Using a Non-Fixed Mesh Patch and Mesh Plug Versus Open Repair

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Abstract

Objective: To determine post-operative outcomes after laparoscopic totally extra-peritoneal hernia repair using a non-fixed mesh patch and mesh plug, compared with open repair.

Material and Method: We retrospectively studied the cases of 70 patients who all underwent hernia repair surgery using either laparoscopic TEP or an open repair technique, performed by a single surgeon (the author). All cases took place between May 18, 2008 and April 30, 2010. Patient characteristics including gender, age, hernia type classification, pain score, operative time, recovery time, recurrence rate and any complications was obtained by reviewing each patient's medical record.

Results: Thirty patients underwent laparoscopic TEP with non-fixed mesh, and 40 patients underwent open repair. Mean patient age was 49.6 ± 16.1 years in the TEP group and 47.8 ± 15.9 years in the open repair group ($P = 0.632$). Patients in the TEP group suffered from indirect hernias (73.3%), direct hernias (20%) or combined hernias (6.7%). Patients in the open repair group had indirect hernias (90%) or direct hernias (10%). The mean operative time was 147.3 ± 33.5 minutes in the TEP group and 43.8 ± 10.8 minutes in the open repair group ($P < 0.001$). Pain scores within 24 hours of the procedures averaged 3.5 ± 2.1 in the TEP group and 5.9 ± 2.9 in the open repair group ($P < 0.001$). Mean hospital stay was 5.6 ± 0.77 days in the TEP group and 3.5 ± 1.8 days in the open repair group ($P < 0.001$). The follow-up period averaged 29.8 ± 4.2 months in the TEP group and 36.3 ± 3.2 months in the open repair group ($P < 0.001$). No recurrences were reported in either group. Common complications included minor morbidities such as seroma, urinary retention, chronic groin pain, epididymitis, and subcutaneous emphysema, which were not significantly different between groups.

Conclusions: Although the operative time for the laparoscopic TEP method was longer and resulted in a longer hospital stay, we demonstrated that it can be performed safely, with only minor complications and with no recurrence.

Keywords: extra-peritoneal repair, inguinal hernia, laparoscopic herniorrhaphy

INTRODUCTION

Minimally invasive surgery has changed the face of traditional surgery, offering patients intervention with less pain, faster recovery times and improved

cosmesis. At present, there are many techniques for tension-free herniorrhaphy, including the Lichtenstein tension-free repair, the "Plug and Patch" technique, pre-peritoneal repair and laparoscopic hernia repair.

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Regardless of the method used, the two main objectives have always been to reduce the incidence of recurrence and to minimize complications. Evans MD et al. conducted a randomized control trial study that compared the laparoscopic TEP technique with the open Lichtenstein technique and found no significant difference between the two with regard to recurrence rate¹. However, the laparoscopic TEP technique yielded other benefits that contributed toward patient quality of life, such as less pain and a speedier return to normal activity¹⁰. In a 2005 review, by Cochrane² laparoscopic TEP was compared to laparoscopic transabdominal pre-peritoneal repair (TAPP). Cochrane concluded that there were no significant differences with regard to operating time, occurrence of hematoma, length of hospital stay, recovery time, hernia recurrence, or conversion to open rate. However, despite these findings, the use of mesh fixation with the laparoscopic TEP technique remains a controversial issue. In some studies, the practice of rolling up the mesh graft has been shown to increase the risk of hernia recurrence^{5,6}. Fixation of the mesh graft with a spiral staple is recommended to prevent recurrence; however, spiral staples have been shown to cause chronic groin pain and neurovascular injury in 2-4% of cases^{7,8}. In addition, the use of such tools may increase the total cost of the surgery. Meta-analyses comparing techniques using non-fixed mesh with those using fixed mesh have shown that no statistically significant differences exist in terms of operation time, reported post-operative pain levels, post-operative complications, length of hospital stay or chronic groin pain^{3,4}. In the present study, we compare the laparoscopic total extra-peritoneal (TEP) technique for inguinal hernia repair vs. the open repair technique. The laparoscopic TEP method discussed here combines the use of a non-fixed mesh patch and a mesh plug. This method is similar to the Plug and Patch technique, except that it uses a posterior approach rather than an anterior one. It was anticipated that, without the use of spiral staples to fix the mesh graft, this technique would result in a lower recurrence rate, no visceral organ injuries, reduced risk of trocar site herniation and neurovascular injury, fewer foreign bodies, and reduced chronic groin pain. Finally, the authors' method followed the philosophy of sufficient economy of His Majesty King Bhumibol Adulyadej of Thailand.

