

# Effect of Early Return to Work After Laparoscopic Total Extraperitoneal Hernia Repair: a Retrospective Comparative Cohort Study

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## Research Article

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# Abstract

## Background

This study compares the outcomes of early and late return to work after laparoscopic total extraperitoneal inguinal hernia repair (TEP).

## Methods

Between March 2008 and December 2019, we reviewed 506 cases who underwent laparoendoscopic total extraperitoneal hernia repair (TEP). Of these, 231 cases, who returned to work within one week after surgery, were classified as the early group, and 275 cases, who had no job or returned to work after longer than one week, were classified as the late group. Primary endpoint is inguinal hernia recurrence. Secondary endpoints were post-operative chronic inguinal pain, which is defined as persistent pain 6 months after operation, seroma formation, and modified medical outcome study (MOS) score.

## Results

The two groups had comparable baseline characteristics, except the early group were younger ( $51 \pm 13.1$  vs.  $58.2 \pm 15.9$ ,  $p < 0.001$ ) and had less constipation risk before operation (10.0% vs. 18.5%,  $p = 0.006$ ). The early return to work group did not increase inguinal hernia recurrence rate (1.7% versus 2.9%,  $p = 0.386$ ). Furthermore, the early group is associated with significant less chronic pain (4.8% versus 11.6%,  $p = 0.006$ ). There is no difference in post-operative seroma formation or MOS scores between early and late group.

## Conclusion

Patients who underwent laparoscopic TEP hernia repair and returned to work within one week did not show increased hernia recurrence rate or complications. Besides, early return to work was associated with significant less chronic pain. Early return to work after TEP repair is safe and feasible. Patients are encouraged to return to work earlier after TEP.

## 1. Introduction

Inguinal hernia repair is a common operation for symptomatic hernia. Laparoscopic total extraperitoneal hernia repair (TEP) is one of the widely used surgical methods. In comparison to open hernia repair, endoscopic hernia repair has advantages of fewer wound infections, fewer hematoma formation, and earlier return to normal activities or work<sup>1,2</sup>. However, early post-operative physical activities are one of the concerns that may increase mesh migration or irritation, which may lead to inguinal hernia recurrence. Intra-abdominal pressure could be increased by physical activity and converted to tensile force<sup>3</sup>. In porcine models, tissue growth into mesh occurred by 2 weeks after laparoscopic placement of hernia prosthesis<sup>4</sup>. The strength of tissue attachment to the mesh increased gradually until 12 weeks after surgery. As a result, the appropriate timing of return to work or activity is important.

With advances in surgical techniques, the goal of an early return to work and normal leisure activities after minimally invasive surgery is progressing. Although surgeons may recommend patients resume leisure activities as soon as the patient can tolerate it, patients cannot choose the physical loading or duration if returning to work. European Hernia Society guidelines give a grade C recommendation that patients are free to resume activity after inguinal hernia repair without mentioning specific operation method, except heavy weight lifting work<sup>1</sup>. Until now, there is no global consensus in the timing of returning to work for patients who underwent laparoscopic hernia repair. Therefore, we investigated the outcomes in patients of early and late return to work after laparoscopic total extraperitoneal (TEP) inguinal herniorrhaphy.

## **2. Methods**

### **2.1. Patient selection**

This is a retrospective study that analyzed the clinical information extracted from a prospectively collected database. From March 2008 to December 2019, 885 patients who underwent elective laparoscopic TEP inguinal hernia repair were enrolled in this database. Patients who had concurrent major abdominal surgery or emergent operations were not enrolled. All operations were performed by a single experienced surgeon, who had performed more than 200 laparoscopic TEP surgeries before initiation of the database collection. Patients' baseline demographics and perioperative outcomes were prospectively collected. Informed consent was obtained from all subjects or, if subjects are under 18, from a parent or legal guardian. The study protocol was approved by the Institutional Review Board of Buddhist Taipei Tzu-Chi General Hospital (IRB code: 08-X-040). Moreover, the study followed STROCSS guideline<sup>5</sup> and all methods were performed in accordance with the relevant guidelines and regulations or Declaration of Helsinki.<sup>6</sup>

