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Laparoscopic Versus Open Surgical Outcomes Repair For Inguinal Hernia- A Combined Prospective And Retrospective Cohort Study

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Introduction: Inguinal hernias are common and have become a common surgical problem. In recent decades, the nature of their treatment has changed and new research is constantly being conducted in this field. To find out the assessment of the laparoscopic versus open surgical outcomes repair for inguinal hernia.

Methods: A combined Prospective and retrospective cohort study was carried out from February 2023 to March 2024 in the Department of General Surgery BSMMU. The sample size was two hundred for each arm; patients aged 18 and above without factors predisposing to recurrence were included in the study. Several secondary outcomes such as hematoma, persistent pain and return to regular activity were also assessed.

Results: Among the 100 individuals analyzed, 75 (75%) were male patients, with the majority of them falling between the ages of 41 and 55. In contrast to the open group of patients, the laparoscopic group experienced a significant increase in operative time with a highly significant statistical difference ($p<0.0001$), and the laparoscopic group experienced a significant decrease in post-operative pain score with an insignificant p-value. A significant statistical difference ($p<0.005$) was estimated among the laparoscopic and open groups of patients in terms of postoperative hospitalization. Returning to normal activities was significantly different for laparoscopic patients relative to the open group (p-value<0.001). With a high level of significance of $p<0.001$, laparoscopic hernia repair required less time to recover before returning to normal activities than open hernia repair ($p<0.005$). However, we observed that 90% of the recurrences in the laparoscopic arm were at the hands of surgeons with less than five years of experience in laparoscopic surgery which was statistically highly significant (P value = 0.00). In the open arm, however, the surgeons' experience did not alter the outcome significantly (P value = 0.341).

Conclusion: Thus, laparoscopic repair for inguinal hernia is a safe alternative in the hands of experienced laparoscopic surgeons.

Keywords: Lichenstein Herniolpasty, Transabdominal Pre-Peritoneal Repair (TAPP)

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Introduction

Inguinal hernias are common and have become a common surgical problem. In recent decades, the nature of their treatment has changed and new research is constantly being conducted in this field [1]. There are two types of inguinal hernias: femoral hernias and direct and indirect inguinal hernias [2]. An open internal inguinal ring allows the peritoneum (with or without peritoneal contents) to protrude laterally into the inferior epigastric vein, resulting in the most common type of inguinal hernia called indirect hernia. Hernioplasty is a common surgical procedure that has historically been performed using open techniques. However, in the past two decades, this has changed with the introduction of minimally invasive surgery [3]. Numerous clinical studies have examined the potential advantages and disadvantages of open and laparoscopic treatment, but no treatment is clearly more beneficial than the other. In the study by Neumayer, Champault, and MRC, the recurrence rate was higher in the laparoscopic group, while the study by Chung, Grant, and McComrack showed no significant difference [4], [5].

Only the Liem study showed a higher recurrence rate in the open group [6]. The advantages of the open technique include a lower recurrence rate, easier introduction, and shorter operative time. In addition, there is a lower risk of serious complications and a shorter learning curve, and the surgery can be performed under local anesthesia. The laparoscopic approach has the advantages of less postoperative pain, faster recovery, and shorter hospital stay. Furthermore, complications such as hematoma, seroma, and persistent pain occur less frequently. However, serious complications such as nerve damage, severe vascular injury, intestinal obstruction, and bladder injury have also been reported. The laparoscopic technique requires a steep learning curve, is difficult to master, and is relatively expensive. Considering the large number of hernia repair procedures, there is an urgent need to resolve this confusion about which procedure is most appropriate. Therefore, this study attempts to clearly answer this question and reach a clear conclusion. Both groups of subjects were followed closely and the outcomes were compared. Unlike most studies on this topic, this one focused on the experience of the operating surgeon and its impact on the outcome.

