

# Laparoscopic versus Open Inguinal Hernia Repair: A Systematic Review

KHALED M.A. HOSNY, M.D.; AMR H. AFIFY, M.D. and EMAN K.Y. EL GARAN, M.Sc.

The Department of General Surgery, Faculty of Medicine, Ain Shams University

## Abstract

**Background:** Inguinal hernia repair is the most frequently performed operation in general surgery. However, the question about the most appropriate technique still confuses the community of surgeons. The standard method for inguinal hernia repair had changed little over a hundred years until the introduction of synthetic mesh. This mesh can be placed by either using an open approach or by using a minimal access laparoscopic technique.

**Aim of Work:** The purpose of this review was to compare laparoscopic techniques with open mesh technique for inguinal hernia repair.

**Material and Methods:** All published randomized and non randomized controlled trial, meta-analysis, case-control trial & NICE guidelines comparing laparoscopic inguinal hernia repair with open inguinal hernia repair were eligible for inclusion. All published trials between 1994 to 2019. Trials were included only published in English. All data collected in 2018 to 2020. Participants were adults diagnosed with inguinal hernia either males or females. The following data items were sought for all trials: Duration of operation (min), vascular injury, visceral injury, length of hospital stay (days), time to return to usual activities (days), time to return to work (days), post-operative pain, chronic persisting inguinal pain (defined as inguinal pain of any severity as near 12 months after the operation as possible provided this was at least after 3 months), hernia recurrence, cost effectiveness, learning curve, quality of life.

**Results:** Overall, recurrence rates were higher among patients whose hernias were repaired by the laparoscopic technique (3.6%) compared to open group (1.9%) ( $p < 0.001$ ). In five studies concerning the treatment of recurrent hernias, the recurrence rate varies between 0.4% and 8.3% for laparoscopic techniques and between 1% and 15.6% for the Lichtenstein procedure. However, the recurrence rate differs greatly between hospitals and individual surgeons, especially for those that perform laparoscopic procedures. For those that have passed an educational program with specific regard to laparoscopy, the recurrence rate is low. Open mesh repair is economical, easy to teach and learn without any steep learning

**Correspondence to:** Dr. Khaled M.A. Hosny,  
The Department of General Surgery, Faculty of Medicine,  
Ain Shams University

curve. Open hernia repair does not need any specialized training and results are same in both specialist and non-specialist center. Open hernia repair does not carry any risk of serious visceral or bowel injuries.

**Conclusion:** Laparoscopic hernia repair is more costly; difficult to learn with a steep learning curve, our results provide evidence that after a laparoscopic repair return to usual activity is faster and persisting pain is reduced. However, operation times are longer and there appears to be a higher rate of serious complication rate in respect of visceral and vascular injuries. The complication rate reduces as the surgeons become more experienced in this procedure comparable with that of open repair. Laparoscopic repair is associated with less post-operative morbidity and faster recovery and satisfaction as documented by less post-operative pain, earlier mobilization and discharge from the hospital, as well as early return to work.

**Key Words:** Laparoscopic – Open inguinal hernia repair.

## Introduction

A **HERNIA** is defined as a protrusion or projection (prolapse) of an organ through the wall of the cavity where it is normally contained. There are many types of hernia, mostly classified according to the physical location, with the abdominal wall being the most susceptible site. Specifically, reports show that the most frequently seen hernia is the inguinal hernia (70-75% of cases), followed by femoral (6-17%) and umbilical (3-8.5%) hernias. Hernias are also found in other sites such as the ventral or epigastric hernia, located between the chest cavity and the umbilicus [1].

Hernias can be uncomfortable and are sometimes accompanied by severe pain, which worsens during bowel movements, urination, heavy lifting, or straining. Occasionally, a hernia can become strangulated, which occurs when the protruding tissue swells and becomes incarcerated. Strangulation will interrupt blood supply and can lead to

infection, necrosis, and potentially life-threatening conditions [2,3].

Hernia formation is a multifactorial process involving endogenous factors including age, gender, anatomic variations, and inheritance and exogenous factors such as smoking, comorbidity, and surgical factors. However, these factors alone do not explain why some develop abdominal wall hernias [4].