MATERIALS AND METHODS

This retrospective cohort study of 70 patients with unilateral hernias was designed to determine the effectiveness of the laparoscopic TEP hernia repair technique compared to traditional open repair. The patients were each informed of the advantages and disadvantages of the procedure as well as the potential complications and risks prior to surgery. All patients underwent surgery between May 18, 2008 and April 30, 2010. Thirty patients underwent laparoscopic TEP, and 40 underwent open repair (modified Bassini operation). The author used the Nyhus classification system (Table 1) for dividing the hernias into four subtypes⁹. Each patient was treated by one surgeon and was assessed postoperatively every 3 - 4 months. Patient data were collected by telephone as well as by reviewing each patient's medical records two years post-surgery. Post-operative pain levels were assessed using a visual analog pain scale (VAS).

Inclusion criteria

Adults who had reducible inguinal hernias were included in the study.

Exclusion criteria

Patients with irreducible hernias, hernia recurrence cases, patients with medical contraindications to surgery and patients with scars from previous lower abdominal surgeries that may have interfered with the operative field were excluded from this study

Variable definitions

The operative time was defined as the time of skin incision to the time of skin closure. Seroma was defined as aspiration of > 5mL of fluid. Subcutaneous emphysema refers to air or gas that is trapped in subcutaneous tissues. Chronic groin pain was defined as pain at the operative site that persisted for three

Table 1 Nyhus hernia classification

Type I	Indirect hernia without dilation of the internal ring
Type II	Indirect hernia with dilation of the internal ring
Type IIIa	Direct hernia with back wall defect
Type IIIb	Indirect hernia with backwall defect (combined hernia)
Type IIIc	Femoral hernia
Type IV	Recurrent hernia

months post-surgery. The length of hospital stay was defined as the total number of nights that the patient remained under hospital care.

Statistical analysis

Pearson's chi-squared test was used to analyze the data in both groups independently, and the mean data from each group was compared using an independent *t*-test. Data collected in the database was analyzed using SPSS version 11.5. A *P*-value of < 0.05 was considered statistically significant.

Open surgical technique

The inguinal canal was accessed through a transverse incision, and the hernia sac was identified and isolated from the spermatic cord. For indirect hernias, the sac was reduced to the peritoneal cavity through ligation. For direct hernias, the sac was reduced without ligation. The transverse fascia was not incised. The medial tissue, including the internal oblique muscle and the transverse abdominis muscle, were then fixed to the shelving edge of the inguinal ligament with 1/0 Prolene interrupted sutures.

Mersilene mesh was not used in open hernia repairs.

Laparoscopic technique

One gram of Cefazolin was administered intravenously 1/2 to 1 hour prior to surgery. A catheter was inserted into the bladder and a naso-gastric tube into the stomach for decompression. After incising the anterior rectus sheath to expose the posterior rectus sheath, a 10 mm port was placed at the midline of the lower abdomen, 1.5-2 cm below the umbilicus. A 5 mm, 30° camera was inserted into the extra-peritoneal channel and bluntly advanced toward the pubic symphysis. Gentle medial to lateral sweeping of the camera helped to create a pre-peritoneal space. The author did not use a space-maker dissection balloon. Carbon dioxide gas was used to insufflate the pre-peritoneal space to 12 mmHg. Two additional 5 mm trocars were placed at the lower midline. One was placed suprapubically, while the other was placed between the first and third trocars. The patient was placed in Trendelenburg to retract bowel from the hernia site. A 14 × 15 cm piece of Mersilene mesh was used for patching. A 2 × 8-10 cm mesh plug was rolled