Methods and Materials

A combined prospective and retrospective Cohort study was conducted from February 2023 to March 2024 in Department of General Surgery BSMMU, Dhaka, Bangladesh. The sample size was one hundred for each study arm with a power of eighty per cent. Half subjects in each arm were studied retrospectively and other half prospectively. Patients who refused surgery were younger than 12 years old, had concomitant conditions (type 2 diabetes mellitus, hypertension, coronary artery disease, or tuberculosis), or had complete and recurrent hernias were excluded. Following a thorough analysis and investigation, data from every inguinal hernia diagnosis that met inclusion and exclusion criteria were considered. Written consent to participate in study was obtained. The outcomes were assessed postoperatively at 2 weeks, 3 months and 1 year intervals. The primary outcome assessed was recurrence. Several secondary outcomes such as incidence of seroma, hematoma, wound infection, mesh infection, length of hospital stay, persistent pain and time to return to regular activity were also measured. The surgeons“ experience was taken into account by dividing them into those with experience more than and less than five years of experience in laparoscopic surgery.

Data were entered into an Excel spreadsheet (Microsoft Corporation, Redmond, Washington, United States), and descriptive and inferential statistical analyses were performed using SPSS Statistics for Windows, Version 21 (SPSS Inc., Chicago, United States). Both quantitative data (mean and standard deviation) and qualitative data (proportions and percentages) were presented accordingly. The Chi-square test was used to analyze proportional difference. The unpaired student T-test for parametric data was used to analyze how means of groups differed from one another. Tests were given a 95% ($p<0.05$) level of significance.

Results

The 100 patients analyzed included 75 (75%) male patients, most of whom were 41-55 years old. In this sample, average age was 47.8 ±14.3 years (Table 1). The duration of open surgery for bilateral direct inguinal hernia repairs was recorded as 58.75 ± 6.8 minutes, whereas laparoscopic surgery took 107.42 ± 8.9 minutes.

In contrast, the duration of indirect surgery for the same was found to be 61.21 ± 3.87 minutes. As a result, compared to bilateral open mesh surgery, laparoscopic hernia repair in situations with bilateral hernias took substantially longer to complete. The techniques of mesh placement compared were the primary open onlay repair (Lichenstein Tension free Hernioplasty) and Laparoscopic approaches i.e. totally extraperitoneal repair and Transabdominal Preperitoneal repair. The patients underwent surgeries in their respective units and followed up post operatively.

Table 1: The demographic characteristics of the recruited patients

Age in groups (years)	Male n (%)	Female n (%)
11-25	4 (5.3)	5 (20)
26-40	17 (22.6)	15 (60)
41-55	30 (40.0)	5 (20)
56-70	19 (25.3)	0
71-85	5 (6.8)	0

In addition, the mean durations for repairs in the case of unilateral direct hernias were found to be 47.14 ±7.2minutes and 84.24 ± 13.8 minutes for open hernia repair and laparoscopic hernia repair, respectively. The average time of laparoscopic repairs for unilateral indirect hernias was recorded as 89.94 ± 9.53 minutes, while open hernia repairs required approximately 52.51 ± 5.61 minutes. As a result, whether the hernia was indirect or direct, unilateral hernias required a significantly greater duration of time to repair laparoscopically, with a p-value<0.001 showing high statistical significance (Table 2).

Table 2: Inguinal hernia classifications with associated operative times for open and laparoscopic procedures

Type of hernia	n (%)	Operation time (minutes)		p-value
		Laparoscopic surgery (mean ± SD)	Open surgery (mean±SD)	
Bilateral direct	12 (12%)	107.42 ± 8.9	58.75 ± 6.8	< 0.001**
Bilateral indirect	2 (2%)	112.5 ± 5.73	61.21 ± 3.87	
Right direct	24 (24%)	84.24 ±13.8	47.14 ± 7.21	
Left direct	8 (8%)	----	-----	
Right indirect	33(33%)	89.94 ± 9.54	52.51 ± 5.61	< 0.001**
Left indirect	21 (21%)	----	-----	

The number of seromas after one week of laparoscopic hernia repair was three, compared to nine after one week of open hernia surgery and nil after four weeks, which was not statistically significant. Laparoscopic surgery patients (8.0%) reported less post-operative discomfort at weeks one and four than those who underwent open surgery, which was shown to be statistically insignificant (Table 3). There were no wound infections reported for both surgeries.