Already in 1924, the anatomist Sir Arthur Keith proposed that surgeons should try to perceive tendons and fascia as living structures in order to understand the hernia disease properly. Research on synthesis and breakdown of connective tissue in relation to pathophysiological mechanisms of hernia formation is important to comprehend herniogenesis and to select a proper treatment strategy for the individual patient [5].

Some patients seem to be especially susceptible to hernia development [6]. Patients operated on for abdominal aortic aneurysms have a higher risk of developing an incisional hernia postoperatively as opposed to patients operated on for aortoiliac occlusive disease [7]. Patients with rare connective tissue disorders such as Marfan's syndrome and Ehlers-Danlos syndrome have an earlier onset and a higher risk of hernia development. Further, patients with direct inguinal, bilateral inguinal, or recurrent inguinal hernia are at higher risk of ventral hernia formation, suggesting a systemic predisposition to hernia formation [5].

Emerging evidence suggests that inguinal hernias represent an inherited disease; however the inheritance pattern remains to be clarified. There is increased risk of developing an inguinal hernia, if a first-degree relative has a history of inguinal hernia repair [8].

Studies on the morphology of the fascial tissue surrounding inguinal hernias found lower total collagen content in patients with inguinal hernias compared with individuals without inguinal hernia. Furthermore, the fascial collagen architecture appears altered as described histologically by an uneven distribution of collagen fibers, thinner collagen fibers, inflammation, and degeneration of muscle fibers. The collagen quality seems to be more important than the collagen quantity. In fascia from hernia patients, there is less type I collagen relative to type III collagen resulting in a decreased type I to III collagen ratio and thinner collagen fibers with less tensile strength. These alterations are also present at the mRNA level suggesting that the problem appears during collagen synthesis. A decreased type I to III collagen ratio is also present

in skin biopsies from hernia patients, suggesting that the connective tissue alterations are systemic [9,10].

The reason for the altered collagen quality and the decreased type I to III ratio remains to be clarified. It has been suggested that altered activity levels of the enzymes involved in the collagen synthesis and maturation process may play a role. Decreased activity of lysyloxidase results in decreased cross-linking of collagen fibrils, which is essential for collagen strength and stability. In addition, recent studies found systemically decreased turnover of type V collagen both in patients with inguinal hernia and in patients with incisional hernia. Type V collagen is necessary for initiation of collagen fibril formation, and decreased levels of type V collagen may thereby impair the collagen synthesis [11,12].

Overall, the collagen alterations found in patients with inguinal hernias are more pronounced in patients with direct hernias as opposed to patients with indirect hernias, suggesting that an imbalance in collagen turnover is especially important in the formation of direct hernias [13].

#### *Aim of the work:*

The purpose of this review was to compare laparoscopic techniques with open mesh technique for inguinal hernia repair.

## **Material and Methods**

### *Criteria for considering studies for this review:*

#### *Types of studies:*

All published randomized and non randomized controlled trial, meta-analysis, case-control trial & NICE guidelines comparing laparoscopic inguinal hernia repair with open inguinal hernia repair were eligible for inclusion. Trials were included only published in English.

#### *Types of participants:*

Participants were adults diagnosed with inguinal hernia either males or females.

#### *Types of interventions:*

#### *Methods of surgical repair of inguinal hernia:*

- A- Laparoscopic inguinal hernioplasty using mesh [including the Trans-Abdominal Pre-Peritoneal technique (TAPP) and the Totally Extra Peritoneal technique (TEP)].
- B- Open mesh repair using tension free hernioplasty.

*Types of outcome measures:*

The following data items were sought for all trials: Duration of operation (min), vascular injury, visceral injury, length of hospital stay (days), time to return to usual activities (days), time to return to work (days), post-operative pain, chronic persisting inguinal pain (defined as inguinal pain of any severity as near 12 months after the operation as possible provided this was at least after 3 months), hernia recurrence, cost effectiveness, learning curve, quality of life.