The aim of this study is to analyze the outcome differences between patients returning to work early and late after laparoscopic TEP repair. Therefore, patients who had an intra-operative conversion to transabdominal preperitoneal (TAPP) method, follow-up of less than 6 months, and lack of information of returning to work were excluded for the final analysis (Fig. 1). According to the timing of returning to work, 231 patients were in the early group (returned to work within one week after surgery), and 275 patients were in the late group (returned to work more than 1 week after surgery or unemployed). The physical loading of work types was classified into three levels (light: sedentary and lifting less than 5 kilograms; medium: lifting 5 to 10 kilograms; heavy: lifting more than 10 kilograms).

### **2.2. Post operation follow-up and assessment**

All patients were followed standardized post-operative care, including early oral intake and early ambulation. There were no post-operative physical activities restriction. Patients were encouraged to resume activities as it can be tolerated. Painkillers were administered according to patients' need. Acute post-operative pain was evaluated by Visual Analog Scale (VAS) rulers with 0-100 on post-operative day 1

and day 7. We accessed patients for pain, complications, and activity level at outpatient clinic at post-operative 1 week, 3 months and 6 months. The timing of return to work was recorded by questionnaire. The primary outcome is inguinal hernia recurrence rate. The secondary outcomes are chronic inguinal pain, seroma formation, and activity level. Chronic inguinal pain is defined by persistent pain more than 6 months after surgery and was assessed by an independent trained nursing staff at outpatient clinic or via telephone interview. We evaluated activity level by modified Medical Outcome Score (MOS; 3–12 items; scores range from 3 to 30) on post-operative day 7 and 3 months (Supplement Table 1.).

## 2.3. Statistical analysis

Statistical analyses were performed with Pearson Chi square for category variables. Continuous variables were tested with Kolmogorov-Smirnov test for normality and compared with t test or Mann-Whitney U test. Multivariate analyses using logistic or linear regression were carried out and adjusted for sex, age, BMI, pain before surgery, mesh fixation methods, mesh types, and operation methods. All tests were two-tailed and considered as statistically significant as  $p < 0.05$ . Statistical analyses were performed with IBM SPSS statistical software version 26 for Windows (IBM Corp., New York, USA).

## 3. Results

The baseline demographic data is presented in Table 1, and the two groups had comparable characteristics in terms of sex, body mass index, comorbidity, initial symptoms, recurrent hernia, and laterality. The early group was younger than the late group ( $51.3 \pm 13.1$  versus  $58.2 \pm 15.9$  years old,  $p < 0.001$ ). Besides, the distribution of work types was significantly different among the two groups, with more light work types in the early group. The early group had less risk factors of benign prostate obstruction (19.5% versus 28.7%,  $p = 0.016$ ) and constipation (10.0% versus 18.5%,  $p = 0.006$ ) compared to the late group.

There was no significant difference regarding operation method, hernia type, mesh material and fixation methods, hernia defect size, and operation time between early and late groups (Table 2). The early group had a shorter hospital stay than the late group ( $23.3 \pm 9.9$  versus  $25.2 \pm 12.9$  hours,  $p = 0.03$ ) (Table 3). For the primary outcome, there is no significant difference in inguinal hernia recurrence rate between the two groups. After adjusted for work types and potential confounding factors, the early groups showed lower odds ratio compared to the late group without statistical significance (Odds ratio: 0.548, 95% confidence interval: 0.142, 2.122,  $p = 0.384$ ) (Table 4). In view of complications, the two groups had similar seroma formation, wound infection, and epididymitis, except that the early group had less acute urine retention (3.9% versus 8.7%,  $p = 0.028$ ). On the post operation day 1, the early group had significantly higher VAS pain scores at rest ( $1.8 \pm 1.8$  versus  $1.4 \pm 1.7$ ,  $p = 0.018$ ). After adjustment with multivariable linear regression, there were no significant differences in VAS pain scores at rest on post operation day 1 between the early and late groups (Table 4).

