Comparison of Open Mesh Repair and Laparoscopic (TEP/TAPP) Techniques in Primary Unilateral Inguinal Hernia Repair

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ABSTRACT

Objective: To evaluate the safety and effectiveness of treatment for inguinal hernia and to compare the short- and long-term outcomes of open mesh repair (OMR) and laparoscopic total extraperitoneal (TEP) and transabdominal preperitoneal (TAPP) techniques in primary unilateral inguinal hernia.

Study Design: Retrospective study.

Place and Duration of the Study: Department of General Surgery, University of Health Sciences, Training and Research Hospital, from January 2018 to September 2023.

Methodology: The authors analysed patients aged 18 years and older who were diagnosed with primary unilateral inguinal hernia and underwent surgery. Patients were divided into three groups according to the surgical techniques used: OMR, TEP, or TAPP. Demographic data, intraoperative and postoperative outcomes, postoperative visual analogue scale (VAS) scores, chronic groin pain scores, and recurrence rates were compared across the groups. The Chi-square test and the Kruskal–Wallis test were used to compare the groups, followed by Dunn's multiple comparison test.

Results: This study involved 1466 patients. Of these, 943 underwent OMR, 322 underwent TEP, and 201 underwent TAPP. The mean follow-up period was 18.80 ± 7.86 months. The OMR group required a shorter operative time than other groups, whereas intraoperative complications did not differ significantly among the groups. The length of hospital stays and time to return to work were significantly longer in the OMR group. Postoperative complications did not differ among the groups. The VAS scores were higher in the OMR group on postoperative day 1 and at 1 year. Similarly, chronic pain scores for the first year were higher in the OMR group. Meanwhile, recurrence was significantly less frequent following the OMR technique.

Conclusion: Laparoscopic techniques such as TEP and TAPP are as safe and effective as OMR for the treatment of primary unilateral inguinal hernia, with similar intraoperative and postoperative complication rates. They also offer additional advantages, including earlier discharge, quicker return to work, and improved results in terms of early postoperative pain and long-term chronic pain when compared with the OMR technique.

Key Words: *Inguinal hernia, Open mesh repair, Total extraperitoneal, Transabdominal preperitoneal, Recurrence, Chronic pain.*

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INTRODUCTION

Inguinal hernia repair is one of the most commonly performed surgeries, and operative techniques and its optimal management are constantly evolving.[1-4] Lyu *et al*.[1] emphasised that there is no difference among the transabdominal preperitoneal (TAPP), total extraperitoneal (TEP), and Lichtenstein procedures in terms of safety and effectiveness for treating inguinal hernias.

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Similarly, Wu *et al*.[2] concluded that TAPP repair did not result in higher morbidity or recurrence rates and is an equivalent approach to open mesh repair (OMR). In contrast, Raajeshwaren *et al*.[3] reported that OMR is associated with lower recurrence and chronic pain rates compared to laparoscopic repairs. More recently, a meta-analysis by Patterson *et al*.[5] reported greater patient-reported satisfaction with laparoscopic technique. Although many studies have compared the OMR and laparoscopic procedures, consensus regarding which approach is better remains unexplored.[1-5]

Laparoscopic inguinal hernia repair is gaining popularity owing to its similar recurrence rates to OMR (<5%), reduced early postoperative pain, and earlier return to normal activities. However, Lyu *et al*.[1] and Raajeshwaren *et al*.[3] reported that the laparoscopic TAPP repair is associated with higher risks of infection, adhesions, and organ injury.

Some disadvantages of the laparoscopic technique have also been noted in the literature.[6-9] Lyu *et al*.[1] reported that shorter operative times are associated with the open technique. Similarly, McCormack *et al*.[10] in their review of 14 randomised controlled trials (RCTs) concluded that the laparoscopic technique is associated with serious complications and longer operative times. At the same time, the high cost of laparoscopic techniques[10] has also been reported as a disadvantage.