*Search strategy for identification of studies:*

We have been conducted electronic searches in PubMed, Google Scholar and the Cochrane Central Controlled Trials Registry to identify relevant articles. For this review, the register was searched using the terms: Inguinal hernia, laparoscopic inguinal hernia repair, Lichtenstein hernia repair, TEP and TAPP techniques for laparoscopic hernia, tention free hernioplasty". Review articles and bibliographies of each randomized controlled trial identified have been searched for additional references that may contain further randomized controlled trials.

*Methods of the review:*

*Locating and selecting studies:*

Abstracts of articles identified using the search strategy above have been viewed, and articles that appear to fulfill the inclusion criteria were retrieved in full. Data on at least one of the outcome measures must be included in the study. Each article identified was reviewed and categorized into one of the following groups:

*Inclusion criteria:*

- Published randomized and non randomized controlled trial, meta-analysis & NICE guidelines comparing laparoscopic inguinal hernia repair with open inguinal hernia repair.
- Studies with patient diagnosed as primary or recurrent inguinal hernia.

*Exclusion criteria:*

- Studies which compare laparoscopic mesh repair and open tissue repair, because there would be superiority of lap mesh repair in the form of low recurrence rate by virtue of placement of mesh.
- Studies included patients with irreducible or strangulated hernia.
- Studies which compare laparoscopic mesh repair and open mesh repair in elderly.
- Studies which compare laparoscopic repair and open repair in children.

Available literature has been analyzed with regards to: Recurrence rate, complications, operating time, cost effectiveness, post-operative pain, length of hospital stay and return to work and activity. When there was a doubt, a second reviewer assessed the article and a consensus was reached.

*Data extraction:*

Data was independently extracted by two reviewers and cross-checked.

**Results**

There were 30 eligible trials included in this review. All trials were restricted to elective inguinal hernia repair. 12 included recurrent as well as primary hernias, 5 were limited to primary hernias only, 5 included recurrent hernias only, and these details were not reported for eight studies. The comparisons in the 30 trials were: TAPP versus open in 9 trials, TEP versus open in 11 trials, mixture of laparoscopic versus open in 10 trials.

*Studies comparing open to laparoscopic repair of inguinal hernia:*

Table (1): Studies comparing operating time.

Studies	Operative time (min)			
	Open		Laparoscopic	
	No.	Mean	No.	Mean
• Murthy and Ravalia, 2018	30	43.5	20	92.25
• Bringman et al., 2003	95	45	90	50
• Andersson et al., 2003	87	59	81	81
• Pawanindra Lal et al., 2003	25	54	25	75.72
• Vidovic et al., 2007	233	58.2	112	58.6
• MRC Trial group, 1999	453	43.3	462	58.4
• Picchio et al., 1999	52	33.9	53	49.6
• G. L. Beets et al., 1999	37	56	42	79
• Wright et al., 1996	64	43.5	67	62.5
• Stoker et al., 1994	66	35	67	53.5
Total	1142	48.49±8.61	1019	66.06±14.85
Independent <i>t</i> -test				33.342
<i>p</i> -value				<0.001 (HS)

*p*-value >0.05: Non Significant (NS).  
*p*-value <0.05: Significant (S).  
*p*-value <0.01: Highly Significant (HS).  
 •: Independent *t*-test.

Table (2): Studies comparing recurrence in laparoscopic versus open mesh repair.

