



Original Article

Effect of early return to work after laparoscopic total extraperitoneal hernia repair: A retrospective comparative cohort study

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ABSTRACT

Objectives: Laparoscopic total extraperitoneal (TEP) hernia repair is one of the widely used surgical methods for symptomatic inguinal hernia. Although laparoscopic procedures provide advantages on postoperative complications and shorter convalescence, there is currently no global consensus on the timing for returning to work following laparoscopic hernia repair. This study compared the outcomes of early and late return to work after laparoscopic TEP inguinal hernia repair. **Materials and Methods:** Between March 2008 and December 2019, we reviewed 506 cases of laparoendoscopic TEP hernia repair. Among these, 231 cases where patients returned to work within 1 week postsurgery were classified as the early group, while 275 cases of patients either unemployed or returning to work after more than 1 week were classified as the late group. The primary endpoint was inguinal hernia recurrence. The secondary endpoints included postoperative chronic inguinal pain (defined as persistent pain 6 months postoperation), seroma formation, and the physical function domain of SF-36 v2. **Results:** The two groups had similar baseline characteristics, except that the early return-to-work group was younger (51 ± 13.1 vs. 58.2 ± 15.9 , $P < 0.001$) and had a lower risk of constipation before the operation (10.0% vs. 18.5%, $P = 0.006$). The early group did not exhibit an increased rate of inguinal hernia recurrence (1.7% vs. 2.9%, $P = 0.386$). In addition, the early group experienced significantly less chronic pain (4.8% vs. 11.6%, $P = 0.006$). There were no differences in postoperative seroma formation or scores of the physical function domain of SF-36 v2 between the early and late groups. **Conclusion:** Patients who underwent laparoscopic TEP hernia repair and returned to work within 1 week did not show increased hernia recurrence rates or complications. In addition, early return to work was associated with significantly less chronic pain. Returning to work early after TEP repair is both safe and feasible. Patients are encouraged to resume work early following TEP repair.

KEYWORDS: *Chronic postoperative inguinal pain, Hernia repair, Laparoscopic total extraperitoneal, Recurrence, Return to work*

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INTRODUCTION

Inguinal hernia repair is commonly performed for symptomatic hernias, with laparoscopic total extraperitoneal (TEP) hernia repair being a widely used method. Compared to open hernia repair, endoscopic hernia repair offers advantages such as fewer wound infections, less hematoma formation, and quicker return to normal activities or work [1,2]. However, early postoperative physical activities pose a concern as they might increase mesh migration or irritation, potentially leading to hernia recurrence. Physical activity can elevate intra-abdominal pressure, converting it into tensile force [3]. Studies in porcine models show that tissue growth into the mesh occurs within 2 weeks after laparoscopic hernia prosthesis placement, with tissue attachment


strength increasing gradually up to 12 weeks postsurgery [4]. Therefore, the timing of return to work or activity is crucial for postoperative care following laparoscopic hernia repair.

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With advances in surgical techniques, the objective of an early return to work and normal leisure activities after minimally invasive surgery has evolved over time. While surgeons may recommend that patients resume leisure activities as soon as they can tolerate them, patients do not have the same flexibility when it comes to the physical demands or duration of work. The European Hernia Society guidelines provide a Grade C recommendation that patients can resume activities after inguinal hernia repair, with the exception of heavy lifting, regardless of the specific surgical method [1]. However, there is currently no global consensus on the timing for returning to work following laparoscopic hernia repair. Therefore, we examined the outcomes of early versus late return to work in patients who received laparoscopic TEP inguinal herniorrhaphy.

MATERIALS AND METHODS

Patients selection

This was 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: 08-X-040). Moreover, the study followed STROCCS guideline [5] and all methods were performed in accordance with the relevant guidelines and regulations or Declaration of Helsinki [6].

The aim of this study was to analyze the outcome differences between patients returning to work early and late after laparoscopic TEP repair. Therefore, patients who had an intraoperative conversion to transabdominal preperitoneal method, follow-up of <6 months, and lack of information about returning to work were excluded from the final analysis [Figure 1]. The physical loading of work types was classified into three levels (light: sedentary and lifting <5 kg; medium: lifting 5–10 kg; and heavy: lifting more than 10 kg). This parameter was assessed by an independently trained nursing staff at an outpatient clinic or via telephone interview on postoperative day 1 or day 7.