Nevertheless, the early group had significantly less chronic pain compared to the late group (4.8% versus 11.6%,  $p = 0.006$ ). Multivariable logistic regression also showed the early group is a protective factor of

chronic pain after adjusting for potential confounding factors (Odds ratio: 0.319; 95% confidence interval: 0.151,0.674;  $p = 0.003$ ). The outcomes of modified Medical Outcome Score (MOS) revealed significant higher scores in the early group on post-operative day 7 ( $27.10 \pm 1.60$  versus  $26.51 \pm 2.02$ ,  $p = 0.001$ ) but comparable scores on post-operative day 1 and at month 3.

## 4. Discussion

This is the first comprehensive study exploring the impact of going back to work early in the laparoscopic hernia repair era. Our study demonstrated that going back to work within one week after laparoscopic TEP hernia repair does not increase inguinal hernia recurrence and seroma formation. In addition, patients going back to work early had significantly less chronic inguinal pain. Early and late groups had similar functional outcomes at three months after operation. These findings suggest early return to work is feasible and safe for patients who underwent laparoscopic TEP.

In the open hernia repair era, early return to work was an important convalescence goal of operation. It was associated with socioeconomic advantages, including decreasing loss of productivity and earning of workers<sup>7</sup>. A review made by Forbes et al. recommended that patients could return to work 1 to 2 weeks after open hernia repair if little or no lifting was involved or 6–8 weeks if lifting more than 10 kilograms<sup>8</sup>. The Hernia Surge Group recommended that patients could resume work or activity within 3–5 days after elective laparoscopic or open hernia repair (upgraded to strong recommendation by panel discussion)<sup>9</sup>. Furthermore, a recent study investigated the determinants of short convalescence after laparoscopic hernia repair showed a median of 5 days of convalescence from work<sup>10</sup>. In our study, we classified patients into the early group if resuming work within 7 days after surgery and the results showed similar recurrence and complication rate compared to the late group. Based on our findings, patients are free to go back to work early after laparoscopic TEP hernia repair.

One of the important considerations of early return to work is inguinal hernia recurrence. Our study revealed that returning to work within one week did not increase inguinal hernia recurrence. From the experience of open hernia, Taylor reported that patients had comparable hernia recurrence rates between early (full work duties at 21 days after surgery) and late (full work duties at 3 months) return to work<sup>11</sup>. Another large-scale open hernia repair study by Bay-Neilsen et al. presented no significant difference in recurrence rate between non-restrictive ( $n = 1059$ ) and restrictive ( $n = 1306$ ) convalescence recommendation groups (0.7% versus 1.6%,  $p = 0.186$ ), in which median time off work after surgery was 7 days in non-restrictive recommendation groups<sup>12</sup>. As compared to open hernia repair, laparoscopic TEP hernia repair offers an earlier return to work (6.4 days versus 11.5 days,  $p < 0.001$ )<sup>13</sup>. Therefore, it is reasonable to define early return to work as within one week after surgery in our study. The early and late groups had comparable hernia recurrence rates (1.7% versus 2.9%,  $p = 0.386$ ) after follow-up of more than 6 months (Table 3). From the results of our study, early return to work did not increase the incidence of inguinal hernia recurrence.

Chronic postoperative inguinal pain is a bothersome complication for patients. A review by Poobalan et al. showed that patients who underwent laparoscopic hernia repair had great variations in incidence of chronic pain (0.8–29%)<sup>14</sup>. Our study revealed the incidence of chronic pain is 4.8% and 11.6 % in the early and late groups, respectively ( $p = 0.006$ ). A younger age was one of the risk factors of chronic postoperative inguinal pain in previous studies<sup>15–17</sup>. In our study, the early group was younger than the late group. After adjusting for age, multivariate regression revealed early return to work had significant less chance of developing chronic pain than the late group. Persistent neuralgia resulting from intraoperative neural injury and neuron entrapment could be the main reason of chronic pain<sup>18–21</sup>. Theoretically, early return to work is associated with more early postoperative physical activity. Physical activity can stimulate blood circulation and angiogenesis, which is beneficial to wound healing<sup>22–24</sup>. Early activity may stimulate tissue regrowth and further prevent nerve irritation by mesh, which in turn decreases chronic pain. The present study demonstrates that returning to work within one week after laparoscopic TEP hernia repair is associated with significant less chronic inguinal pain than those returning more than one week or being unemployed. Based on our findings and references, we recommend patients return to work within one week after laparoscopic TEP hernia repair owing to less chronic inguinal pain.