Table 3: Post-operative complications reported during follow-up

Post-operative Complications	At week 1, n (%)		At week 4, n (%)		p-value
	Laparoscopy	Open	Laparoscopy	Open	
Pain	4 (8.0%)	17 (34.0%)	0	6 (12.0%)	0.687
Seroma formation	4 (8.0 %)	11 (22.0 %)	0	0	0.541
Wound infection	0	0	0	0	NA

The recovery times for open and laparoscopic repairs were 14.5 days and 7 days, respectively (Table 4). Laparoscopic hernia repair required less recovery time before getting back to regular activities than open hernia repair, with high levels of significance (p<0.001 and p<0.005, respectively).

Table 4: Days of hospitalization after surgery and return to normal life activities

Type of surgery undergone	Days (Mean ± SD)	
	Hospitalization	Returned to normal life activities
Laparoscopy	1.9 ± 0.29	7 ± 1.9
Open Repair	2.21 ± 0.41	14.5 ± 1.7
p-value	<0.005*	< 0.001**

The incidence of other complications such as seroma (P value = 0.025), persistent pain (P value = 0.035), and mesh infection (P value = 0.025) was significantly higher in the less experienced group of surgeons in both arms. The incidence of persistent pain was a significant finding of this study. The incidence in the laparoscopic arm was 3.5% while the open arm showed a significantly higher rate at 16.5%, (P value = 0.00).

Discussion

The techniques of mesh placement compared were the primary open onlay repair (Lichenstein Tension free Hernioplasty) and Laparoscopic approaches i.e. totally extraperitoneal repair and Transabdominal Preperitoneal repair. The patients underwent surgeries in their respective units and followed up post-operatively.

The majority of study participants were male (75%), and 40% of them were between the ages of 41 and 55. We documented 100 inguinal hernia repairs, including both open (n=50) and laparoscopic (n=50) hernia repairs. While Charles et al. [7] stated that 93.2% of all their cases were male, Gupta et al. [8] reported that inguinal hernia occurs 96% more frequently in men, demonstrating a low prevalence in females. The average age of study participants was 47.8 ±14.3 years. A total of 33 (33%) of the 100 instances had right indirect hernias, whereas bilateral (2%) were rare. In the current study, it was shown that the average operating times for open and laparoscopic hernia repairs were 47.14± 7.2 minutes and 84.24 ±13.8 minutes, respectively, for unilateral direct hernias, whereas 52.51 ± 5.61 minutes and 89.94 ± 9.54 for unilateral indirect hernias.Therefore, compared to open surgery, which was also consistent with other studies [9], the time needed to execute a laparoscopic hernia repair in cases of unilateral hernia, whether indirect or direct, was considerably longer ($p<0.001$).

The average time to repair a bilateral direct inguinal hernia using open surgery was 58.75±6.8 minutes while adopting a laparoscopic approach took 107.42± 8.9 minutes; in bilateral indirect hernias, it took 61.21± 3.87 minutes and 112.5± 5.73 minutes, respectively. Due to this, bilateral hernia laparoscopic repairs took longer than bilateral open mesh surgery. These findings are consistent with previous studies [10][11],[12], but they contrast with other studies that showed no statistically significant difference in the mean operative times between the two groups [13],[14]. The open repair (Lichtenstein technique) in our study caused more post-operative pain than the laparoscopic repair (TEP), which (p-value<0.5) may be related to the considerable dissection required for tissue repair. As a result, since it is not statistically significant, the number of days of post-operative pain experienced after Lichtenstein's repair and a laparoscopic repair are not comparable. This study was in line with that of Shah et al. [15]. This reflects the steep learning curve involved in laparoscopic surgery and validates the need for better supervision and standardizing laparoscopic training. The incidence of other complications such as seroma (P value = 0.025), persistent pain (P value = 0.035), and mesh infection (P value = 0.025) was significantly higher in less experienced group of surgeons in both arms.