Postoperative follow-up and assessment

All patients were followed with standardized postoperative care, including early oral intake and early ambulation. There were no postoperative physical activity restrictions. Patients were encouraged to resume activities as tolerated. Painkillers were administered according to patients' needs. Acute postoperative pain was evaluated by Visual Analog Scale (VAS) rulers with 0–10 on postoperative day 1 and day 7. We assessed patients for pain, complications, and activity level at the outpatient clinic at postoperative 1 week, 3 months, and 6 months. The timing of return to work was recorded by questionnaire. As shown in

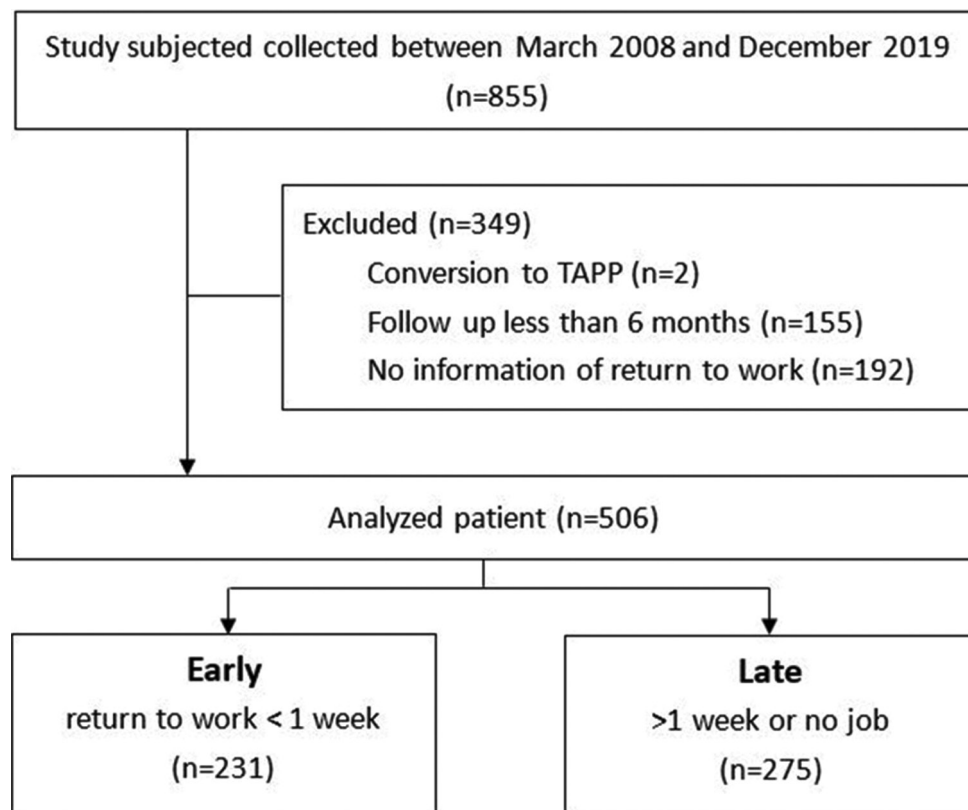


Figure 1: Flowchart of patient inclusion. TAPP: Transabdominal preperitoneal

Figure 1, the late group included those who returned to work later than 1 week and who had no jobs.

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 as persistent pain more than 6 months after surgery and was assessed by an independently trained nursing staff at an outpatient clinic or via telephone interview. Seroma formation was detected by ultrasonography. We evaluated activity level by the physical function domain of SF-36 v2 (36-Item Short Form Health Survey; 3rd–12th items; scores range from 10 to 30) on postoperative day 7 and 3 months.

Statistical analysis

Statistical analyses were performed with Pearson's 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, body mass index (BMI), pain before surgery, mesh fixation methods, mesh types, and operation methods. All tests were two-tailed and considered statistically significant at $P < 0.05$. Statistical analyses were performed with IBM SPSS statistical software version 26 for Windows (IBM Corp., New York, USA).