Although laparoscopic repair offers more advantages for bilateral and recurrent hernias, the OMR technique remains the most commonly used technique for primary unilateral repair among general surgeons. Therefore, the debate over the gold standard technique continues.[1-7]

This study aimed to evaluate the safety and effectiveness of treatment for inguinal hernias by comparing the short- and long-term outcomes of OMR and laparoscopic TEP and TAPP techniques in primary unilateral inguinal hernias.

METHODOLOGY

Patients (male and female, aged >18 years) diagnosed with primary unilateral inguinal hernia who underwent surgery between 2018 and 2023 were retrospectively analysed. Ethical approval was obtained from the Local Ethics Committee of the Training and Research Hospital. Patients who met the inclusion criteria during this period were included without the application of a sampling method, thereby ensuring that the entire eligible population was studied. Therefore, no power analysis was conducted, as the study population represented the complete cohort within the specified timeframe. Patients with femoral hernia, those undergoing emergency surgery for intestinal obstruction or incarceration/strangulation, those with a history of previous abdominal surgery, cases requiring conversion for any reason, bilateral hernia, or recurrent hernia were excluded. Data for the included patients were extracted by reviewing the hospital automation system and examining patient files over a 6-month period.

OMR was performed using the Lichtenstein method, while laparoscopic repairs were performed using either the TEP or TAPP method. In laparoscopic techniques, the mesh was fixed to the Cooper ligament medially and to the superomedial and superolateral areas with three absorbable tackers. All techniques were performed under general anaesthesia using polypropylene prosthetic meshes. All patients underwent standard postoperative treatment.

Demographic data (age, gender, and body mass index [BMI]), side of the hernia, and hernia type were recorded. Recurrence was evaluated through physical examination and ultrasonography by independent, blinded observers who were not the authors of the study.

Postoperative visual analogue scale (VAS) scores at 24 hours and one year after surgery were compared to assess postoperative pain. Chronic groin pain was measured using a four-point scale, where score of 1 indicated no complaint, 2 indicated mild pain (occasional discomfort or pain not interfering with daily activities), 3 indicated moderate pain (occasional discomfort or pain that interfering with daily activities), and 4 indicated severe pain (discomfort or pain consistently interfering with daily activities). Additionally, operative data (operative time and intraoperative complications), length of hospital stay, time to return to work, and postoperative complications (within 2-4 weeks) were compared between the techniques.

Statistical Package for the Social Sciences (SPSS) for Windows (version 22.0; SPSS Inc., Chicago, IL, USA) was used for statistical analysis. Categorical variables were presented as frequencies and percentages, and continuous variables were expressed as medians and interquartile ranges (IQRs). The normality of the variables was tested using the Shapiro–Wilk test. Non-normally distributed data were analysed using the Kruskal–Wallis test, followed by the post-hoc analysis using Dunn's multiple comparison test. The Chi-square test was used to compare the categorical variables, such as gender, hernia side, hernia type, intraoperative and postoperative complications, and recurrence. Statistical significance was set at $p < 0.05$.

RESULTS

This study included 1,466 patients, with a median follow-up period of 18 months (IQR: 8 months; Table I).

The OMR group required significantly shorter operative time than the other groups ($p < 0.001$). Intraoperative complications did not differ among the groups ($p = 0.026$, Table II).

Table I: Comparison of demographic data.

Parameters	OMR Group (n = 943)	TEP Group (n = 322)	TAPP Group (n = 201)	p-values
Age (years) (median, IQR)	51 (21)	46 (21.5)	45 (23.5)	**<0.001**$^{+}$
Gender (n, %)				
Female	99 (10.5%)	21 (6.5%)	22 (10.9%)	0.092^{-}
Male	844 (89.5%)	301 (93.5%)	179 (89.1%)	
BMI (kg/m^2)	26 (5)	26 (4)	26 (4.85)	0.154^{+}
Hernia Side (n, %)				
Right	689 (73.1%)	250 (77.6%)	148 (73.6%)	0.265^{-}
Left	254 (26.9%)	72 (22.4%)	53 (26.4%)	
Hernia type (n, %)				
Direct	306 (32.4%)	93 (28.9%)	68 (33.8%)	0.240^{-}
Indirect	516 (54.7%)	198 (61.5%)	108 (53.7%)	
Combined (direct+ indirect)	121 (12.8%)	31 (9.6%)	25 (12.4%)	
Follow-up (months) (median, IQR)	18 (8)^{a,b}	16 (7.5)^{a,c}	14 (8)^{b,c}	**0.001**$^{+}$