Studies	Recurrence				Test value	p-value
	Open		Laparoscopic			
	No.	No. (%)	No.	No. (%)		
Ramsay et al., 2019	78445	1397 (1.8%)	10145	362 (3.6%)	147.47	<0.001
Myers et al., 2010	90	2 (2.2%)	90	3 (3.3%)	0.206	0.650
McCormack K et al., 2003	3504	109 (3.1%)	3138	86 (2.7%)	0.796	0.372
Hallan et al., 2008	87	4 (4.6%)	81	3 (3.7%)	0.084	0.772
NICE, 2004	2064	35 (1.7%)	2059	49 (2.4%)	2.417	0.120
Neumayar, 2004	834	41 (4.9%)	862	87 (10.1%)	16.28	<0.001
Anderson, 2003	87	0 (0.0%)	81	2 (2.5%)	2.174	0.140
Douek M et al., 2003	120	3 (2.5%)	122	2 (1.6%)	0.221	0.638
MRC Lap Groin Hernia Trial group, 1999	349	0 (0.0%)	362	7 (1.9%)	6.816	0.009
Champault, 1997	49	1 (2%)	51	3 (5.9%)	2.862	0.091
G.L. Beets et al., 1999	52	1 (1.9%)	56	7 (12.5%)	4.398	0.036
Dedemadiet et al., 2006	32	2 (6.3%)	50	1 (2.0%)	1.000	0.317
Demetrashvili et al., 2011	28	0 (0.0%)	24	0 (0.0%)	0.000	1.000
Eklund et al., 2007	74	12 (16.2%)	73	12 (16.4%)	0.001	0.975
Kouhia et al., 2009	47	3 (6.4%)	49	0 (0.0%)	3.229	0.072
Kumar et al., 1999	25	2 (8.0%)	25	1 (4.0%)	0.355	0.551
<b>Total</b>	<b>85932</b>	<b>1612 (1.9%)</b>	<b>17268</b>	<b>625 (3.6%)</b>	<b>206.109</b>	<b>&lt;0.001</b>

p-value >0.05: Non Significant (NS).  
p-value <0.05: Significant (S).

p-value <0.01: Highly Significant (HS).  
\*: Chi-square test.

Table (3): Studies comparing complications between laparoscopic and open mesh repair of Inguinal Hernia.

Studies	Complications				Test value	p-value
	Open		Laparoscopic			
	No.	No. (%)	No.	No. (%)		
McCormack et al., 2003	5357	6 (0.1%)	4813	15 (0.3%)	4.904	0.027
Vidovic et al., 2007	233	1 (0.4%)	112	2 (1.8%)	1.615	0.204
Neumayar, 2004	994	1 (0.1%)	989	10 (1.0%)	7.450	0.006
MRC Lap Groin Hernia Trial group, 1999	453	6 (1.3%)	462	25 (5.4%)	11.671	0.001
<b>Total</b>	<b>7037</b>	<b>14 (0.2%)</b>	<b>6376</b>	<b>52 (0.8%)</b>	<b>25.975</b>	<b>&lt;0.001</b>

p-value >0.05: Non Significant (NS).  
p-value <0.05: Significant (S).

p-value <0.01: Highly Significant (HS).  
\*: Chi-square test.

Table (4): Studies comparing time to return to usual activities between laparoscopic and open mesh repair of Inguinal Hernia.

Studies	To usual activities (days)			
	Open		Laparoscopic	
	No.	Mean ± SD	No.	Mean ± SD
• Neumayar, 2004	994	5.0	989	4.0
• Bringman 2003	86	7.0	84	5.0
• MRC Lap Groin Hernia Trial group, 1999	276	14.0	314	10.0
• Lawrence et al., 1995	66	28.0	58	22.0
• Stoker et al., 1994	72	7.0	73	3.0
• G. L. Beets et al., 1999	29	29.0	33	21.0
<b>Total</b>	<b>1523</b>	<b>15.00±10.90</b>	<b>1551</b>	<b>10.83±8.61</b>
<b>Independent t-test</b>				<b>-11.781</b>
<b>p-value</b>				<b>&lt;0.001 (HS)</b>

p-value >0.05: Non Significant (NS).  
p-value <0.05: Significant (S).  
p-value <0.01: Highly Significant (HS).  
•: Independent t-test.

Table (5): Studies comparing time to return to work between laparoscopic and open mesh repair of Inguinal Hernia.

Studies	Return to work (days)			
	Open		Laparoscopic	
	No.	Mean ± SD	No.	Mean ± SD
• Pawanindra Lal et al., 2003	25	19.30±4.30	25	12.8±7.1
• Anderson, 2003	81	11.00±8.00	75	8.00±5.00
• Stoker et al., 1994	39	28.00±0.00	40	14.00±0.00
• G. L. Beets et al., 1999	16	23.00±12.4	16	13.00±8.2
<b>Total</b>	<b>161</b>	<b>20.33±7.17</b>	<b>156</b>	<b>11.95±2.69</b>
<b>Independent t-test</b>				<b>-13.693</b>
<b>p-value</b>				<b>&lt;0.001 (HS)</b>

p-value >0.05: Non Significant (NS).  
p-value <0.05: Significant (S).  
p-value <0.01: Highly Significant (HS).  
•: Independent t-test.