RESULTS

According to the timing of returning to work, 231 patients were in the early group (returned to work within 1 week after surgery), and 275 patients were in the late group (returned to work more than 1 week after surgery or unemployed). The baseline demographic data are presented in Table 1, and the two groups had comparable characteristics in terms of sex, BMI, comorbidity, initial symptoms, recurrent hernia, and laterality. The early group was younger than the late group (51.3 ± 13.1 vs. 58.2 ± 15.9 years old, $P < 0.001$). All patients (231) had jobs in the group of early resuming of work. However, there were 80 of 275 patients having no jobs in the group of late resuming of work. 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 (BPO) (19.5% vs. 28.7%, $P = 0.016$) and constipation (10.0% vs. 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 hernia defect size was estimated by comparing the defect length with the distance between two arms of a fully opened grasper (about 1.5 cm). As for mesh, some were mesh implants, such as TiO₂ mesh and TiO₂ mesh light (BioCer, Germany). The early group had a shorter hospital stay than the late group (23.3 ± 9.9 vs. 25.5 ± 12.9 h, $P = 0.03$) [Table 3].

For the primary outcome, there was no significant difference in inguinal hernia recurrence rate between the two groups [Table 3]. After adjusting for work types and potential confounding factors (sex, age, BMI, pain before operation, mesh fixation method, mesh type, and operation method), the early groups showed a lower odds ratio compared to the late group without statistical

Table 1: Baseline patient characteristics

	Return to work		P
	Early (n=231)	Late (n=275)	
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: Nonavailable, SD: Standard deviation

significance (odds ratio: 0.548, 95% confidence interval: 0.142–2.122, $P = 0.384$) [Table 4]. In view of complications in Table 3, the two groups had similar seroma formation, wound infection, and epididymitis, except that the early group had less acute urine retention (3.9% vs. 8.7%, $P = 0.028$). On the postoperative day 1, the early group had significantly higher VAS pain scores at rest (1.8 ± 1.8 vs. 1.4 ± 1.7 , $P = 0.018$). After adjustment with multivariable linear regression, there were no significant differences in VAS pain scores at rest on postoperative 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% vs. 11.6%, $P = 0.006$). The results of multivariable logistic regression also showed that the early group is a protective factor of chronic pain after adjusting for potential confounding factors (Odds ratio: 0.283; 95% confidence interval: 0.132–0.601; $P = 0.001$). The outcomes of the physical function domain of SF-36 v2 revealed significantly higher scores in the early group on postoperative day 7 (27.10 ± 1.60 vs. 26.51 ± 2.02 , $P = 0.001$) but comparable scores on postoperative day 1 and at month 3 [Table 3].

DISCUSSION

This comprehensive study is the first to delve into the effects of returning to work early in the era of laparoscopic

Table 2: Intraoperative parameters

	Return to work		P
	Early (n=231), n (%)	Late (n=275), n (%)	
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			
Lightweight	130 (56.3)	147 (53.5)	0.369
Heavyweight	100 (43.3)	125 (45.5)	
Surgisis®	0	2 (0.7)	
Mesh fixation			
Tack	202 (87.4)	233 (84.7)	0.519
Glue	29 (12.6)	40 (14.5)	
None	0	1 (0.4)	
Hernia defect size (cm)			
<1.5	10 (10.3)	10 (3.6)	0.574
1.5–3	54 (55.7)	85 (61.6)	
>3	33 (34.0)	43 (31.2)	
Operation time (min) [#]	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). TEP: Totally extraperitoneal, LESS: Laparoendoscopic single-site surgery, IQR: Interquartile range

Table 3: Postoperative outcomes

	Return to work		P
	Early (n=231)	Late (n=275)	
Hospital stay (h)	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, n (%)			
Seroma	31 (13.4)	37 (13.5)	0.991
AUR	9 (3.9)	24 (8.7)	0.028*
Wound infection	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 on POD 0	5.5±2.1	5.1±2.9	0.109
Cough on POD1	4.0±2.0	3.6±2.3	0.059
Rest on POD 0	3.3±2.5	3.2±2.7	0.591
Rest on POD1	1.8±1.8	1.4±1.7	0.018*
Physical function domain of SF-36v2			
POD1	21.67±4.24	21.14±4.16	0.176
POD7	27.10±1.60	26.51±2.02	0.001*
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, POD: Postoperative day, POM: Postoperative month, IQR: Interquartile range

hernia repair. Our findings show that resuming work within a week of laparoscopic TEP hernia repair does not lead

to higher rates of inguinal hernia recurrence and seroma formation. In addition, patients who returned to work early experienced significantly less chronic inguinal pain. At 3 months postoperation, both early and late return groups had similar physical functions. These results indicate that an early return to work is both feasible and safe for patients undergoing laparoscopic TEP.

