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A PROSPECTIVE COMPARATIVE STUDY OF LAPAROSCOPIC (TEP) AND OPEN(LICHTENSTEIN) INGUINAL HERNIA REPAIR

DR. GURASHISH SINGH GULATI[1], DR. SANJEET KUMAR[2], DR. RAVI SINHA[3*]

[1]Pg Resident-3, Department Of General Surgery, Dr Knsmims, Gadia, Barabanki,Up, India.
[2]Pg Resident-3, Department Of General Surgery, Dr Knsmims, Gadia, Barabanki,Up, India;
[3]Professor & Hod, Department Of General Surgery, Dr Knsmims, Gadia, Barabanki,Up, India;

***Corresponding Author-** Dr. Ravi Sinha
*Professor And HoD, Department Of General Surgery, Dr Knsmims, Gadia, Barabanki,Up, India.

Abstract
Background: Laparoscopic inguinal hernia repair has emerged as a viable alternative to the open procedure. But laparoscopic hernia repair is technically difficult and has long learning curve than open repair. However, laparoscopic hernioplasty by totally extraperitoneal repair (TEP) technically eliminates the hazards of intra operational injuries. The present study was undertaken to compare the effectiveness of laparoscopic repair (TEP) Vs open (Lichtenstein Method) repair of inguinal hernia.
Methods: This prospective study was conducted in the Department of General Surgery, DR KNSMIMS, GADIA, BARABANKI,UP, INDIA., from June 2024 to May 2025, in a tertiary referral hospital. In this prospective observational study of 100 patients including unilateral, bilateral, direct and indirect inguinal hernia and excluding obstructed and strangulated hernia, 60 patients underwent open repair (Group B) and 40 patients underwent laparoscopic hernia repair (group A). Pain analysis was done with visual analogue scale.
Results: Demographic characteristics such as age, sex of the two groups were similar. Mean operative time in laparoscopic group (TEP-A) was 95.21±25.22 minutes and in open group (Lichtenstein-B) was 70.87±26.42 minutes ($p<0.001$). There was statistically significant difference in mean pain score of laproscopic verses open techniques ($p<0.001$). Urinary retention was the most common post-operative complication in both groups but was statistically not significant. Mean hospital stay in laparoscopic group was 2.10±0.40 days and in open group was 3.3±0.70 days. Mean time taken to return to usual activity in open repair was 31.9±14.55 days and in laparoscopic group was 15.33±8.37 days . Postoperative complication rate was 33.54% in the group A and 40.17% in group B.
Conclusions: This study showed that in laparoscopic repair of inguinal hernia patients have less post-operative pain, shorter hospital stays,lesser analgesic dose requirement, early resumption of normal activity and better quality of life in consideration with bodily pain. However, the laparoscopic technique had longer operative time duration.

Keywords: Laparoscopic repair; lichtenstein method; Inguinal hernia; hernioplasty.

Introduction:

When an organ or fatty tissue protrudes through a weak area in the fascia or surrounding muscles, it causes a hernia. They can have a variety of origins and frequently develop where the abdominal wall is weaker, such as in the abdomen (belly area) or groin.[1]. When fatty tissue or a portion of the colon

pushes through into the groin near the top of the medial part of thigh, it is known as an inguinal hernia. Inguinal hernia accounts for 75% of all abdominal wall hernia with a lifetime risk of 27% in men and 3% in women [2]. It's frequently linked to ageing and consistent abdominal strain. The hernia repair reaches a peak percentage of 4.2% for males aged 75 to 80 year, fall of after that. This pattern is similar for female except that the peak percentage of women aged 75 to 80 only reach about 0.4% [3,4]. Femoral hernias can also develop near the top of the medial thigh when fatty tissue or a portion of the colon protrudes into the groin. When fatty tissue or a portion of your colon protrudes through the abdomen close to the umbilicus, it is called as an umbilical hernia. Hiatus hernias happen when a portion of stomach pushes through a hole in the diaphragm, the thin muscle sheet that divides the chest from the abdomen. Some other types are also known. Epigastric hernias are instances of fatty tissue poking through the abdomen between the umbilicus and the lower portion of the breastbone. Incisional hernias are instances of tissue poking through surgical wounds that have not fully healed. Spigelian hernias occur when a portion of the colon pushes through the side of the abdominal muscle, typically below the umbilicus [5-8].

