

## ORIGINAL

# The safety and usefulness of the single incision, transabdominal pre-peritoneal (TAPP) laparoscopic technique for inguinal hernia

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**Abstract : Background :** The safety and usefulness of the SILS-TAPP (transabdominal pre-peritoneal) procedure remain unclear. The aim of this study was to clarify the safety and usefulness of the SILS-TAPP procedure compared with standard laparoscopic TAPP and TEPP (totally extra-peritoneal pre-peritoneal) procedures. **Patients and methods :** 85 patients underwent laparoscopic inguinal hernia repairs (TEPP, 30 patients ; TAPP, 20 patients ; SILS-TAPP, 35 patients) from 2007 to 2011. The operative outcomes of the three groups were compared. **Results :** There was no difference in the patients' characteristics among the three groups. The TEPP Group had a longer operation time. One patient in the SILS-TAPP group had an intraoperative complication. One patient in the TAPP group had a postoperative complication, and one patient had ileus and one had an umbilical hernia in the SILS-TAPP group. The postoperative hospital stay was not significantly different among the three groups. There were no recurrences in the TEPP group, 1 case of recurrence (5.0%) in the TAPP group, and 1 case (2.9%) in the SILS-TAPP group. **Conclusions :** The present findings show that the SILS-TAPP repair is safe and feasible for the repair of adult inguinal hernia. *J. Med. Invest.* 59 : 235-240, August, 2012

**Keywords :** single incision, transabdominal pre-peritoneal (TAPP), inguinal hernia

## INTRODUCTION

Inguinal hernias are common, with a lifetime risk of 27% for men and 3% for women (1). Inguinal hernia surgery is one of the most common surgical procedures performed worldwide (2). The standard method for inguinal hernia repair had changed little during the 100 years before the introduction of

synthetic mesh. This mesh can be placed using either an open approach or a minimal access laparoscopic technique. Compared with open repairs, laparoscopic inguinal hernia repair has some advantages, including less postoperative pain, a shorter recovery period, earlier return to daily activities and work, and better cosmetic results (3-5).

Currently, most laparoscopic inguinal hernia repairs are performed with placement of a synthetic mesh into the pre-peritoneal space, which can be accomplished in one of two ways : the transabdominal pre-peritoneal (TAPP) approach or the totally extra-peritoneal pre-peritoneal (TEPP) approach. Of the two approaches, TAPP is easier to learn and

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Received for publication December 26, 2011 ; accepted January 25, 2012.

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may be associated with a shorter learning curve (6). This is largely related to the small working space in TEPP compared with TAPP repairs (7, 8).

As a bridge between traditional laparoscopy and natural orifice transluminal endoscopic surgery (NOTES), the recent focus has been on the development of single-incision laparoscopic surgery (SILS) to further minimize the invasiveness of laparoscopy by reducing the number of incisions and, hopefully, the pain and complications associated with them (9). The main reasons for reducing the number of incisions include each incision risks the morbidity of bleeding, incisional hernia, and organ damage, and decreases cosmesis.

Recently, SILS has been used in several operations, including various urologic and upper gastrointestinal and lower gastrointestinal operations (10-13). The SILS technique has the potential to disrupt the current laparoscopic surgical field similar to the way that laparoscopy challenged open surgery 20 years ago.

In this study, the feasibility and safety of SILS-TAPP hernia repair were compared with those of standard laparoscopic TAPP and TEPP repairs by analyzing the operation time, postoperative hospital stay, conversion to conventional methods, intra- and postoperative complications, and recurrence.

## PATIENTS AND METHODS

A total of 85 patients who underwent an elective laparoscopic inguinal hernia repair in the Department of Tokushima University Hospital since January 2007 through December 2011 was prospectively enrolled in this study. All patients diagnosed preoperatively with inguinal hernia were included, while patients with previous lower abdominal and pelvic surgery were excluded.

