

# Outcomes and Learning Curve in Total Extraperitoneal Hernia Repair: A Cross-sectional Study

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## ABSTRACT

**Introduction:** Hernia surgery can be performed via the classical open technique, or laparoscopically. However, the later techniques i.e, total extraperitoneal repair and transabdominal preperitoneal techniques are allied to a steep learning curve.

**Aim:** To define the learning curve associated with a Total Extraperitoneal (TEP) in inguinal hernia repair.

**Materials and Methods:** A cross-sectional study was conducted in Department of Surgery at Mahatma Gandhi Hospital, Jaipur, Rajasthan, India, from January 2018 and January 2022. Total 125 patients with inguinal hernia posted for laparoscopic inguinal hernia repair by a TEP technique, to assess the learning curve using the moving average method. Two surgeons i.e, surgeon 1 (assessee, junior surgeon) and surgeon 2 (assessor, senior surgeon) were chosen. The learning curve was assessed for surgeon 1, who was a general laparoscopic surgeon, not performing laparoscopic hernia repair, while surgeon 2 was regularly performing laparoscopic hernia repairs. A direct comparison was made, based on operative time, peritoneal laceration, vascular injury, conversion rates, hospital

stay and complications. Chi-square test and Fisher's-exact test was used wherever applicable.

**Results:** Out of 125 patients, 50 patients were operated by the surgeon 1 and 75 patients were operated by surgeon 2. Mean operating time by surgeon 2 was 52±4.5 minutes, and 66±4.18 minutes for surgeon 1 with a p-value of 0.0005. This was the only statistically significant variable, while hospital stay and surgical complications like peritoneal laceration was statistically insignificant (p-value >0.05). Surgeon 1 (assessee) required to perform 10 TEP surgeries to overcome the learning curve. Oral intake was started at mean of postoperative day 1.08±0.32 for surgeon 1 and 1.04±0.20 for surgeon 2. Full diet was initiated on postoperative day 1.5±0.5 for senior surgeon, while 2.08±0.8 days for the junior surgeon.

**Conclusion:** Surgeons with a prior experience in laparoscopic surgery needs a shorter learning curve as compared to a beginner in laparoscopic surgery, when it comes to laparoendoscopic groin hernia repair.

**Keywords:** Junior surgeon, Operative time, Peritoneal laceration, Senior surgeon, Vascular injury

## INTRODUCTION

A hernia is an abnormal protrusion of a tissue or an organ through a defect in the wall which contains it. The incidence of hernia is high in a general population [1]. Numerous sites in the body are susceptible or vulnerable to hernia, with the most common being the inguinal region [2]. Approximately, 70 to 75% of all hernias occur in the groin, of which, 95% are of inguinal origin, while the rest are femoral hernias. An inguinal hernia is quite a common occurrence in both males, and females, with a male predilection. They can either be direct, or indirect [3,4].

The aim of a successful hernia repair includes lowest rates of recurrence, achieving an effective and robust repair, minimal intra and postoperative complication and rapid return to normal lifestyle, while keeping the cost of procedure low. To accomplish these aims, a variety of methods and techniques of hernia repair have been established, which include open herniorrhaphy and hernioplasty, to numerous laparoscopic approaches, including Total Extraperitoneal Approach (TEP), Transabdominal Preperitoneal Approach (TAPP), extended view Total Extraperitoneal Approach (e-TEP) and Stoppa technique [5]. The TEP and TAPP have gained a significant acceptance as a standard procedure for inguinal hernia repair owing to its uniformity, accuracy and reproducibility [6]. However, these techniques come with their own pitfalls and difficulties. The TEP repair requires laparoscopic anatomical knowledge, has a steep learning curve, bi-manual manipulation for hernia reduction, and difficulties encountered during placement of mesh, due to restricted working field. Hence, implementation and consistency in performing laparoscopic inguinal hernia repair have been gradual and time consuming, compared to adoption of other laparoscopic procedures like cholecystectomy [7,8].