One of the most frequent surgeries performed by surgeons worldwide is the repair of inguinal hernias. Inguinal Hernia is one of the most common surgical conditions in the world which is especially more common in developing countries due to occupational exposure associated with heavy weight lifting. Its diagnosis is made mostly by clinical examination and if needed ultrasound scan can be done [9,10]. The incidence of inguinal hernia in India is around 18% with 70% male predominance mostly due to their occupation [11,12].

Inguinal hernia repair is one of the most common operations in general surgery. Despite more than 200 years of experience, the optimal surgical approach to inguinal hernia remains controversial. Surgeons and patients face many decisions when it comes to inguinal hernias: repair or no repair, mesh or no mesh, what kind of mesh, open or laparoscopic, extra-peritoneal or trans-abdominal, and so forth. Inguinal hernia repairs have morbidity and recurrence rates that are not inconsequential. Hence,the search for the gold standard repair is still continued [13]. As with the introduction of any new technology, debate have been challenging the benefits of laparoscopic over open surgery [14].

Though laparoscopy has gained widespread acceptance in today's era of surgery, there is still a debate between laparoscopic and open hernia mesh repair. Several studies have shown the benefits of laparoscopic hernioplasty such as lesser postoperative pain and morbidity, wound complications, early resumption of activity and work. But it had some limitations such as longer operative time, harder learning curve and higher recurrence rate and complications [13-16]. Moreover, laparoscopic hernioplasty can be accomplished in two ways i.e. trans-abdominal preperitoneal repair (TAPP) and totally extraperitoneal repair (TEP) [17]. TEP, like Lichtenstein's open mesh repair, does not need invasion of the peritoneal cavity. Technically it eliminates the hazards of intra operational injuries.

The current study was conducted to compare the treatment groups undergoing open (Lichtenstein) and laparoscopic repair (TEP) of hernia with respect to operative time, postoperative pain, complications, duration of hospital stay, early recurrence rate and chronic pain assessment, also to decide regarding superiority between these two methods of surgery.

Materials and Methods

Materials:

Study site: Department of General Surgery, DR KNSMIMS, GADIA, BARABANKI,UP, INDIA.

Study Design: Comparative Prospective study

Study groups: Two Groups . Gr.B= Open (Lichtenstein Method); Gr.A= Laparoscopic (TEP method).

Study Period: June 2024 to May 2025, after obtaining Institutional Ethical Committee approval and written informed consent from patients.

Sample size: 100, Male. Aged 18 to 70 years. 60 for gr.B and 40 for gr.A .

Study Subjects: A total of 100 healthy patients presented with unilateral or bilateral inguinal hernia and who underwent uncomplicated inguinal hernia repair either open (Lichtenstein Method) or laparoscopic (TEP) method were enrolled.

Inclusion Criteria:
All unilateral, bilateral and direct and indirect inguinal hernia were included in the study.

Exclusion Criteria:
Patients with complicated inguinal hernia & recurrent inguinal hernia, coagulopathy, severe cardio-pulmonary disease, deranged renal function and patients not willing for surgery were excluded from the study.