The incidence of persistent pain was a significant finding of this study. The incidence in the laparoscopic arm was 3.5% while the open arm showed a significantly higher rate at 16.5%, (P value = 0.00). The incidence varies among studies, ranging between 0% and 62.9%, with 10% of patients fitting in the moderate to severe pain group [7],[15],[16],17],[18]. However, only 2%-4% of the patients are adversely affected by chronic groin pain in their everyday lives. Inguinodynia following Lichtenstein tension-free hernia repair is significant, considering the volume of the operations performed worldwide [8]. The ilioinguinal, iliohypogastric and genitofemoral nerves are commonly involved. Nerve entrapment during mesh fixation and removal of the cremasteric covering of the cord are postulated to cause damage to the nerves. Traditional teaching has always been to preserve the nerve, but recent studies have looked into the intentional severance based on the concept of "no nerve, no pain" [9]. Guidelines recommend limited dissection, staying above the iliopubic tract and not straying too far lateral to the internal ring while fixing the mesh. The technique of mesh placement therefore needs closer attention by the operating surgeon and a better understanding of the anatomy may help in reducing the incidence of this debilitating complication. Similar to findings reported by other studies, the length of hospital stay was significantly shorter in the experienced laparoscopic surgeon group by 1.3 days, P value of 0.00. Under the current study, the average hospital stays following open and laparoscopic hernia repairs are 2.21 ± 0.41 days and 1.9 ± 0.29 days, respectively. The study observed that patients who underwent laparoscopic hernioplasty had significantly shorter hospital stays compared to those who underwent open surgery ($p<0.001$). Specifically, the mean hospital stay for the laparoscopic group was 1.56 days, while for the open group, it was 1.9 days ($p=0.002$) [19]. In open hernia surgery, there were nine cases of seroma development, whereas laparoscopic hernia repair resulted in three cases ($p>0.05$). This difference in seroma occurrence could potentially be associated with the use of a larger incision and/or the presence of a larger hernial sac. In the current study, laparoscopic and open hernia repairs took 14.5 days and seven days, respectively, to allow patients to return to their regular jobs. When compared to other studies [20], laparoscopic hernia repair took considerably less time to recover than open repair ($p <0.001$).

The results of other investigations were ambiguous in comparison with this [21],[22]. The open group experienced increased immediate post-operative pain which led to slower recovery and resumption of regular activities. Hence, laparoscopic hernia repair by an experienced surgeon shortens the hospital stay significantly with faster recovery, thereby reducing the economic burden and partially compensating for the increased cost of laparoscopic surgery.

The open repair remains a good option, especially for older, high-risk patients and for the underprivileged, as it has a low rate of recurrence, easy to perform, is inexpensive and can be done under local anesthesia. However, the trend in surgery today is in favour of minimally invasive surgery and rightfully so as this study proves.

Laparoscopic repair has the advantage of less post-operative pain, decreased hospital stay, faster recovery and improved cosmesis. It may soon become the procedure of choice not only for bilateral and recurrent hernias but also for primary, unilateral hernias. As a result, the findings may be influenced by confounding variables that were not considered in the study.

The study primarily focused on short-term outcomes, including post-operative pain and return to normal activities. Long-term outcomes, such as chronic discomfort and recurrence rates, were not extensively evaluated, necessitating additional research with extended follow-up periods to draw more comprehensive conclusions. The issue of the steep learning curve for laparoscopic surgery should be addressed with better supervision and standardization of training in laparoscopy. Strict adherence to the protocols of laparoscopic surgery will go a long way in reducing intraoperative complications and improving post-operative outcomes.

Conclusion

Open repair has a definite advantage over laparoscopic repair financially; however, the decreased hospital stay and faster recovery may reduce the economic burden of laparoscopic surgery to some extent. The operative cost may be reduced further by employing cheaper reusables and optimal use of resources. From the results of this study, we find the outcomes of laparoscopic inguinal hernia are comparable with open repair.