During the era of open hernia repair, early return to work was a crucial goal, offering socioeconomic benefits such as reduced productivity loss and financial impact for workers [7]. According to Forbes *et al.*, patients could return to work 1–2 weeks postopen hernia repair if no heavy lifting was involved or 6–8 weeks if lifting over 10 kg [8]. The Hernia Surge Group later recommended resuming work or activity within 3–5 days postelective laparoscopic or open hernia repair, a recommendation solidified by panel discussion [9]. A recent study identified determinants of short recovery periods after laparoscopic hernia repair, with a median convalescence of 5 days [10]. One week was arbitrarily chosen as the time point for dividing the early and late groups of resuming work in this study because it (7 days) was a value between 3 and 5 days and 1–2 weeks. In our research, patients who returned to work within 7 days had similar recurrence and complication rates as those who took longer. Our findings support the feasibility and safety of early return to work following laparoscopic TEP hernia repair.

One important consideration of early return to work is the risk of inguinal hernia recurrence. Our study revealed that returning to work within 1 week did not increase this risk. Drawing from open hernia repair experiences, Taylor and Dewar reported that patients had similar hernia recurrence rates whether they resumed full work duties at 21 days or at 3 months postsurgery [11]. Another large-scale study by Bay-Nielsen *et al.* showed no significant difference in recurrence rates between patients with short ($n = 1059$) and control ($n = 1306$) convalescence groups, with a median time off work being 7 days in the short-convalescence group [12]. Compared to open hernia repair, laparoscopic TEP hernia repair facilitates an earlier return to work (6.4 days vs. 11.5 days, $P < 0.001$) [13]. Therefore, it is reasonable to define early return to work as within 1 week postsurgery in our study. The median follow-up durations are 11.0 and 12.0 months for the early and late groups, respectively, in this study. Both early and late return groups had comparable hernia recurrence rates (1.7% vs. 2.9%, $P = 0.386$) after more than 6 months of follow-up [Table 3]. Moreover, it should be long enough to monitor hernia recurrence.

In a review about causes of recurrence in laparoscopic inguinal hernia repair authored by Siddaiah-Subramanya *et al.*, it was mentioned that patients' risk factors such as higher BMI, smoking, diabetes, and postoperative surgical site infections increase the risk of recurrence and can be modified [14]. Time to return to work is not included. However, in a study for open hernia repair conducted by the same group, they concluded that time to return to physical activity and work was one of the factors increasing the risk of recurrence [15]. This area is still considerably controversial. Moreover, our findings indicate that early return to work post-TEP laparoscopic hernia repair does not increase the incidence of inguinal hernia recurrence.

Table 4: Multivariable regression analysis (after adjusting) of the early group for Visual Analog Scale pain scores, physical function domain of SF-36v2, chronic pain, seroma, and recurrence

	Return to work - Early (<1 week)		P
	β	95% CI	
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
SF36 POD1	0.948	0.125-1.770	0.024*
SF36 POD7	0.529	0.145-0.912	0.007*
SF36 POM3	0.106	-0.041-0.254	0.158
	OR	95% CI	P
Chronic pain	0.283	0.132-0.601	0.001*
Seroma	1.018	0.552-1.878	0.954
Recurrence	0.548	0.142-2.122	0.384

*: $P < 0.05$, Adjustment for sex, Age, BMI, pain before operation, mesh fixation method, mesh type, operation method, and work type. VAS: Visual Analog Scale, POD: Postoperative day, POM: Postoperative month, SF36: Physical function domain of SF-36v2, OR: Odds ratio, CI: Confidence interval, BMI: Body mass index, SF36: 36-Item Short Form Health Survey