Methods:
Patients were investigated on an OPD basis. The demographic details, site of hernia namely right, left or bilateral and type of hernia was noted. Through clinical examination and laboratory investigations were done. Preoperative fitness was taken. Patients were admitted in the surgical wards one day prior to the surgery. Perioperative antibiotic inj ceftriaxone (1 gm) single dose was given. Out of 100 patients, 40 underwent laparoscopic repair (TEP group=A) and 60 underwent open repair (Lichtenstein group= B). All patients of the group A were administered spinal anesthesia while all patients in the study group B were given general anesthesia. Patients were operated in surgical operation theaters by the consultant. In all patients per urethral catheter was placed in a perioperative period and it was removed before shifting the patient back to the ward. Postoperative urinary retention and need of recatheterization was noted. Tablet diclofenac 50 mg 12 hourly was used as an analgesic in the postoperative period. Pain was recorded on a visual analogue scale. Additional doses of analgesic were given as required and noted. No antibiotic was prescribed postoperatively. All operated patients were assessed for intraoperative complications, duration of surgery, postoperative complication and duration of hospital stay. Also patients were assessed for post-operative pain on postoperative day 1st, 2nd and 7th. The maximum score for a given patient was taken into account. Discharge was given as the patient had no gross complication needing hospitalization and minimum pain managed on tablet diclofenac. After discharge patients were followed up after 7 days for suture removal then after 2 weeks, 1 month, 3 months and after 6 months for the assessment of postoperative pain, complications like seroma, wound infection, wound gape, etc and recurrence rate.
Statistical Analysis: Continuous variables (demographic, operative time, blood loss, pain on VAS, hospital stay) were presented as Mean ± SD. Categorical variables were expressed in frequency and percentages. Continuous variables were compared between 2 study groups performing independent t-test for normalized data and for non normalized data, Mann-Whitney test. Categorical variables were compared between 2 study groups by performing chi-square tests. For small numbers, Fisher exact test was used wherever applicable. $p<0.05$ was considered as statistical significance. Statistical software SPSS version 26.1 was used for statistical analysis.

Results: A total of 100 patients were enrolled in the study, of whom 97 were male (97%) and 3 were female (3%). The mean age in the TEP group was 49.15± 8.77 (18 –70) years and in the Lichtenstein Open group it was 48.63±9.16(18 – 70) years, (p=0.583) which was statistically not significant (table-1). Hence both the groups were comparable according to age. In this study the mean operative time in laparoscopic group (TEP-A) was 95.21±25.22 minutes and in open group (Lichtenstein-B) was 70.87±26.42 minutes ($p<0.001$), hence there was statistically significant difference in the operative time of both the groups (table-3) .

Table 1: Comparison of mean age of the patients in two groups.

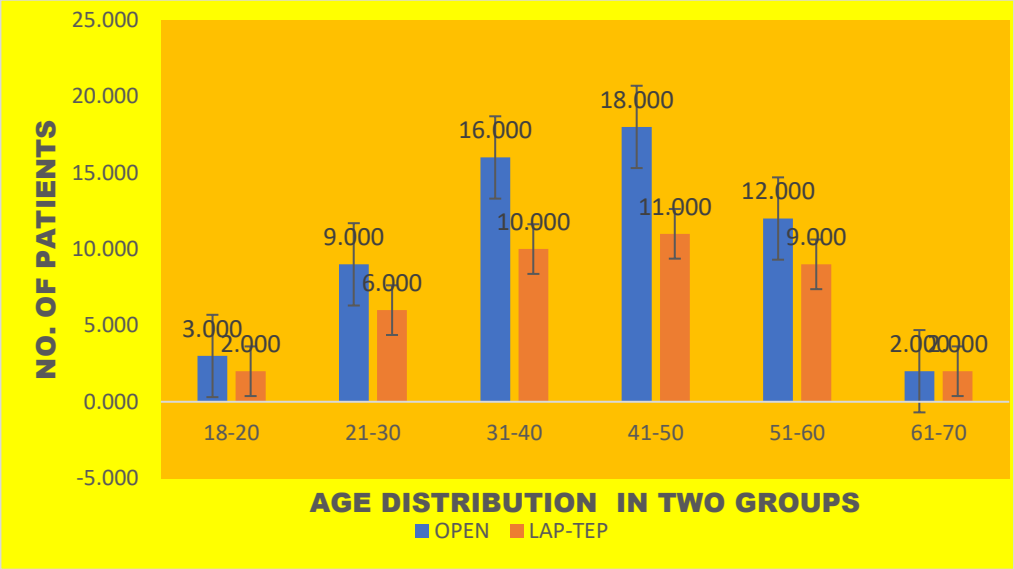
Type	TEP-LAP	LIC-OPEN	P value
Mean age of patients	**49.15± 8.77**	**48.63±9.16**	**p=0.583/NS**

***p <0.05, considered statistically significant, NS= not significant**
The detail demographic (age & Sex) profile of patients was shown in Table 2 and Figure-1. In both the groups, the left side and indirect type of hernia was found to be more common. Out of 100 cases 20 had both direct and indirect components.