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References

1. Neumayer L, Giobbie-Hurder A, Jonasson O, Fitzgibbons R Jr, Dunlop D, Gibbs J, Reda D, Henderson W; Veterans Affairs Cooperative Studies Program 456 Investigators. Open mesh versus laparoscopic mesh repair of inguinal hernia. N Engl J Med. 2004 Apr 29;350(18):1819-27. *doi: 10.1056/NEJMoa040093. Epub 2004 Apr 25. PMID: 15107485 [Crossref][PubMed][Google Scholar]*

2. Champault GG, Rizk N, Catheline JM, Turner R, Boutelier P. Inguinal hernia repair: totally preperitoneal laparoscopic approach versus Stoppa operation: randomized trial of 100 cases. Surg Laparosc Endosc. 1997 Dec;7 (6):445-50. *PubMed PMID: 9438623 [Crossref][PubMed][Google Scholar]*

3. Laparoscopic versus open repair of groin hernia: a randomised comparison. The MRC Laparoscopic Groin Hernia Trial Group. Lancet. 1999 Jul 17;354(9174):185-90. *PMID: 10421299 [Crossref] [PubMed][Google Scholar]*

4. Grant AM; EU Hernia Trialists Collaboration. Laparoscopic versus open groin hernia repair: meta-analysis of randomised trials based on individual patient data. Hernia. 2002 Mar;6(1):2-10. *doi: 10.1007/s10029-002-0050-8. PMID: 12090575 [Crossref][PubMed][Google Scholar]*

5. McCormack K, Scott NW, Go PM, Ross S, Grant AM; EU Hernia Trialists Collaboration. Laparoscopic techniques versus open techniques for inguinal hernia repair. Cochrane Database Syst Rev. 2003;2003(1):CD001785. *doi: 10.1002/14651858.CD001785. PMID: 12535413; PMCID: PMC8407507 [Crossref][PubMed][Google Scholar]*

6. Liem MS, van Steensel CJ, Boelhouwer RU, Weidema WF, Clevers GJ, Meijer WS, Vente JP, de Vries LS, van Vroonhoven TJ. The learning curve for totally extraperitoneal laparoscopic inguinal hernia repair. Am J Surg. 1996 Feb;171(2):281-5. *doi: 10.1016/S0002-9610(97)89569-4. PMID: 8619468 [Crossref][PubMed][Google Scholar]*

7. Callesen T, Bech K, Kehlet H. Prospective study of chronic pain after groin hernia repair. Br J Surg. 1999 Dec;86(12):1528-31. *doi: 10.1046/j.1365-2168.1999.01320.x. PMID: 10594500 [Crossref] [PubMed][Google Scholar]*

8. Kehlet H, Jensen TS, Woolf CJ. Persistent postsurgical pain: risk factors and prevention. Lancet. 2006 May 13;367(9522):1618-25. *doi: 10.1016/S0140-6736(06)68700-X. PMID: 16698416 [Crossref][PubMed][Google Scholar]*

9. Wantz GE. Hernioplasty controversy. J Am Coll Surg. 1998 Mar;186(3):372-3. *doi: 10.1016/s1072-7515(97)90159-9. PMID: 9510271 [Crossref] [PubMed][Google Scholar]*

10. Mui WL, Ng CS, Fung TM, Cheung FK, Wong CM, Ma TH, Bn MY, Ng EK. Prophylactic ilioinguinal neurectomy in open inguinal hernia repair: a double-blind randomized controlled trial. Ann Surg. 2006 Jul;244(1):27-33. *doi: 10.1097/01.sla.0000217691.81562.7e. PMID: 16794386; PMCID: PMC1570605 [Crossref] [PubMed][Google Scholar]*

11. Malekpour F, Mirhashemi SH, Hajinasrolah E, Salehi N, Khoshkar A, Kolahi AA. Ilioinguinal nerve excision in open mesh repair of inguinal hernia--results of a randomized clinical trial: simple solution for a difficult problem? Am J Surg. 2008 Jun;195(6):735-40. doi: 10. *1016/j.amjsurg.2007.09.037. Epub 2008 Apr 28. PMID: 18440489 [Crossref][PubMed][Google Scholar]*