Patients' demographic data, operative and postoperative course, and outpatient follow-up were studied. The following data were collected prospectively: age, sex, duration of surgery, intraoperative complications, postoperative complications, hospital stay, recurrence, and distant events. All data were compared among the three groups (TEPP, 30 patients; TAPP, 20 patients; SILS-TAPP, 35 patients). Statistical analysis was performed using the unpaired Student's *t*-test and the Mann-Whitney U-test for continuous variables, and the Chi-square test for categorical variables. For all three tests,  $P < 0.05$  was interpreted as being significantly different.

Values for all continuous variables were expressed as means  $\pm$  standard deviation (SD).

## OPERATIVE TECHNIQUE FOR SILS-TAPP

Under general anesthesia in the supine position, a single, 15-mm, completely transumbilical skin incision and a 15- to 20-mm rectus fasciotomy were made to enter the peritoneal cavity. An EZ trocar (Hakko Medical, Nagoya, Japan) device was placed in position through the incision.

Through this EZ access port, three 5-mm trocars were introduced. The pre-peritoneal space was inflated with carbon dioxide (CO<sub>2</sub>) gas, and a flexible camera was inserted through the 5-mm trocar. The intra-abdominal pressure was maintained at 12 mmHg. The surgical technique was the same as that described for a laparoscopic TAPP repair. The peritoneum was incised over the hernia and extended laterally using the Harmonic ACE™ (Ethicon Endo Surgery). The hernial sac was reduced meticulously, carefully preserving the epigastric vessels and vas deferens using a combination of Roticulator Endo Dissector™ (Covidien) and Harmonic ACE™ (Ethicon Endo Surgery). The pubic tubercle was then clearly defined. Once the dissection was complete, the EZ access was removed, a 15 × 11-cm polypropylene mesh was inserted into the abdominal cavity, and no gas leak was observed. The mesh was fixed medially over the pubic tubercle and superiorly to the abdominal wall using ProTack™ (Covidien™). The peritoneum was closed over the mesh by 3-0 V-Loc™ (Covidien absorbable) 180. The pneumoperitoneum was then released under vision to ensure that the repair remained firm. The fascial and skin incisions were closed using 1-0 and 4-0 PDS (Ethicon) sutures, respectively.

## RESULTS

### *Patients' demographics and hernia characteristics*

The patients' demographic, site and type of hernia are shown in Table 1. Patient age, sex ratio, body mass index (BMI), site of hernia, and type of hernia were similar among the three groups. Most patients were males. A total of 93 was included in the study; 77 patients had unilateral (32 right and 46 left), while 8 patients had bilateral hernias. Overall, 73 patients had indirect hernias, 19 had direct hernias, and 1 patient had a femoral hernia. One

Table 1 : Patients' clinicopathological characteristics (n=74)

Factors	TEPP (n=30)	TAPP (n=20)	SILS-TAPP (n=35)	p-value
Age : Mean (years)	62.7 ± 17.0	60.2 ± 8.4	64.3 ± 15.4	0.76
Sex :				
Male/Female	27/3	18/2	28/7	0.43
Body mass index	22.2 ± 2.8	23.6 ± 3.5	23.1 ± 5.9	0.25
Site of hernia				
Left/Right/Bilateral	11/19/0	6/12/2	15/14/6	0.11
Type of hernia				
Indirect/Direct/Femoral	27/3/0	16/6/0	30/10/1	0.35
Previous operation				
Primary/Recurrence	30/0	21/1	41/0	0.43

patient underwent TAPP repair for recurrence after TAPP repair.