Currently, the burden of laparoscopic hernia repair for inguinal hernia accounts to only 15-20%. Even though numerous attempts have been made to define a learning curve for this procedure, the results of the study, have been quite wide inconsistent, ranging from 10 to 60 cases over multiple studies [9-11].

Hence, the present study was conducted with objectives to assess a learning curve for an otherwise experienced laparoscopic surgeon, not performing laparoscopic inguinal hernia repair and to predict the number of cases which are required to be proficient with respect to duration of surgery, intraoperative complications, peritoneal laceration, vascular injury, conversion rates, hospital stay and postoperative complications.

## MATERIALS AND METHODS

A cross-sectional study was conducted in Department of Surgery at Mahatma Gandhi Hospital, Jaipur, Rajasthan, India, from January 2018 to January 2022. The study was approved by the Institutional Ethical Committee (IEC: MGMCH/IEC/JPR/2018/11). A well-informed written consent was obtained from the patients before their enrolment.

All 125 patients, who met the inclusion criteria and were fit for surgery in the period of 1.5 years, and followed them postoperatively formed the sample population.

**Inclusion criteria:** Patients age between 18 to 70 years, with an uncomplicated primary or recurrent, unilateral or bilateral inguinal hernia were included in the study.

**Exclusion criteria:** Patients with complicated hernias like, incarcerated, strangulated or irreducible hernias, or patients who were unfit to undergo general anaesthesia were excluded from the study.

## Procedure

- Junior surgeon: Surgeon 1 (assessee) had 23 years of experience in laparoscopic surgery. He was a 1<sup>st</sup> assistant (camera assistant) to the senior surgeon (surgeon 2, assessor).
- Senior surgeon: Surgeon 2 (assessor) had been performing TEP surgeries for the past 29 years.

Surgeon 1 had assisted and performed hernia surgeries under the direct supervision of surgeon 2. Study focused to compare the learning curve of laparoscopic inguinal hernia repair (TEP) between surgeon 1 and surgeon 2 over the following parameters:

- Creating an adequate extraperitoneal space.
- Defining the laparoscopic anatomy satisfactorily.
- Dissection of the peritoneum from the cord structures.
- Handling indirect versus direct sac, handling small versus large sac.
- Separation of sac from the cord structures, mesh placement, tackers/suture placement, conversion rate.
- Assessment of difficulty of procedure by the assessee and the assessor.
- Operation time, blood loss, intraoperative complications and postoperative complications.

The learning curve is defined as a number of cases or operations that are required to stabilize the total duration of the surgery performed and the rates of complication. The learning curve encompasses three major components, i.e, the point of initiation, the slope and the plateau of the curve. This learning curve was used to interpret the demographic details, duration of surgery, intraoperative complications, postoperative complications and duration of hospital stay [12].

## STATISTICAL ANALYSIS

The data was analysed with the Statistical Package for Social Sciences (SPSS) version 23.0 IBM software. The learning curve analysis was done using the moving average method. A Moving average calculates the average value from an initial set of results that are further used for control purposes. It is called "moving" because the average (moving average) is recalculated each time a new entry, or result is obtained, that results in a data that is continuously updated and evaluated, after every sample is received and analysed [13]. To find significance in categorical data, Chi-square test was used, and similarly, if the expected cell frequency was less than 5 in 2x2 tables, then Fisher's-exact test was used. To find significance in continuous data, independent t-test was used. Level of significance was set when p-value was less than 0.05.

## RESULTS

A total of 125 patients were operated for laparoscopic TEP inguinal hernia repair. Out of the 125 patients, 50 patients were operated by the surgeon 1 and 75 were operated by surgeon 2. There was a total of 150 inguinal hernias that were operated in the study.