$^{a}p = 0.044$ OMR vs. TEP; $^{b}p = 0.002$ OMR vs. TAPP; $^{c}p = 0.762$ TEP vs. TAPP; IQR: Interquartile range; OMR: Open mesh repair; TEP: Total extraperitoneal; TAPP: Transabdominal preperitoneal. $^{+}$Kruskal-Wallis test, $^{-}$ Chi-square test.

Table II: Operative data.

Parameters	OMR Group (n = 943)	TEP Group (n = 322)	TAPP Group (n = 201)	p-values
Operative time (minutes) (median, IQR)	30 (16.25)[a,b]	40 (20)[a,c]	45 (10)[b,c]	**<0.001**[+]
Intraoperative complications (n, %)				
None	923 (97.9%)	316 (98.1%)	193 (96.0%)	
Bleeding	19 (2.0%)	3 (0.9%)	5 (2.5%)	
Bowel injury	0	0	1 (0.5%)	0.026[-]
Others	1 (0.1%)	3 (0.9%)	2 (1.0%)	

[a]p <0.001 OMR vs. TEP; [b]p <0.001 OMR vs. TAPP; [c]p = 0.843 TEP vs. TAPP; IQR: Interquartile range; OMR: Open mesh repair; TEP: Total extraperitoneal; TAPP: Transabdominal preperitoneal. [+]Kruskal-Wallis test, [-]Chi-square test.

Table III: Comparison of postoperative outcomes between the three groups.

Parameters	OMR Group (n = 943)	TEP Group (n = 322)	TAPP Group (n = 201)	p-values
Hospital stay (hours) (median, IQR)	48 (24)[a,b]	24 (24)[a,c]	24 (24)[b,c]	**<0.001**[+]
Recovery time (days) (median, IQR)	12 (13)[d,e]	8 (10)[d,f]	7 (8)[e,f]	**<0.001**[+]
Complications (n, %)				
None	824 (87.4%)	268 (83.2%)	167 (83.1%)	
Wound infection	14 (1.5%)	4 (1.2%)	1 (0.5%)	
Haematoma	17 (1.8%)	7 (2.2%)	2 (1.0%)	
Seroma	34 (4.0%)	19 (5.9%)	14 (7.0%)	
Testicular pain	17 (1.8%)	8 (2.5%)	6 (3.0%)	0.055[-]
Testicular paraesthesia	16 (1.7%)	9 (2.8%)	6 (3.0%)	
Ileus	0	0	2 (1.0%)	
Others	17 (1.8%)	7 (2.2%)	3 (1.5%)	

[a]p <0.001 OMR vs. TEP; [d]p <0.001 OMR vs. TEP; [b]p <0.001 OMR vs. TAPP; [e] p <0.001 OMR vs. TAPP; [c]p = 0.355 TEP vs. TAPP; [f]p = 0.586 TEP vs. TAPP; IQR: Interquartile range; OMR: Open mesh repair; TEP: Total extraperitoneal; TAPP: Transabdominal preperitoneal; [+]Kruskal-Wallis test; [-]Chi-square test.

Table IV: Comparison of recurrence and pain scores between the three groups.

Parameters	OMR Group (n = 943)	TEP Group (n = 322)	TAPP Group (n = 201)	p-values
Recurrence (n, %)				
None	897 (95.2%)	295 (91.6%)	185 (92.0%)	**0.029-**
Yes	45 (4.8%)	27 (8.4%)	16 (8.0%)	
VAS score (24 hours) (median, IQR)	4 (4)[a,b]	3 (3)[a,c]	3 (3)[b,c]	<0.001[+]
VAS score (one year) (median, IQR)	1 (1)[d,e]	0 (1)[d,f]	0 (1)[e,f]	<0.001[+]

[a]p = 0.015 OMR vs. TEP; [d]p <0.001 OMR vs. TEP, [b] p = 0.009 OMR vs. TAPP, [e]p <0.001 OMR vs. TAPP, [c]p >0.99TEP vs. TAPP, [f]p >0.99 TEP vs. TAPP. IQR: Interquartile range; OMR: Open mesh repair; TEP: Total extraperitoneal; TAPP: Transabdominal preperitoneal; [+]Kruskal-Wallis test; -Chi-square test.