Table-2: Demographic age and sex distribution of patients in two groups

Demographic data		TEP (Laparoscopic) (n=40)	LIC-Open Hernia Repair (n=60)
Age group in year	18-20	2 (5%)	3 (5%)
	21 - 30	6 (15%)	9 (15%)
	31 – 40	10 (25%)	16 (26.66%)
	41 – 50	11 (27.5%)	18 (30%)
	51 – 60	9 (22.5%)	12 (20%)
	61-70	2 (5%)	2 (3.33%)
Sex	Male	39 (97.5 %)	58 (96.66%)
	Female	1(2.5 %)	2(3.33 %)

Figure-1:Demographic age distribution of patients in two groups



The operative time for laparoscopic TEP hernioplasty was more than open Lichtenstein's repair while intraoperative blood loss, post operative pain and hospital stay (days) was significantly more in open inguinal hernia repair group as shown in Table- 3.

Table- 3. Comparison of mean of different study parameters between 2 groups

Parameters	TEP (Laparoscopic)	LIC-Open Repair	p-value
Operative time (min)	**95.21±25.22**	**70.87±26.42**	<0.0001
Blood loss	13.2±5.11	22.7±6.84	<0.0001
Pain on VAS	4.26±1.64	5.48±2.77	0.0102
Hospital stay (days)	**2.10±0.40**	**3.3±0.70**	<0.0001

In this study post-operative pain was observed statistically significant in laparoscopic group (TEP) as compared to open group (LIC) at 6 hours, 24 hour post operatively (Table 4).

Table-4: Visual analogue scale at different follow up period in two groups.

Group		At 6 Hours	At 24 Hours	At 1 Week
Lap-TEP	N	40	40	40
	Mean	5.85	2.79	0.36
	SD	1.118	1.123	0.541
Open-LIC	N	60	60	60
	Mean	6.23	5.41	0.98
	SD	1.225	1.305	0.596
Total	**N**	**100**	**100**	**100**
	Mean	**6.65**	**3.82**	**0.66**
	SD	**1.821**	**1.636**	**0.579**
P value		<0.001	<0.001	<0.001

Table-5: Distribution of the cases according to post-operative complications.

Complication	Lap.		Open		Grand Total		P value
	N	%	N	%	N	%	
Wound infection	0	0	0	0	0	0	NA
Hematoma	0	0	0	0	0	0	NA
Urine retention	14	35	23	38.33	37	37	0.975
Hematuria	0	0	0	0	0	0	NA
Seroma	1	2.5	2	3.33	3	3	0.584
Incisional hernia	0	0	0	0	0	0	NA
Wound leakage	0	0	0	0	0	0	NA
Pulmonary embolism	0	0	0	0	0	0	

Postoperative complication rate was 33.54% in the group A and 40.17% in group B. However subcutaneous emphysema was exclusively seen in TEP hernioplasty which was secondary to CO2 insufflation and not seen in the open repair. The other complications were depicted in table-5. Table-6 shown that blood loss; pain on VAS and hospital stay was significantly higher in open inguinal hernia repair than TEP repair in both unilateral as well as bilateral hernia repair whereas, operative time was significantly higher in bilateral open inguinal hernia repair than bilateral laparoscopic TEP inguinal hernia repair.