Post-operative urine retention is one of the common complications after laparoscopic hernia repair. Previous studies identified some risk factors, including age, narcotic medication used, and history of benign prostate hyperplasia<sup>25,26</sup>. Patel et al. reported that patients older than 50-years-old were associated with post-operative urine retention (odds ratio 3.0,  $p = 0.01$ )<sup>25</sup>. In our study, the late group was older (51.3 versus 58.2,  $p < 0.001$ ) and had more benign prostate obstruction (BPO) at presentation (19.5% versus 28.7%,  $p = 0.016$ ) (Table 1). Although the two groups had comparable post-operative narcotic use (Table 3), more patients with BPO had post-operative urine retention in the late group (3.9% versus 8.7%,  $p = 0.028$ ). The way to prevent post-operative urine retention is an important issue warranting further study.

There are some limitations in our study. First, this is a retrospective cohort study. Further prospective investigation with measurable post-operative activity is warranted. Second, the two groups had different distributions in physical loading of work. Limited evidence is available for convalescence from light to heavy work after TEP repair. In addition to work, leisure activity is also an important convalescence factor, and this was not analyzed in the current study.

## 5. Conclusion

In conclusion, our study found that return to work within one week after laparoscopic TEP hernia repair did not increase hernia recurrence rates. Furthermore, patients early return to work are associated with significantly less chronic inguinal pain. Postoperative seroma formation and complication rates are comparable between groups. Therefore, we recommend that patients should return to work early within one week after laparoscopic TEP hernia repair.

# Declarations

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## Author contributions

T.E.T. wrote the main manuscript. T.E.T, A.C.C., C.C.L. and C.K.W. collected and analyzed the data. Y.C.T. constructed the study and produced the final manuscript. All authors reviewed the manuscript.

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## Competing Interests

The authors declare no competing interest

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## Tables

**Table 1.** Baseline patient characteristics

### Return to work

	Early (n=231)	Late (n=275)	p value
Sex, male (n, %)	211 (91.3%)	248 (90.2%)	0.654
Age (Mean+SD)	51.3+13.1	58.2+15.9	<0.001*
BMI (Mean+SD)	24.2+3.2	23.6+3.1	0.058
Risk factor			
Weightlifting	50 (21.6%)	65 (23.6%)	0.594
COPD	18 (7.8%)	24 (8.7%)	0.704
BPO	45 (19.5%)	79 (28.7%)	0.016*
Constipation	23 (10.0%)	51 (18.5%)	0.006*
Comorbidity			
DM	15 (6.5%)	31 (11.3%)	0.063
HTN	56 (24.2%)	72 (26.2%)	0.617
CAD	8 (3.5%)	15 (5.5%)	0.284
CVA	2 (1.0%)	7 (2.5%)	0.191
Initial symptoms			
Pain	85 (36.8%)	115 (41.8%)	0.250
Bulging	225 (97.4%)	270 (98.2%)	0.549
Recurrent	28 (12.1%)	33 (12.0%)	0.967
Clinical hernia side			
Left	78 (33.8%)	80 (29.1%)	0.335
Right	84 (36.4%)	117 (42.5%)	
Bilateral	69 (29.9%)	78 (28.4%)	
Work type			
Light	195 (84.4%)	133 (68.2%)	0.001*
Medium	20 (8.7%)	32 (16.4%)	
Heavy	14 (6.1%)	21 (10.8%)	
NA	2 (0.9%)	9 (4.6%)	
No Job	0	80	