Chronic postoperative inguinal pain is a significant issue for patients. A review by Poobalan *et al.* found that the incidence of chronic pain varied widely (0.8%–29%) among those who underwent laparoscopic hernia repair [16]. Our study showed that the incidence of chronic pain was 4.8% in the early return-to-work group and 11.6% in the late group ($P = 0.006$). Previous studies have identified younger age as a risk factor for chronic postoperative inguinal pain [17-19]. In our study, the early group was younger than the late group. After adjusting for age, multivariate regression revealed that early return to work significantly reduced the likelihood of developing chronic pain compared to the late group. Persistent neuralgia due to intraoperative neural injury and neuron entrapment could be the primary cause of chronic pain [20-23]. Theoretically, early return to work is linked to increased early postoperative physical activity, which can stimulate blood circulation and angiogenesis, aiding wound healing [24-26]. Early activity with enhanced tissue perfusion may also promote tissue regeneration, preventing nerve irritation by the mesh and thus reducing chronic pain. Our study demonstrates that returning to work within 1 week after laparoscopic TEP hernia repair is associated with significantly less chronic inguinal pain compared to later returns or unemployment. Based on our findings, we recommend patients return to work within 1 week after laparoscopic TEP hernia repair to reduce the risk of chronic inguinal pain.

Postoperative urine retention is a common complication following laparoscopic hernia repair. Previous studies have identified several risk factors, including age, narcotic use, and a history of benign prostate hyperplasia [27,28]. Patel *et al.* found that patients over 50 years old had an increased risk of postoperative urine retention (odds ratio = 3.0, $P = 0.01$) [27]. In our study, the late return-to-work group was older (51.3 vs. 58.2 years, $P < 0.001$) and had a higher prevalence of BPO at presentation (19.5% vs. 28.7%, $P = 0.016$) [Table 1]. Although both groups had similar postoperative narcotic use, a greater proportion of patients with BPO in the late group experienced

postoperative urine retention (3.9% vs. 8.7%, $P = 0.028$). Further research is needed to identify effective strategies for preventing postoperative urine retention.

As to other postoperative complications, there is no difference between the early and late groups in occurrence of seroma, wound infection, and epididymitis. The rates of seroma formation were 13.4 and 13.5%, respectively, in the early and late groups. In a retrospective analysis on 1763 cases undergoing laparoscopic indirect inguinal hernia repair, 233 (13.2%) patients developed postoperative seroma [29]. The wound infection rates of several randomized controlled trials were reported from 1.2% to 2.2% [30]. Our results seem even better than them (0% and 0.7% in the early and late groups). The occurrence of epididymitis was 3.4% in a randomized controlled trial and ours are lower than that (0.9% and 0.7% in the early and late groups) [30].

With regard to postoperative pain, higher VAS pain scores were observed for the early group than the late group (1.8 ± 1.8 vs. 1.4 ± 1.7 , $P = 0.018$). However, after adjustment with multivariable linear regression, there were no significant differences in VAS pain scores at rest on the postoperative day 1 between the early and late groups [Table 4]. In a study conducted by Varshney *et al.*, VAS = 4 was noted on postoperative day 1 and decreased to VAS = 2 on day 14 [31]. It seems that our patients experienced lower VAS pain scores than theirs.

For physical function, the physical function domain of SF-36 v2 revealed significantly higher scores in the early group on postoperative day 7 (27.10 ± 1.60 vs. 26.51 ± 2.02 , $P = 0.001$) but comparable scores on postoperative day 1 (21.67 ± 4.24 vs. 21.14 ± 4.16 , $P = 0.176$) and at month 3 (29.87 ± 0.47 vs. 29.08 ± 0.84 , $P = 0.274$). In Chuah *et al.*'s study for quality of life after laparoscopic TEP inguinal hernia repair, they reported that the physical function domain of SF-36 v2 was 28.59 and 29.54, respectively, at months 1 and 6 [32].

There are a few limitations to our study. First, it is a retrospective cohort study, so further prospective research with measurable postoperative activity is needed. Second, the groups had varying physical work demands, and there is limited evidence on convalescence from light to heavy work post-TEP repair. In addition, we did not analyze leisure activities, which also play a significant role in convalescence.

CONCLUSION

Our study found that returning to work within 1 week after laparoscopic TEP hernia repair does not increase hernia recurrence rates. In addition, patients who return to work early experience significantly less chronic inguinal pain. Postoperative seroma formation and complication rates are comparable between groups. Therefore, we recommend that patients return to work within 1 week after laparoscopic TEP hernia repair.

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Data availability statement

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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Conflicts of interest

There are no conflicts of interest.

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