Table-6: Unilateral and BIlateral hernia parameters among the study groups

Parameter	Laterality	TEP(laparoscopic)	Open Repair	p-value
Operative time	Unilateral	93.50 ± 6.49	68.95 ± 11.06	<0.452
	Bilateral	110.66± 4.47	71.00 ± 10.45	0.0040
Blood loss	Unilateral	12.28 ± 4.22	21.94 ± 5.47	<0.0001
	Bilateral	20 ± 7.07	53.33 ± 5.77	0.0005
Pain on VAS	Unilateral	4.8 ± 0.71	5.08 ± 0.70	0.0189
	Bilateral	5.4 ± 0.54	7 ± 0	0.0027
Hospital stay	Unilateral	2.11±0.68	3.51 ± 1.28	<0.0001
	Bilateral	2.8 ± 0.45	6.0 ± 1.73	0.0062
Complications	Unilateral	19	21	0.919
	Bilateral	4	3	0.408
Recurrence	Unilateral	1	0	0.309
	Bilateral	0	0	--

Chronic pain at 6 months was significantly higher in Laparoscopic hernia repair group (6; 15%) than Open inguinal Hernia (3; 5%) (P=0.001). Out of 40 subjects, 1 from the laparoscopic group had recurrence. It was not statistically significant. (P = 1.000).

Table-7: Site of hernia among the study groups.

Laterality	OPEN-LIC	TEP-LAP	Total
Right	33(55%)	21(52.5%)	54 (54%)
Left	16(26.66%)	7(17.5%)	23 (23%)
Bilateral	11(18.33%)	12(30%)	23 (23%)
Total	60(100%)	40(100%)	100 (100%)

The distribution of hernias based on side was compared between the groups. The number of bilateral hernias was found to be more in TEP group but this difference was not statistically significant (p =0.103) as given in Table-7.

Table-8: Types of hernia among the study groups.

Types	OPEN-LIC	TEP-LAP	Total
Direct	12(20%)	10 (25%)	22 (22%)
Indirect	38 (63.33%)	26(65%)	64 (64%)
Direct + Indirect	10 (16%)	4 (10%)	14 (14%)
Total	60 (100%)	40 (100%)	100 (100%)

Table-8 described the type of hernia in both the groups and revealed that in either group percentage of indirect hernias was more. The difference was not statistically significant (p value =0.374) and hence the two groups were equally well matched for type of hernia

Table-9: Mean operative time based on type and site of hernia.

Mean operative time (in min)	OPEN-LIC	TEP-LAP
Unilateral (D/I)	68.95	93.50
Direct	72.66	98.66
Indirect	80.33	105.30
Bilateral	71.00	110.66
Mean OP time	**70.87±26.42**	**95.21±25.22**

On comparing the unilateral or bilateral variety, the time for TEP-LAP was shown to be significantly higher than the OPEN-LIC group (p value =0.001). On comparing the direct and indirect variety the time for each shown to be higher in TEP than OPEN group. In OPEN or TEP also the time taken to complete unilateral direct hernia was shown to be less than that of unilateral indirect and bilateral as given in Table-9.

Figure-3.Inguinalherniarepair

a) Lichtenstein hernioplasty **b) TEP hernioplasty**

The mean time taken by patients to execute their daily activities was 4.56±2.51 in TEP group as compared to OPEN group 5.76±1.26 days and the difference was statistically significant. The mean time to return to work also was significantly lower in the TEP group (15.33±8.37 vs. 31.9±14.55 in OPEN group). Thus patients in TEP group returned to their work early as shown in Table 10.

Table-10: Comparison of resumption of daily activities and work between two groups.

Grades	OPEN-LIC	TEP-LAP	P value
Resumption of daily activities	5.76±1.26	4.56±2.51	0.03
Resumption of work	**31.9±14.55**	**15.33±8.37**	0.005

Discussion:

In the present study, the mean age of patients was comparable and found no significant difference in both the groups; this was similar to earlier studies [18-21]. The male preponderance (97%) was also seen as reported in previous researches [8, 9]. The left sided inguinal hernia was the most common