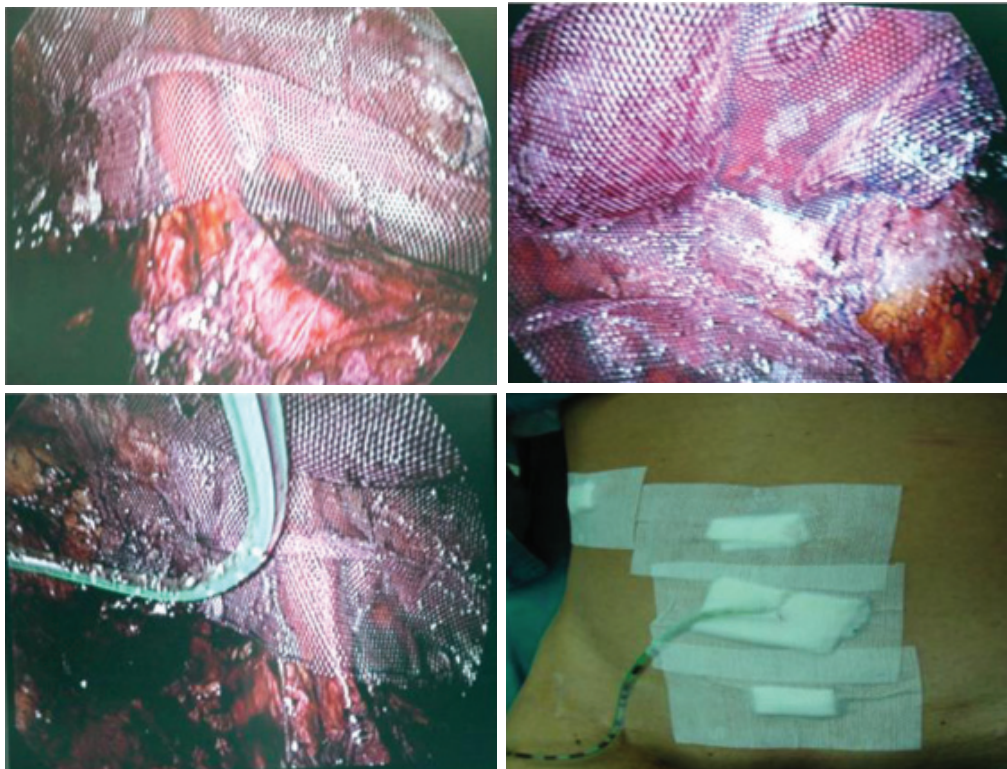


Figure 1 Laparoscopic totally extra-peritoneal (TEP) hernia repair and drain

in a cylindrical fashion and inserted into the internal ring to occlude the indirect hernia sac entrance. Mersilene mesh was selected because of its light weight and flexibility, allowing it to easily mold to the anterior abdominal wall. A #8 Redivac drain was inserted into the middle trocar and placed in the pre-peritoneal space. The space was then deflated slowly under direct visualization to ensure proper mesh positioning. The trocars were removed and only the camera port site was sutured using 3/0 Vicryl. The skin was sutured using 4/0 nylon. The surgical steps are illustrated in Figure 1.

RESULTS

Data for all patients are shown in Table 2. The mean age was 49.6 ± 16.6 years in the TEP group and

47.8 ± 15.9 years in the open repair group. No significant difference was observed between groups, $P = 0.632$. The male-to-female ratio was 29:1 in the TEP group and 9:1 in the open repair group. Thirty-three cases were right-sided hernias (12 in the TEP group, 21 in the open repair group) and thirty seven cases were hernias located on the left side (18 in the TEP group, 19 in the open repair group), with no significant difference in the distribution of right vs. left-sided repairs, $P = 0.427$. Most of the cases were indirect hernia (73% in the TEP group, 90% in the open repair group, with no statistically significant difference between the two groups, $P = 0.109$). Based on Nyhus hernia classifications, however, there were significant differences between the hernia types found in each group ($P < 0.001$). The operative time was significantly longer for the TEP group, averaging 147.3 ± 33.5

Table 2 Patient characteristics based on intervention

Variable	TEP (n = 30)	Open (n = 40)	P- value
Age in Years (Mean \pm SD)	49.6 ± 16.1	47.8 ± 15.9	0.632
Gender (Male: Female)	29 : 1	36 : 4	0.383
Hernia side (Right : Left)	12 : 18	21 : 19	0.427
Hernia type			0.109
Indirect hernia	22 (73.3%)	36 (90%)	
Direct hernia	6 (20%)	4 (10%)	
Combined	2 (6.7%)	0	

Table 3 Nyhus Hernia Classification

Type	TEP (n = 30)	Open (n = 40)=	P- Value
I	0	0	-
II	11(36.7%)	31(77.5%)	< 0.001
IIIa	6(20%)	1(2.5%)	< 0.001
IIIb	13(43.3%)	8(20%)	< 0.001
IIIc	0	0	-
IV	0	0	-