An increasing trend was observed in the study, only two patients belonged to the age of <20 years [Table/Fig-1]. The patients operated by surgeon 2 had a higher mean age of 54±16.56 years, as compared to patients operated by surgeon 1, which was 47±13.36 years being statistically significant (p-value=0.0003). Mean operating time by surgeon 2 was 52±4.5 minutes, and 66±4.18 minutes for surgeon 1 with a p-value of 0.0005, which found to be highly significant [Table/Fig-2].

Age group (years)	Total	Male	Female
<20	2	2	0
21-30	10	10	0
31-40	20	19	1
41-50	26	26	0
51-60	32	31	1
61-70	35	34	1

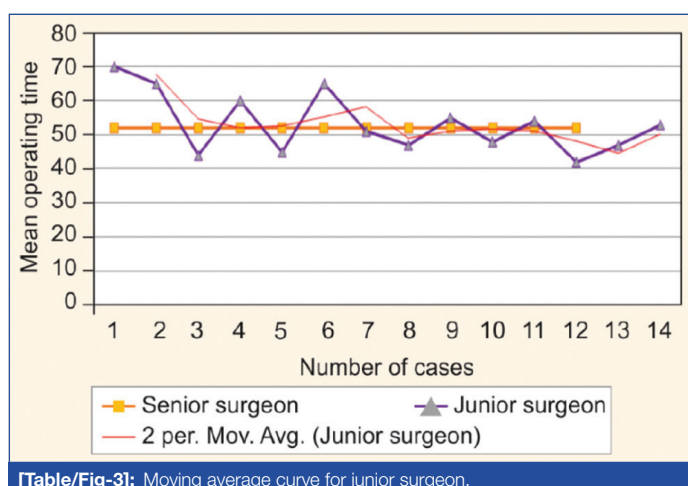
[Table/Fig-1]: Age and Gender-wise distribution of subjects.

Variables	Senior surgeon (n=87)	Junior surgeon (n=63)	p-value
Mean age (years) (mean±SD)	54±16.56	47±13.36	0.0003 <sup>y</sup>
Type of Hernia:			
Indirect (n,%)	23 (26.4%)	34 (54%)	0.44
Direct (n,%)	25 (28.7%)	15 (23.8%)	
Bilateral (n,%)	39 (44.8%)	14 (22.2%)	
Mean operating time (minutes) (mean±SD)	52±4.5 minutes	66±4.18 minutes	0.0005 <sup>y</sup>
<b>Intraoperative complications</b>			
Peritoneal laceration	12	16	0.42 <sup>*</sup>
Vascular injury	0	0	-
Postoperative complications urinary retention	4	6	0.65 <sup>*</sup>
Mean days to discharge	2.02	2.60	0.58 <sup>y</sup>

[Table/Fig-2]: Variables compared between Senior surgeon and Junior surgeon. <sup>y</sup>Independent t test; <sup>\*</sup>Chi-square test; p-value <0.05 was considered as statistically significant. Senior Surgeon operated 87 inguinal hernia while junior surgeon performed 63 surgeries

The peritoneal injuries were observed in patients who had a large sac in both, direct and indirect hernias, which were managed by inserting a Veress needle intraperitoneally at palmar point. If the leak was minor, no treatment or conversion was required.

Using the moving average method for analysis of the learning curve, it was established that surgeon 1, the assessee surgeon, needed a minimum of 10 TEP hernia repairs to reach a mean operating time of statistical insignificance or, at par with the mean operating time for surgeon 2, the assessor surgeon [Table/Fig-3].



[Table/Fig-3]: Moving average curve for junior surgeon.

Oral intake was started at mean of postoperative day 1.08±0.32 for surgeon 1 and 1.04±0.20 for surgeon 2. Full diet was initiated on postoperative day 1.5±0.5 for senior surgeon, while 2.08±0.8 days for the junior surgeon.