which was in contrast with the previous studies [22, 23]. Out of 100 patients, 60 in the open hernioplasty group and 40 patients in the laparoscopic hernia repair group (TEP) whereas the follow-up period was 6 months. This patient distribution and follow up period was significantly less compared to study conducted previously [24]. The overall mean operative time was less in open repair than in laparoscopic repair. This was also in accordance with any laparoscopic surgeries, which were time consuming, but for few surgeries the operative time did not vary much whether the repair was for unilateral or bilateral hernia in laparoscopic repair. On the contrary the operative time for bilateral open hernia repair was definitely more than that for unilateral repair. The similar results were also reported where laparoscopic mesh repair took longer than Lichtenstein's open mesh repair [14,25-28]. No patient was converted from laparoscopic repair to open repair due to technical difficulties or peritoneal tears which was well correlated with other studies[13, 30-31]. No other serious intraoperative complications like visceral and vascular injury were observed in present study as reported by other studies [17, 21]. Postoperative complications in the TEP group was having urinary retention (35%) . Thus, a total of 15 of 40 patients had complications, 37.5%. While in open inguinal hernia repair group, urinary retention was having 38.33% So, of the total 25 of 60 patients had complications 41.66%. However, the laparoscopic repair had fewer postoperative complications as compared to open inguinal hernia repair which was comparable with the previous studies [9,11,12,32-34]. In contrast to this a few studies shown higher complication rates in laparoscopic groups [18, 35-37].

Post-operative pain for laparoscopic hernia was lower than that of open mesh repair by visual analogue scale assessment on 24 hr and was statistically significant which was in accordance with the previous studies [16, 19, 38]. In patients who underwent open surgery, pain score was higher for bilateral hernias than for unilateral hernias. For laparoscopic hernia, there was no significant difference. Recovery was faster with laparoscopic repair with a mean postoperative hospital stay of 2.10±0.40 days and compared to 3.3±0.70 days for open mesh repair, this result was similar to the previous studies [19,39].

The incidence of chronic pain after hernioplasty varies widely. It lies between 0 and 75% after open mesh and 0 and 29% after laparoscopic repair [20, 21]. The frequency of pain that affects daily activities was reported to be in the range of 5- 6% [22, 40]. Several authors report mesh repair to result in less chronic pain than non-mesh, and laparoscopic less than open mesh repair [23, 24]. Other studies have reported higher rates of chronic pain among patients who have had open operation [25, 26]. In the present study, the incidence of chronic pain at 6 months was 15 % in the TEP repair group and 5 % in the open inguinal hernia repair group which was statistically significant. These results were in line with those of previous studies [23,28, 41] .

Lichtenstein et al recommended preserving the nerves in the inguinal canal to minimize the incidence of chronic groin pain. In one study dividing the inguinal nerves did not reduce the incidence of chronic groin pain [27]. The typical postoperative pain occurs immediately after surgery, is easily managed with analgesics, and subsides as the wound heals. Chronic neuralgia is an often incapacitating pain with hyperesthesia, paresthesia and dysesthesia [, 11, 24, 40-42]. Recurrence rate varies between 0.2% and 15% and it depends on the technique applied; only a better technique mainly concentrating on strengthening of the posterior wall can reduce the recurrence rate less than 2% [28]. Laparoscopic surgery has shown recurrence rates as less as 0.25% to 2% [29]. In the current study, a total of 1 recurrence was observed in the TEP repair group at the end of 6 months, this finding correlated with the other studies [15, 19]. Cost factor was not studied as the study was conducted in a private run hospital, where all the facilities including mesh and instruments were not available free of cost like Government hospital. There is certainly a reason for continuing to use the laparoscopic technique for hernia repair. The major advantage of laparoscopic approach is the ability to detect and repair a contralateral defect at the same operation with only moderate increase in operating time. It is clear that the technique already offers advantages in some indications and these should be expanded and the technique should be offered on a wider basis.

Conclusion:

Laparoscopic TEP hernioplasty offers a significant advantage over open Lichtenstein hernioplasty such as early recovery, reduced hospital stay, lesser analgesic dose requirement, early resumption of normal activity and better quality of life in consideration with bodily pain. For bilateral hernia laparoscopic repair was more preferable as compared to open repair, which resulted in reduced operative period, as same port placement may be utilized for both side hernia repairs. In terms of short term results laparoscopic surgery is better than the open mesh repairs but the long term results of laparoscopic and open mesh repairs are still awaited, for that further multi-centre studies with large samples are suggested for interested researchers.

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