Table (6): Studies comparing chronic persisting inguinal pain between laparoscopic and open mesh repair of Inguinal Hernia.

Studies	Chronic persisting pain				Test value	p-value
	Open		Laparoscopic			
	No.	No. (%)	No.	No. (%)		
Myers et al., 2010	90	9 (10.0%)	90	3 (3.3%)	3.214	0.073
Hallan et al., 2008	81	11 (13.6%)	73	6 (8.2%)	1.124	0.289
M Douek et al., 2003	120	12 (10.0%)	122	2 (1.6%)	7.758	0.005
MRC Lap Groin Hernia Trial group, 1999	362	133 (36.7%)	394	113 (28.7%)	5.583	0.018
Dedemadi et al., 2006	32	2 (6.3%)	50	2 (4.0%)	0.213	0.644
Demetrashvili et al., 2011	28	12 (42.9%)	24	4 (16.7%)	4.161	0.041
Eklundet al., 2007	74	1 (1.4%)	73	1 (1.4%)	0.000	1.000
Kouhiaet al., 2009	47	13 (27.7%)	49	4 (8.2%)	6.257	0.012
<b>Total</b>	<b>834</b>	<b>193 (23.1%)</b>	<b>875</b>	<b>135 (15.4%)</b>	<b>16.379</b>	<b>&lt;0.001</b>

p-value >0.05: Non Significant (NS).

\*: Chi-square test.

p-value <0.05: Significant (S).

•: Independent t-test.

p-value <0.01: Highly Significant (HS).

Table (7): Studies comparing Cost of laparoscopic and open mesh repair of Inguinal Hernia.

Studies	Cost comparison	
	Open	Laparoscopic
Jacobs et al., 2008	117 USD	237 USD 4757 USD 314 £
Anderson, 2003	4408 USD	more pounds than open
MRC Trial group, 1999		7063 SEK
Jhoansson et al., 1999	417 SEK	746.87 USD
Wellwood et al., 1998	412.27 USD	1239 USD
Heikkine et al., 1998	782 USD	716 USD
G. L. Beets et al., 1999	566 USD	850 £
Lawrence et al., 1995	269 £	

Table (8): Studies discussing learning curve of laparoscopic and open mesh repair of Inguinal Hernia.

Studies	Learning curve	
	Open	Laparoscopic
• Merola et al., 2019	• 100 Lichtenstein procedures performed by 4 trainees from three different institutions and compared them with the same number of procedures performed by 3 senior surgeons from the same institutions. No differences about biometrical features were found between the seven groups of patients. Analysis showed that the trainees achieve the learning curve after 37-42 procedures, reaching an operative time similar to that one of the senior surgeons.	
• Neumayar et al., 2004	• The recurrence rate associated with laparoscopic repair was greater than 10 percent for the 58 urgeons who reported having performed 250 or fewer laparoscopic repairs in any category, whereas the recurrence rate was less than 5 percent for the 20 surgeons who reported having performed more than 250 laparoscopic repairs (p <0.001 for the comparison of this category to all other categories). For open repairs, there was no significant difference in the rate of recurrence between the most experienced group of surgeons (those who had performed more than 250 renairs) and surgeons with less experience.	

### Discussion

Laparoscopic inguinal hernia repair takes longer than open mesh repair (p<0.001). In technology appraisal guidance 83 by National Institute for clinical excellence, Sept. 2004, it was stated that laparoscopic surgery was associated with a statistically significant increase in operation time compared with open methods of hernia repair. Meta-analysis of 16 randomized control trials of Trans

Abdominal Pre Peritoneal (TAPP) repair demonstrated on overall increase of 13.33 minutes compared with open repair. Meta-analysis of eight randomized control trial of Trans Extra-Peritoneal (TEP) repair demonstrated an overall increase of 7.89 minutes compared with open repair [14].