Table 4 Postoperative outcomes

Variable	TEP (n = 30)	Open (n = 40)	P- Value
Operative time in minutes (Mean \pm SD)	147.3 ± 33.5	43.8 ± 10.8	< 0.001
Pain score 24 hrs post surgery (Mean \pm SD)	3.5 ± 2.1	5.9 ± 2.9	< 0.001
Length of hospital stay in days (Mean \pm SD)	5.6 ± 0.77	3.5 ± 1.8	< 0.001
Time of follow-up in months (Mean \pm SD)	29.8 ± 4.2	36.3 ± 3.2	< 0.001
Recurrence rate (%)	0	0	-

Table 5 Postoperative complications

Variable	TEP (n = 30)	Open (n = 40)	P- Value
Seroma	1 (3.3%)	1(2.5%)	1.000
Subcutaneous emphysema	1 (3.3%)	0	0.429
Chronic groin pain	0	2(5%)	0.503
Epididymitis	0	2(5%)	0.503
Visceral organ injury	0	0	-
Urinary retention	0	1(2.5%)	1.000

minutes and 43.8 ± 10.8 minutes for the open repair group, $P < 0.001$. The pain score recorded 24 hours postsurgery for the TEP group and open repair group were 3.5 ± 2.1 and 5.9 ± 2.9 , respectively. The pain levels for those patients who underwent open repair procedures were significantly higher than those observed in the TEP group, $P < 0.001$. The length of hospital stay, however, was longer for the TEP group than for the open repair group, with stays of 5.6 ± 0.77 days and 3.5 ± 1.8 days, respectively, $P < 0.001$. Average follow-up was more than two years for both groups. There were no recurrences reported in either group after two years.

As shown in table 5, minor complications occurred in both groups. They occurred more frequently in the open repair group, however, the difference was not statistically significant. Complications experienced by patients in the TEP group were seroma 1(3.3%), subcutaneous emphysema 1(3.3%), pneumoperitoneum 7(23.3%). Additionally, patients in the open repair group experienced seroma 1(5%), chronic groin pain 2(5%), epididymitis 2(5%) and urinary retention 1(2.5%).

DISCUSSION

In the early 1990s, laparoscopic inguinal herniorrhaphy was first described by Ger, Schultz, Corbitt, and Filipi¹². A 2002 meta-analysis^{13,14} concluded that the laparoscopic technique is superior to the open technique because it allows patients to return to their normal activities more quickly, and it reduces persistent pain and resulted in lower recurrence rates than those associated with open non-mesh repairs. Interestingly, no difference was found when compared to open mesh repairs. In spite of these apparent benefits, laparoscopic hernia repair carries higher costs and

prolonged operative time, compared to open surgery¹². Thus, the question is raised: Which type of laparoscopic hernia repair yields the best patient outcomes and is most cost-effective? In a 2005 Cochrane review, laparoscopic TEP and laparoscopic trans-abdominal pre-peritoneal repairs (TAPP) were compared and contrasted. It was concluded that there were no significant differences in operative time, occurrence of hematoma, length of hospital stay, recovery time, recurrence rates, or conversion to open rates². In this study, patients underwent hernia repair using either the laparoscopic TEP technique, with a non-fixed mesh patch and a mesh plug or a traditional open repair. There was no difference in patient characteristic data between the two groups.

The operative time for the laparoscopic TEP procedures in this study averaged 147 ± 33.5 minutes. This is significantly longer than operative times recorded for the same procedure in the Cochrane review². One of the primary reasons for this difference in operative time is the inexperience of the surgeon. The Cochrane review suggested that the operative time for an inexperienced surgeon (up to 20 cases) performing laparoscopic TEP should average 95 minutes. In three different studies of Thai surgeons performing laparoscopic TEP, operative times were estimated at 81.5 ± 37.9 minutes, 72.74 minutes and 132.15 ± 37.2 minutes^{14,16,17}. Many authors have reported that the average operating time for laparoscopic TEP hernia repair could be longer than procedures using the open repair technique^{12,21,22}; however, other studies^{18,20} have found the operative times to be similar.