12. Ravindran R, Bruce J, Debnath D, Poobalan A, King PM. A United Kingdom survey of surgical technique and handling practice of inguinal canal structures during hernia surgery. Surgery. 2006 Apr;139(4):523-6. *doi: 10.1016/j.surg.2005.09.008. PMID: 16627062 [Crossref][PubMed][Google Scholar]*

13. Picchio M, Palimento D, Attanasio U, Matarazzo PF, Bambini C, Caliendo A. Randomized controlled trial of preservation or elective division of ilioinguinal nerve on open inguinal hernia repair with polypropylene mesh. Arch Surg. 2004 Jul;139(7):755-8; discussion 759. *doi: 10.1001/archsurg.139.7.755. PMID: 15249409 [Crossref][PubMed][Google Scholar]*

14. Wright D, O'Dwyer PJ. The learning curve for laparoscopic hernia repair. Semin Laparosc Surg. 1998 Dec;5(4):227-32. *doi: 10.1177/155335069800500405. PMID: 9854130 [Crossref][PubMed][Google Scholar]*

15. Poobalan AS, Bruce J, King PM, Chambers WA, Krukowski ZH, Smith WC. Chronic pain and quality of life following open inguinal hernia repair. Br J Surg. 2001 Aug;88(8):1122-6. *doi: 10.1046/j.0007-1323.2001.01828.x. PMID: 11488800 [Crossref][PubMed][Google Scholar]*

16. Courtney CA, Duffy K, Serpell MG, O'Dwyer PJ. Outcome of patients with severe chronic pain following repair of groin hernia. Br J Surg. 2002 Oct;89(10):1310-4. *doi: 10.1046/j.1365-2168.2002.02206.x. PMID: 12296903 [Crossref] [PubMed][Google Scholar]*

17. Bay-Nielsen M, Perkins FM, Kehlet H; Danish Hernia Database. Pain and functional impairment 1 year after inguinal herniorrhaphy: a nationwide questionnaire study. Ann Surg. 2001 Jan;233(1):1-7. *doi: 10.1097/00000658-200101000-00001. PMID: 11141218; PMCID: PMC1421158 [Crossref] [PubMed][Google Scholar]*

18. Cunningham J, Temple WJ, Mitchell P, Nixon JA, Preshaw RM, Hagen NA. Cooperative hernia study. Pain in the postrepair patient. Ann Surg. *1996 Nov;224(5):598-602. doi: 10.1097/00000658-199611000-00003. PMID: 8916874; PMCID: PMC1235436 [Crossref][PubMed][Google Scholar]*

19. Choudhary S, Soni H, Mehta JM, Kalia S. A prospective comparative study of outcome between open lichtenstein versus laparoscopic repair of inguinal hernia. Int J Res Med Sci. 2021;9:1417–1421. *[Crossref][PubMed][Google Scholar]*

20. Liem MS, van Duyn EB, van der Graaf Y, van Vroonhoven TJ; Coala Trial Group. Recurrences after conventional anterior and laparoscopic inguinal hernia repair: a randomized comparison. Ann Surg. 2003 Jan;237(1):136-41. *doi: 10.1097/00000658-200301000-00019. PMID: 12496541; PMCID: PMC1513978 [Crossref][PubMed][Google Scholar]*

21. Ortenzi M, Williams S, Solanki N, Guerrieri M, Haji A. Laparoscopic repair of inguinal hernia: retrospective comparison of TEP and TAPP procedures in a tertiary referral center. Minerva Chir. 2020 Oct;75(5):279-285. *doi: 10.23736/S0026-4733.20.08518-1. PMID: 33210522 [Crossref] [PubMed][Google Scholar]*

22. Hamza Y, Gabr E, Hammadi H, Khalil R. Four-arm randomized trial comparing laparoscopic and open hernia repairs. Int J Surg. 2010;8(1):25-8. *doi: 10.1016/j.ijsu.2009.09.010. Epub 2009 Sep 29. PMID: 19796714 [Crossref][PubMed][Google Scholar]*