Memon and colleagues reviewed the data from 29 published randomized clinical trials and concluded that patients who underwent laparoscopic

repair of inguinal hernia took longer time for surgery [15]. In a Bringman trial operating time was found to be 5 minutes shorter in open mesh repair in comparison to laparoscopic group [16].

In a non-randomized comparative study by Murthy and Ravalia, the mean operating time in laparoscopic group was 92.25 minutes while in the open repair group was 43.5 minutes, which is significantly supplementary ( $p \leq 0.05$ ) [17].

With regard to operation length, most evidence in the literature points to a shorter operation duration with open repair [18]. The 2003 Cochrane Database Systematic Review demonstrated that the duration of operation was longer in the laparoscopic groups [19]. A meta-analysis in the British Journal of Surgery described a similar increase of 15.2 min with laparoscopic inguinal hernia repair [15]. The difference in the duration of the operation can be partly attributed to operative complications, which although uncommon for both methods, were more frequent in the laparoscopic group for visceral and vascular injuries [20].

Overall, recurrence rates were higher among patients whose hernias were repaired by the laparoscopic technique (3.6%) compared to open group (1.9%) ( $p < 0.001$ ).

An ideal approach to hernia repairs should have a low recurrence rate [14]. The frequency of hernia recurrence depends on a number of factors including the type of hernia repair initially performed, the co-morbidities of the patient and the length of time from the original hernia repair [19].

The largest reviews of inguinal hernia repairs suggest no apparent difference in recurrence between laparoscopic and open mesh methods of hernia repair [20].

Kavic in his critical review, (2013), reported a separate meta-analysis published in the British Journal of Surgery in 2000 reported similar findings in that overall recurrences did not differ between the laparoscopic and open groups [19].

There is, however, some evidence in the literature demonstrating increased recurrences with laparoscopic repair. In 2004, Neumayer et al., found in a randomized, controlled study that laparoscopic repair resulted in significantly more recurrences at 2 years (10.1% vs. 4.9%) and was associated with more complications (39% vs. 33.4%) including more life-threatening complications (1.1% vs. 0.1%) [21].

In 2019a cohort study in Scotland by Ramsay and his colleagues on 88,590 patients, there were 10,145 LHR and 78,445 OHR. Recurrent operations were required in 1397 (1.8%) OHR and 362 (3.6%) [22].

There may be a component of experience involved, as surgeons who have performed a high volume of hernia operations appear to have better results. In another study published in the Lancet, all seven hernia recurrences occurred in the laparoscopic group while there were no recurrences in the open repair group (1.9% vs. 0.0%,  $p = 0.017$ ) [19].

In addition, a 2003 meta-analysis comparing laparoscopic and open repair demonstrated a trend toward more short-term recurrences with laparoscopic repair although the results were not statistically significant [15].

When treating recurrent hernias, there may be a difference. In one review, laparoscopic repair of inguinal hernias was found to have a similar recurrence to open repair (10.0% vs. 14.1%). Thus, although there is no clear consensus in the literature, there may be a marginal benefit in terms of recurrence for open versus laparoscopic surgery [19].

Recurrence rates were higher among patients whose hernias were repaired by the laparoscopic technique. There was significant interaction between the surgical approach and the type of hernia (primary or recurrent). Recurrence rates were significantly higher after laparoscopic repair of primary hernias than after open repair of primary hernias, but recurrence rates associated with the two techniques were similar for the repair of recurrent hernias [21].

In five studies concerning the treatment of recurrent hernias, the recurrence rate varies between 0.4% and 8.3% for laparoscopic techniques and between 1% and 15.6% for the Lichtenstein procedure. However, the recurrence rate differs greatly between hospitals and individual surgeons, especially for those that perform laparoscopic procedures. For those that have passed an educational program with specific regard to laparoscopy, the recurrence rate is low.