Table V: Comparison of chronic pain score between the three groups.

Parameters	OMR Group (n = 943)	TEP Group (n = 322)	TAPP Group (n = 201)	p-values
Chronic pain score (one year) (median, IQR)	1 (0)[a,b]	1 (0)[a,c]	1 (0)[b,c]	<0.001[+]

[a]p = 0.001 OMR vs. TEP; [b]p = 0.011 OMR vs. TAP; [c]p >0.99TEP vs. TAPP. IQR: Interquartile range; OMR: Open mesh repair; TEP: Total extraperitoneal; TAPP: Transabdominal preperitoneal; +Kruskal-Wallis test.

Both the length of hospital stays and time to return to work were significantly longer in the OMR group (p <0.001 for both), whereas no significant differences were observed between the laparoscopic groups (p = 0.355 and p = 0.086, respectively). Furthermore, postoperative complications did not differ among the groups (p = 0.055, Table III).

Recurrence was significantly less frequent in the OMR group (p = 0.029). The VAS score was higher in the OMR group on postoperative day 1 (p <0.001), whereas no significant difference was observed between the laparoscopic groups (p >0.99). Furthermore, the VAS score for the first postoperative year was higher in the OMR groups (p <0.001), whereas no significant difference was observed between the laparoscopic groups (p >0.99, Table IV).

Additionally, chronic pain scores for the first postoperative year were higher in the OMR group (p <0.001), whereas no significant difference was observed between the laparoscopic groups (p >0.99, Table V).

DISCUSSION

OMR, first described by Lichtenstein in 1986,[1] is the most common surgical procedure for inguinal hernia repair. At present, many guidelines refer to the Lichtenstein technique as the standard reference method, offering advantages such as short operation time and the requirement for relatively low surgical skill. With the development of laparoscopic techniques, laparoscopic hernia repair has been increasingly used to treat inguinal hernias, with TAPP and TEP being the most common procedures.[1] Although laparoscopic repairs, introduced in the 1990s, are highly desirable, they are not considered the gold standard for primary unilateral inguinal hernia repairs, despite their superiority over OMR.

In this study, the OMR group consisted of older patients (p <0.001), likely due to the difficulty of applying laparoscopic techniques in older patients. In contrast, Pang *et al*.[8] reported better postoperative outcomes in older adults undergoing laparoscopy surgery compared with OMR surgery.

Considering the general advantages of laparoscopy, early discharge and an early return to work and normal activities are desirable outcomes after hernia surgery. Consistent with the literature,[2,3,6,7] laparoscopic techniques were associated with shorter hospital stays and quicker return-to-work time (both p <0.001) in this study. Results regarding operation times vary across studies, as laparoscopic techniques involve a learning curve, and surgeon experience differs. While some studies have reported longer operative times with laparoscopic techniques,[1,3,6,10-12] others found no significant difference.[7,8,13] In the present study, operative time was shorter in the open group (p <0.001).

Intraoperative, early postoperative, and life-threatening complications have been reported as more frequent in the laparoscopic groups;[10,11] however, the long-term compli-cation rate is similar between the OMR and laparoscopic groups.[1-3,5-9] Seromas, haematomas, and wound infections are common complications of inguinal hernia repair. McCormack *et al*.[10] reported that although the rates of wound infection and haematoma were lower with laparoscopic techniques (specifically TEP), seroma development rate was higher. However, some studies have reported that these complications are less common with laparoscopic techniques,[1,2,13] whereas others have reported no significant difference.[3,11] This study found no difference in terms of complications such as seroma, haematoma, and wound infection among the groups (p = 0.175). In contrast to previous studies,[2,5] which indicated less common testicular pain and paraesthesia with laparoscopic techniques, the present study did not detect any difference (p = 0.175). In particular, McCormack *et al*.[10] reported a higher rate of serious complications in terms of visceral (especially bladder) and vascular injuries with laparoscopic techniques.[10] Although bowel injury is a major complication of laparoscopic techniques, the authors of this study did not observe a significant difference in the intraoperative or postoperative complication rates among the groups (p = 0.058 and p = 0.175).