\*:  $p < 0.05$ ; BMI: body mass index; COPD: chronic obstructive pulmonary disease; BPO: benign prostate obstruction; DM: diabetes mellitus; HTN: hypertension; CAD: coronary artery disease; CVA: cerebrovascular accident; NA: non-available

**Table 2.** Intraoperative parameters

	Return to work		
	Early (n=231)	Late (n=275)	p value
Operation method			
TEP	54 (23.4%)	85 (30.9%)	0.059
LESS TEP	177 (76.6%)	190 (69.1%)	
Hernia type			
Indirect	136 (58.9%)	157 (57.1%)	0.598
Direct	59 (25.5%)	82 (29.8%)	
Femoral	1 (0.4%)	3 (1.1%)	
Mixed	31 (13.4%)	32 (11.6%)	
Mesh material			
Light weight	130 (56.3%)	147 (53.5%)	0.369
Heavy weight	100 (43.3%)	125 (45.5%)	
Surgisis	0 (0%)	2 (0.7%)	
Mesh fixation			
Tack	202 (87.4%)	233 (84.7%)	0.519
Glue	29 (12.6%)	40 (14.5%)	
None	0 (0%)	1 (0.4%)	
Hernia defect size			
< 1.5 cm	10 (10.3%)	10 (3.6%)	0.574
1.5-3 cm	54 (55.7%)	85 (61.6%)	
> 3 cm	33 (34.0%)	43 (31.2%)	
Operation time (mins)#	60.0 (48.0,75.0)	60.0 (47.0,75.0)	0.340
Peritoneal tear	28 (12.1%)	42 (15.3%)	0.306
#median, IQR			

**Table 3.** Post-operative outcomes

	Return to work		
	Early (n=231)	Late (n=275)	p value
Hospital stay (hr)	23.3±9.9	25.5±12.9	0.030*
Morphine equivalent dose(mg/kg)	0.10552±0.90414	0.09095±0.72839	0.842
Complications			
Seroma	31 (13.4%)	37 (13.5%)	0.991
AUR	9 (3.9%)	24 (8.7%)	0.028*
Wound infection	0 (0%)	2 (0.7%)	0.503
UTI	4 (1.7%)	3 (1.0%)	0.708
Epididymitis	2 (0.9%)	2 (0.7%)	1.000
Recurrence	4 (1.7%)	8 (2.9%)	0.386
Chronic pain	11 (4.8%)	32 (11.6%)	0.006*
VAS for pain			
Cough at ward	5.5±2.1	5.1±2.9	0.109
Cough on POD1	4.0±2.0	3.6±2.3	0.059
Rest at ward	3.3±2.5	3.2±2.7	0.591
Rest on POD1	1.8±1.8	1.4±1.7	0.018*
Modified medical outcome score			
MOS POD1	21.67±4.24	21.14±4.16	0.176
MOS POD7	27.10±1.60	26.51±2.02	0.001*
MOS POM3	29.87±0.47	29.08±0.84	0.274
Follow up (months)#	11.0 (6.0,32.0)	12.0 (6.0,32.0)	0.860

\*:  $p < 0.05$ ; #: median, IQR; AUR: acute urine retention; UTI: urinary tract infection; VAS: Visual analog scale; MOS: modified medical outcome study; POD: post-operative day; POM: post-operative month

**Table 4.** Multivariable regression analysis of visual analog scale (VAS) pain scores, modified medical outcome study (MOS) scores, chronic pain, seroma, and recurrence