Vale et al., concluded in 2004 involving 2164 patients in 14 centers in USA measured recurrence of hernia at two years as the primary outcome. Recurrence was found to be 10.1% in the laparoscopic group and 4.1% for open group in the repair of primary inguinal hernias but rates of recurrence

were similar in two groups after repair of recurrent hernias (10% and 14.1% respectively) [23].

MRC laparoscopic hernia trial group found 1.9% recurrence rate in laparoscopic group and zero percent recurrence rates in open group at one year this was reported in the study of Jain et al., [14], this study involved 928 patients with inguinal hernias from 26 hospitals in UK and Ireland [14].

Also, in the study of Champault et al., [24] found recurrence rate of 6% in laparoscopic group versus 2% in open group in a series of 100 patients in a randomized trial.

Incidence of complications is significantly higher in laparoscopic group (0.8%) versus (0.2%) in open group ( $p < 0.001$ ). Incidence of vascular and visceral injuries was found to be higher after laparoscopic repair (0.79% after lap repair versus 0% after open repair in NICE paper). IN MRC hernia trial group, all serious complications occurred in the laparoscopic group. In Vale trial, (2004), complication rate was 39.1% in lap group including 2 deaths but 33.4% in open group [23].

In an extensive review by Cochrane group in conjunction with European Hernia trialist group [21], found serious vascular and visceral injuries more often in laparoscopic group (visceral injuries 8:2315 and vascular injuries 7:2498). A higher rate of post-operative urinary retention was found in the TEP group (6.3%) than in the open group (1.7%). This complication was successfully managed by urinary catheterization during the night.

In a randomized controlled trial by Vidovic and his colleagues in a meta-analysis by Schmidt et al., in 2005 involving 34 trials the incidence of urinary bladder injuries in laparoscopic repairs was significantly higher at 0.1% versus zero after open mesh repairs. Also, the overall incidence of vascular injury during laparoscopic repairs was 0.09% as against no reported cases during open operations [25].

Post-operative pain is another important outcome to consider when choosing between laparoscopic and open repair of inguinal hernias. Most of studies used the visual analogue scale (VAS) for pain measurement. The VAS is a straight line, usually 100mm in length, with the left end of the line representing no pain and the right end of the line representing the worst pain. Patients are asked to mark on the line where they think their pain is. The VAS is thought to be more sensitive than using categorical ratings.

Laparoscopic repair has been associated with less post-operative pain than open repair. A 2003 Cochrane Database Systematic Review demonstrated less persisting pain, and less persisting numbness in the laparoscopic groups. Similarly, another meta-analysis study from the EU Hernia Trialists Collaboration reported decreased post-operative pain with the employment of laparoscopic methods [20].

Post-operative pain was found to be less in laparoscopic hernia repair group across the board. Vale and his colleagues in their study did not find any difference in post-operative pain after 14 days [23]. Stoker et al., found less post-operative pain for the first 4 hours after open hernia repair probably due to effect of local anesthesia [14]. The proportion of patients with reported testicular pain was higher in the TEP group ( $p = .003$ ) in a study reported by Hallan and his coworkers in a randomized control trial comparing TEP with open mesh inguinal repair [26].

In a randomized controlled study by Pawanindra Lal and his colleagues found that the TEP repair was significantly less painful than the open repair at 12h and 24h:  $2.64 \pm 1.4$  and  $1.76 \pm 1.4$  versus  $3.52 \pm 1.7$  and  $2.74 \pm 1.5$ , respectively. The Visual Analog Scale (VAS) pain score at 48h and 72h in TEP group were less than in the open group ( $p = 0.06$ ). On day 7, there was no significant difference in VAS score between the two groups:  $0.36 \pm 0.75$  versus  $0.60 \pm 0.95$ . The mean analgesic intake in the TEP group was significantly less than in the open group [27].

The post-operative pain can further be reduced with the help of newer analgesic techniques like TAPP block, peri-portals infiltration of bupivacaine and advances in fixation devices like glue and self-retaining meshes [17].

There was marked heterogeneity in length of hospital stay, with greater differences in mean stay between different hospitals than there were between laparoscopic and open repairs in the same hospital. In respect of between trial group differences, the trials tended to show either no difference or a clear difference, sometimes in exact days. This suggests that the overall finding of shorter stay after laparoscopic repair reflects hospital policy rather than a true effect of the repair [20].