## DISCUSSION

The repair of an inguinal hernia had a long history and has undergone a plethora of refinement techniques, leading upto a laparoscopic tension free repair technique, which have proved to be successful [14]. The TEP technique for inguinal hernia is considered to be a rather difficult one to master, given the anatomical complexity and limited space, leading to a steep learning curve [15,16].

The patients operated by surgeon 2 had a higher mean age, compared to surgeon 1, which is coherent with the study concluded by Bansal VK et al., which had a mean age of 50.9 years for the senior surgeon and 42.76 years for the junior surgeon [15]. In the present study, the majority of patients were males (97.6%). This was comparable with the results of Malangoni MA et al., which reported that the prevalence of groin hernia is more in males than females by a ratio of 7:1. Mens are 25 times more likely to be affected by inguinal hernia than women [2]. In the current study, the mean operating

time by surgeon 1 was  $66 \pm 4.18$  minutes, while that of surgeon 2 was  $52 \pm 4.5$  minutes, with a p-value of 0.0005. Similar results to the present study were observed by Bökeler U et al., [17].

Bansal VK et al., reported a rate of 25.4% of all TEP repairs which were performed by a junior surgeon, which had major or minor peritoneal injuries, compared to a total of 15.2% of TEP repairs complicated with peritoneal injuries performed by the senior surgeon [15]. The present study has similar results, in which peritoneal injury as a complication was noted in 24% of cases performed by the junior surgeon, and 21% by the senior surgeon. In a study conducted by Hasbahceci M et al., there was a peritoneal injury prevalence of 33.3% cases, of which 33.3% were converted from laparoscopy to open [18].

**Postoperative complications:** In present study there was a total of 20% postoperative complications, of which 8% of cases had urinary retention. They were then catheterised and the catheter was removed once retention was relieved. No patient complained of burning micturition or suffered from urinary tract infection. Multiple studies like that of Kwon OC et al., [19], Kim MJ and Hur KY [20], Vărcuș F et al., [21] and Maheshwari S et al., [22] found the prevalence of urinary retention to be ranging from 3.2 to 22%.

The mean days to discharge duration for patients operated by the senior surgeon was 2.02 days, while that of junior surgeon was 2.60 days. The present study yielded similar results to that of Vărcuș F et al., wherein, patients had an average hospital stay of 2 days; also Kwon OC et al., yielded similar results of patients having an average hospital stay of 2.92 days [19,21].

It was concluded from the present study, that a junior surgeon, with a good prior experience of laparoscopy requires a minimum of 10 cases of TEP to reach at par with an experienced laparoscopic TEP repair, with respect to the operating time. While in a study by Bansal VK et al., they found that the learning curve for the junior surgeon was 14 cases for TEP repair [15]. In a study conducted by Kwon OC et al., Choi YY et al., and Lim JW et al., they reported a learning curve for TEP to be 30, 37, and 60 cases, respectively [8,19,23]. The surgeon 1 in the present study was highly experienced in laparoscopic surgery which was most likely the reason for a fewer number of procedures required to overcome the learning curve. Hence, a surgeon with a prior excellent laparoscopic learning skill needs a shorter learning curve compared to a beginner. For future recommendation, to assess the learning curve other surgical procedures for an already established laparoendoscopic surgeon who is not performing laparoscopic groin hernia surgeries, like TAPP and e-TEP should be studied.

### Limitation(s)

Authors did not studied the several operative outcomes including long-term recurrence and postoperative pain in this study, although these parameters are the most important endpoints for a successful evaluation of an endoscopic hernia repair. The current study results were derived from a single teaching hospital and from a

single surgeon experience. Although there may be some difficulty to generalize these findings because of the individual differences based on skill set and training structure.

### CONCLUSION(S)

Surgeons with excellent laparoscopic skills, with a prior working knowledge of laparoscopic procedures need a shorter learning curve compared to the trainee in laparoscopic surgery, when it comes to laparoendoscopic groin hernia repair.

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