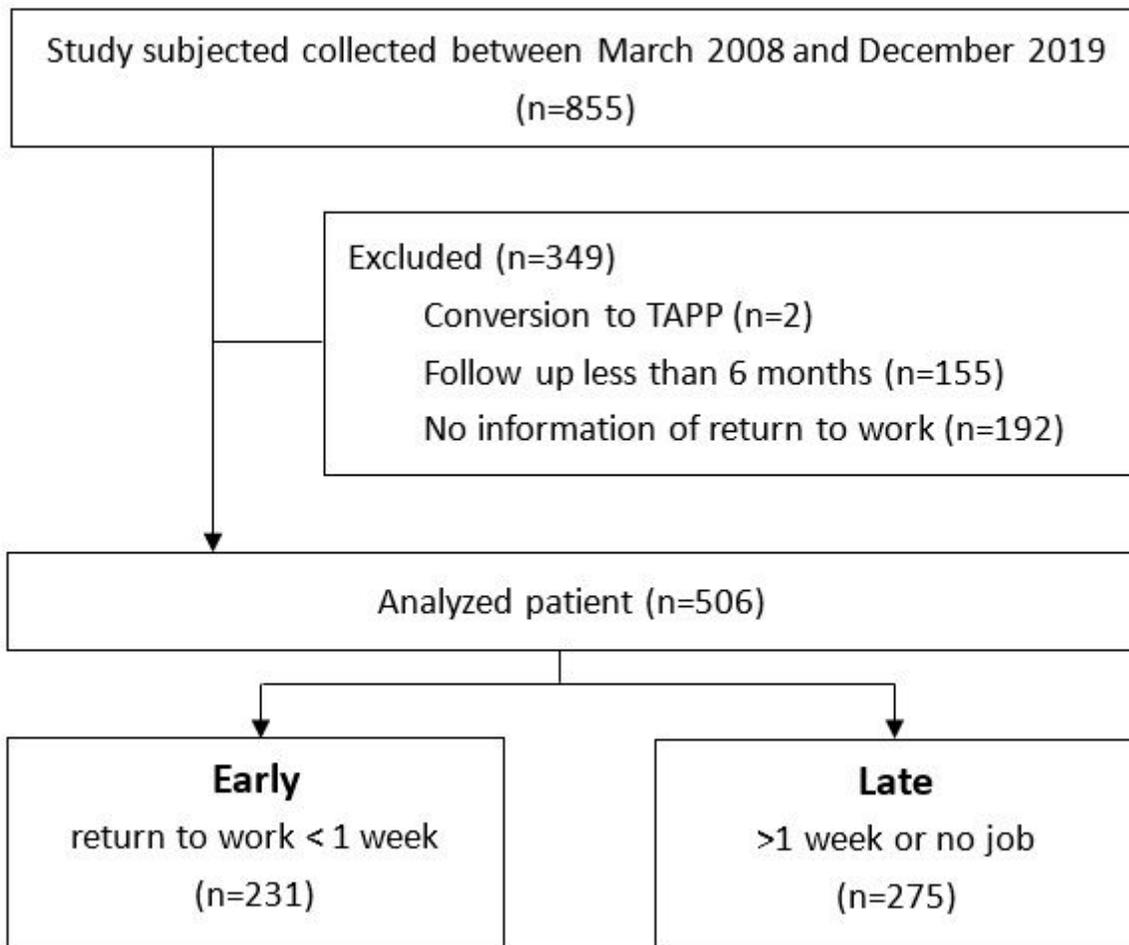
## Return to work

### < 1 week

	$\beta$	95% Confidence interval	<i>p</i> value
VAS/Cough/ward	-0.091	(-0.613, 0.431)	0.731
VAS/Cough/POD1	0.094	(-0.339, 0.527)	0.668
VAS/rest/ward	-0.152	(-0.653, 0.349)	0.551
VAS/rest/POD1	0.169	(-0.177, 0.516)	0.337
MOS POD1	0.948	( 0.125, 1.770)	<b>0.024*</b>
MOS POD7	0.529	( 0.145, 0.912)	<b>0.007*</b>
MOS POM3	0.106	(-0.041, 0.254)	0.158
	OR		
Chronic pain	0.283	( 0.132, 0.601)	<b>0.001*</b>
Seroma	1.018	( 0.552, 1.878)	0.954
Recurrence	0.548	( 0.142, 2.122)	0.384

#adjuster for sex. Age, BMI, pain before operation, mesh fixation method, mesh type, operation method, and work type; VAS: Visual analog scale; POD: post-operative day; POM: post-operative month

## Figures



**Figure 1**

Flowchart of patient inclusion

## Supplementary Files

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