#### Perioperative data

The perioperative data are summarized in Table 2. Preoperative risk was evaluated according to the American Society of Anesthesiologists (ASA) physical status score. The mean operation time for unilateral hernias was 94.1 ± 35.4 min for TEPP, 86.1 ± 42.0 min for TAPP, and 91.2 ± 24.6 min for SILS-TAPP. There was no significant difference among the three groups in operative time. The mean operation time for bilateral hernias was 145.0 ± 7.1 min for TAPP and 136.0 ± 46.3 min for SILS-TAPP. There was no significant difference between the two groups. One (2.9%) intraoperative complication occurred in the SILS-TAPP group (bleeding from epigastric vessels) ; it was treated laparoscopically by clip application. There was no significant difference in intraoperative complications among the three groups. Two hernias (1 TEPP, 1 TAPP) required conversion to conventional repair. The conversion in the TEPP group was due to a huge hernia sac, while

in the TAPP group it was due to a pre-peritoneal adhesion associated with a previous TAPP repair. There was no significant difference in the conversion rate among the three groups. The mean hospital stay was 3.6 ± 1.4 days for TEPP, 4.2 ± 1.7 days for TAPP, and 4.5 ± 1.7 days for SILS-TAPP. There was no significant difference among the three groups. Postoperative complications were reported in 3 patients : 1 patient (5%) developed a seroma in the TAPP group, which was resolved by aspiration ; 1 patient (2.9%) developed ileus in the SILS-TAPP group, which was resolved laparoscopically ; and 1 patient (2.9%) in the SILS-TAPP group developed a postoperative umbilical hernia arising from the umbilical port site and underwent re-operation six months after the hernia repair. There was no significant difference among the three groups in the postoperative complication rate. There was no chronic pain or infection in the three groups. One patient (5.0%) after TAPP and one patient (2.9%) after SILS-TAPP developed recurrences ; there was no significant difference among the three groups in the recurrence rate.

Table 2 : Summary of perioperative data (n=74)

Factors	TEPP (n=30)	TAPP (n=20)	SILS-TAPP (n=35)	p-value
Operation time (min)				
Unilateral	94.1 ± 35.4	86.1 ± 42.0	91.2 ± 24.6	0.73
Bilateral		145.0 ± 7.1	136.0 ± 46.3	0.80
Intraoperative				
Complications (%)	0	0	2.9	0.59
Conversions (%)	3.3	5.0	0.0	0.44
Hospital stay (days)	3.6 ± 1.4	4.2 ± 1.7	4.5 ± 1.7	0.08
Postoperative				
Complications (%)	0.0	5.0	5.7	0.99
Recurrence (%)	0	5.0	2.9	0.93

## DISCUSSION

Minimally invasive surgery has been widely viewed as superior to traditional surgery in many gastrointestinal fields. The major advantages include postoperative pain reduction, shorter hospital stay, and earlier return to work (14-16).

Concerning hernia repair, in the beginning of the 1990s, laparoscopic hernia repair was controversial because various studies reported early recurrence rates as high as 25% (17, 18).

However, after a decade of experience in laparoscopic hernia surgery, this method had made significant strides and has become the first choice for inguinal hernia repair in many centers (19, 20). In terms of recurrence rates alone, laparoscopic techniques are superior to anterior suture repairs, as confirmed by a systematic review of randomized, controlled trials. A comparison of mesh procedures showed no significant differences with regard to recurrences between open and laparoscopic approaches in the case of primary hernias (21).

Several laparoscopic techniques to manage groin hernias have been described (22-28). Two laparoscopic techniques have become the most common procedures to repair groin hernias: TAPP and TEPP repairs. In both methods, a mesh prosthesis is implanted into the pre-peritoneal space dorsal to the transversalis fascia. The TEPP procedure combines the advantages of tension-free mesh reinforcement of the groin with those of laparoscopic surgery, with its low postoperative pain and shortened recovery time, while obviating the need for a transabdominal approach.

In addition to its well-known benefits of decreased postoperative pain and shorter recovery time, laparoscopic hernia repair has the major advantage of allowing the surgeon to explore the side contralateral to the clinically diagnosed hernia, therefore diagnosing and repairing any unsuspected contralateral hernia encountered. While laparoscopic TAPP hernia repair allows easy identification of the hernia sac without any need to dissect the spermatic cord, TEPP repair requires additional dissection to make the diagnosis of a contralateral hernia.