In this study, the average operative time for the laparoscopic TEP procedures was significantly longer than operative times for the open repairs. The average laparoscopic TEP operative time was longer than those recorded in other studies due to six factors, including 1) operating teamwork, 2) surgical technique (no balloon dissector was used to create pre-peritoneal space and a non-fixed mesh patch and plug repair technique was used) and 3) surgeon inexperience (the learning curve for performing laparoscopic TEP repairs is typically at least 30 cases^{2,15}). Next, 4) The presence of pneumoperitoneum in 23.3% of the laparoscopic TEP cases, which caused a narrowing of the operative space and contributed to an accidental tear in the peritoneal layer while dissecting to identify the hernia sac or dividing the hernia sac in Type IIIB

hernias. This was remedied by using a 10 mm clip staple to seal the hole in the peritoneal layer and by positioning one 5 mm trocar through the lateral abdominal wall and into the peritoneum to release carbon dioxide. 5) A combination of DIH and IIH or secondary disease also contributed to lengthier operative times. For example, one 27-year-old patient had an undescended testis in the extra-peritoneal cavity that was identified 10 years prior to this procedure. As such, a laparoscopic orchiectomy was performed with the TEP (no malignant changes were observed). The final contributing factor, 6) was the difference in types of hernias among patients within the two groups ($P < 0.001$). The reported pain scores 5.9 ± 2.9 in the patients who underwent open repairs were higher than those reported by patients in the TEP group ($P < 0.001$). It should be noted that when pain scores were higher than 5, intravenous analgesic drugs were used. The length of hospital stay was 5.6 ± 0.77 days in the laparoscopic TEP group, longer than those in the open repair group. In many studies, the average hospital stay was less than three days, due largely to the placement of a closed-system drain into pre-peritoneal space to drain serum fluid, prevent rolling, folding and twisting of the Mersilene mesh, and reducing the risk of scrotal seroma. The drain was typically removed one day prior to discharge.

There was no hernia recurrence in either group, after greater than two years of follow up for each patient. A recurrence rate of between 1.6-4.3% is generally found in cases that constitute a surgeon's "learning curve" period¹⁶. The factors¹¹ that most commonly contribute to hernia recurrences are inexperienced surgeons, inadequate dissection, insufficient prosthesis size, insufficient prosthesis overlap of the hernia defect, folding and twisting of the prosthesis, mesh lifting from hematoma/seroma and a missed hernia. Patients with indirect inguinal hernias experience the majority of recurrences, with rates estimated at 22%⁶. The etiologies of these recurrences are typically inadequate lateral fixation of the spiral staple due to fear of vessel or nerve injury, and inadequate dissection below the iliopubic tract. Therefore, in this study, a mesh plug was placed into the internal ring entrance so as to prevent an indirect inguinal hernia recurrence. The hope was that by using the non-fixed mesh and mesh plug, one could greatly reduce the risk of accidental nerve and vessel

injury, bleeding and chronic groin pain.

There are currently two accepted methods for avoiding chronic groin pain. The first is the use of a non-fixed mesh hernia repair technique. The second is the use of fibrin glue to fix the mesh. Treepongkaruna et al.¹⁴ presented a novel technique for mesh fixation by using a Cyanoacrylate agent - an adhesive substance that when used, has resulted in no chronic groin pain and no cases of recurrence, similar to the results of this study.

There were no serious complications in either the laparoscopic TEP group or the open repair group, however, minor complications were observed more frequently in the open repair group (6 cases, 15%) than in the TEP group (2 cases, 6.6%). In the cases involving seroma, the seroma was aspirated 2-3 times, after which it did not appear again. In one case, subcutaneous emphysema extended to the lower chest wall on the same side as the repaired hernia, however, it did not cause any serious issues and it spontaneously reabsorbed within one day. There was one case of urinary retention, which was treated with a Foley catheter for 2-3 days. The cases of chronic groin pain typically subsided after six months with conservative treatment. The cases of epididymitis were treated with antibiotics and analgesic drugs, and resolved within one week.

Based on these findings, it is anticipated that the laparoscopic TEP technique for hernia repair will continue to increase in popularity as a favorable alternative to open repair. However, careful patient selection, expertise with the surgical technique and good teamwork in the operating room are crucial for a successful surgery and good patient outcomes.

CONCLUSION

By using a non-fixed mesh patch and mesh plug, the laparoscopic TEP procedure can be performed safely with only minor complications, and with a low or absent rate of recurrence, similar to those associated with open repair. Some factors may extend operative time and length of hospital stay; however, for some patients, the minimization of pain and improved cosmetic appearance associated with laparoscopic TEP will make this surgical option preferable to open repair.

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