A meta-analysis of 58 RCTs by Patterson *et al*. revealed less pain at 24 hours and 1 week postoperatively with laparoscopic techniques compared with the OMR technique.[5] Although Neumayer *et al*.[11] reported equivalent results for laparoscopic and OMR techniques in terms of pain at 3 months postoperatively, Patterson *et al*.[5] highlighted that the laparoscopic technique was associated with less pain even at 1-year of follow-up. The general advantages of laparoscopy in reducing postoperative pain, combined with the greater trauma associated with groin dissection in the open anterior approach, suggest that laparoscopic repair techniques generally result in less short-term pain. Chronic pain following hernia repair surgery occurs in 16–53% of cases, with 2–5% of patients reporting a considerable impact on daily activities.[1] The International Association for the Study of Pain defines chronic pain following hernia repair as groin pain lasting for 3 months postoperatively. Lichtenstein repair is most associated with chronic postoperative pain, followed by TAPP, with TEP being the least likely to result in chronic pain.[1] Consistent with the literature, the VAS scores were lower in the laparoscopic groups at postoperative day 1 in this study (p <0.001). Neumayer *et al*.[11] reported equivalent chronic groin pain for the laparoscopic and OMR repairs at 3 months postoperatively. Similarly, other studies have reported a lower incidence of chronic groin pain with laparoscopic techniques.[5,8,12,14] In the present study, the chronic pain score at 1 year postoperatively was lower in patients who underwent laparoscopy (p <0.001). Notably, previous studies have reported an increase in acute and chronic postoperative pain due to mesh fixation,[15] which is reportedly associated with nerve injury or impingement during fixation. In the present study, three fixations were performed using absorbable tackers, placed strategically away from nerve regions during laparoscopic repairs, with the aim of preventing acute and chronic pain.

The recurrence rate varies from 0 to 8% for laparoscopic repair and 0 to 3.6% for OMR.[4] In the present study, the recurrence rate was lower in the OMR group. A recent systematic review of RCTs highlighted the lack of evidence for a difference in recurrence rates between laparoscopic and OMR techniques.[14] Meanwhile, some studies have reported fewer recurrences with the OMR technique.[3,11] O'Dwyer[9] reported that recurrence rates may change during the learning curve of laparoscopic procedures. According to the European Hernia Society, at least 100 laparoscopic repairs are necessary to achieve results comparable with those of OMR.[4] The high recurrence rate in the laparoscopic group in this study (p <0.001) may be attributed to the learning curve. In addition, although the number of patients in this study was sufficient, the relatively short follow-up period limited the evaluation of long-term recurrence rates. Moreover, the absence of a cost-effectiveness evaluation between these techniques represents a limitation of the study. Although the costs for laparoscopic techniques are higher,[10] this difference may be offset when considering the productivity cost due to earlier return to work.

CONCLUSION

Laparoscopic techniques such as TEP/TAPP are as safe and effective as the OMR (Lichtenstein) technique, with equivalent intraoperative and postoperative compli-cation rates. Meanwhile, the laparoscopic techniques offer advantages, including earlier discharge, quicker return to work, and improved results in terms of early postoperative pain and long-term chronic pain when compared with OMR.

ETHICAL APPROVAL:
This study was approved by the Ministry of Health and the Local Ethics Committee of Training and Research Hospital (Approval No: KAEK/2023.04.47).

COMPETING INTEREST:
The authors declared no conflict of interest.

AUTHORS' CONTRIBUTION:
AS, SY: Conception of the study design, preparation of the manuscript, drafting of the work, and discussion and literature review, analysis and interpretation of the results.
CO, CC, HT, ES: Data Collection.
All authors approved the final version of the manuscript to be published.

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