Sayad *et al.* (29) and Koehler (30) have previously reported the rate of occult contralateral hernias found during TEPP repair to be 11% and 13%, respectively. They concluded that systematic contralateral exploration using the TEPP approach is safe and does not greatly increase operating time, while the patient can avoid re-operation, exposure

to second anesthesia, and another period of work loss.

Traditionally, the operation involves inserting three ports: the camera port below the umbilicus, and two ports bilaterally, just lateral to the rectus muscle, resulting in three surgical scars (31). The development of SILS has the aim of reducing the invasiveness of traditional laparoscopy and improving the cosmetic outcome. The main reasons for reducing the number of incisions and trocar placements include that each incision risks the morbidity of bleeding, incisional hernia, and organ damage, and decreases cosmesis (32).

Different methods are used for port access to perform SILS. Multiple fascial punctures have been performed through one skin incision (33). Recent advances in laparoscopic surgery include single-port access devices that facilitate a single incision and single-site ports that include multiple channels to accommodate multiple surgical instruments through one access site. These channels provide a pathway to the abdomen, thus eliminating the requirement for multiple incisions and multiple ports (34). For these reasons, the EZ access port was used for all patients in the present study. It did not add new risks, and in the present series it provided an operating view that was the same as in standard laparoscopic TAPP. In addition, the mesh can be easily inserted by removing the EZ access, which is an advantage of EZ access.

The cosmetic outcomes of SILS are expected to be better when the operation is performed through the umbilicus because the surgical wound is hidden within the umbilicus, leaving no visible abdominal scars (35). Apart from cosmesis, the only other proposed benefits of SILS include less incisional pain. Over the past 2 years, numerous reports of transumbilical SILS application have been published, showing the feasibility of this approach for even complex urologic, gynecologic, and visceral procedures (10-13).

Based on the present results, all procedures could be performed successfully using conventional instruments, although one patient underwent conversion to conventional repair. The mean operative time was no longer than for standard TEPP and TAPP, and a trend of decreasing operative time with increasing experience was found. The cosmetic results were excellent, with the single incision placed inside the natural fold of the umbilicus. The length of hospital stay was comparable with that for standard TEPP and TAPP repair.

The difficulty of this procedure lies in avoiding conflict amongst the instruments when operating in such a confined space. The roticulated dissector forceps is useful to avoid interference. There are three main methods of using forceps: the cross method using two roticulated dissectors with both hands; the combined method using one roticulated dissector and one straight dissector; and the parallel method using two straight dissectors. In our experience, the cross method is the best method. Though the specialized instruments, either bent or flexible, could facilitate viewing and dissection, the crossed instrument technique is useful. We believe that good coordination between the surgeon and the camera assistant could reduce clashing of the instruments and the laparoscope during the surgery. We would recommend closing the peritoneum over the mesh using intracorporeal suturing, as direct contact with the bowel increases the incidence of adhesive obstruction. The absorbed suture of 3-0 V-Loc™180 is very useful for peritoneal suture because no loosening occurs.

Although our operative time was 91.2 min for unilateral hernias and 136.0 min for bilateral hernias, we believe that further refinement of the technique and modification of the instruments will considerably reduce this. The results of the present study suggest that SILS-TAPP can be extended safely to the TAPP approach for inguinal hernia repair. The advantage of such an approach above and beyond cosmesis remains to be evaluated.

## CONCLUSIONS

The present findings show that SILS-TAPP repair using the EZ access port and standard instruments is safe and feasible for the repair of adult inguinal hernia and provides excellent cosmetic outcomes. A prospective, randomized study should be conducted to confirm the efficacy and safety of this procedure.

## DISCLOSURES

Drs. Sato, Shimada, Kurita, Iwata, Nishioka, Morimoto, Yoshikawa, Miyatani, Goto, Kashiwara, and Takasu have no conflicts of interest or financial ties to disclose.

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