In Murthy study, the mean post-operative hospital stay was 2.6 days for laparoscopic hernia repair group, whereas it was 6.1 days for Open Lichtenstein's repair. Hence the mean post-operative hospital stay was significantly less in laparoscopic repair than open hernia repair with  $p < 0.0001$  which

was extremely significant. So, from this study it can be concluded that laparoscopic hernia repair is associated with less post-operative hospital stay and better comfort than open hernia repair [17].

On the other hand, post-operative pain is an important determinant of hospital stay and return to work. The mean post-operative hospital stay after TEP repair was 1.48 days (range, 1-2 days). All the patients who underwent TEP repair were fit for discharge within 24h. The mean hospital stay after open repair was 1.40 days (range, 1-2 days). There was no significant difference in hospital stay between the two groups [27].

Another variable that is used as a primary outcome in numerous studies comparing laparoscopic and open techniques is return to normal activities and work. There is a general consensus in the literature that patients who undergo laparoscopic inguinal hernia repair return to work and normal activities more rapidly than those who undergo open repair [28].

However, there was evidence of statistical heterogeneity and this is likely to be due to differences between trials in: Post-operative advice, definition of usual activity (e.g work, walking, sport), existing co-morbidity, and local cultures. Majority of patients are able to perform normal activities at one week whether after open or laparoscopic surgery. Data regarding time to return to activity are rather subjective. Time to return to daily activities was found to be one day shorter for laparoscopic group than those undergoing open repair of hernia in Vale and his colleagues study [14].

The time to the resumption of sexual activity was similar in the two groups (median time, 14 days in the laparoscopic group and 14 days in the open group). More patients in the laparoscopic group than in the open group were able to perform specific activities (e.g., climbing stairs and engaging in vigorous activities, such as shoveling or weight lifting) at two weeks [21].

Type of employment or profession, to which patient is returning will influence how long he needs to be away from work. Patient who is doing desk job in office will return to work earlier than a patient with a job that entails heavy lifting. Some patients will be getting paid sick leave, so they will have less incentive to go back to work early.

Liem et al., reported that patients who underwent laparoscopic repair resumed normal daily activity 4 days earlier (6 days vs. 10 days;  $p < 0.001$ ), returned to work 7 days earlier (14 days

vs. 21 days;  $p < 0.001$ ) and resumed athletic activities 12 days earlier (24 days vs. 36 days;  $p < 0.001$ ) than those who had open repair. Thus, individual consideration of a patient's work situation can play a role in the decision for laparoscopic or open inguinal hernia repair [19].

In the study of Pawanindra Lal and his colleagues the mean time until return to work was significantly earlier in the TEP group ( $12.8 \pm 7.1$  days) than in the open group ( $19.3 \pm 4.3$ ;  $p < 0.001$ ) [27].

According to Technology appraisal guidance Published in 2004, there were fewer cases of persistent pain at 1 year post-operation after laparoscopic repair, compared with open repair, in both TAPP and TEP studies.

A meta-analysis published in the British Journal of Surgery in 2010 used chronic pain as a primary outcome and found no significant difference between the laparoscopic and open cohorts [29]. However, these results differ from many other reports including the 2003 Cochrane Database Systematic Review, which reported less persisting pain in the laparoscopic groups [19]. Similar results were reported by Eklund et al., in 2010, a comparison of open and laparoscopic repair found that 5 years post-operatively, 1.9% of patients who had undergone laparoscopic repair continued to report moderate or severe pain compared with 3.5% of those in the open repair group [30].

Bignell and his colleagues reported a similar higher incidence in chronic groin pain in open versus laparoscopic inguinal hernia repair. However, the decrease in chronic groin pain with laparoscopic repair reported in this study did not translate into a significant improvement in the quality of life [31].

In 2004, a paper by NICE concluded that laparoscopic inguinal repairs was associated with an increased cost of between 100-400 sterling pounds per procedure. Open pre-peritoneal method was found to be most cost effective method of open repair. Hospital stay was shortest with this method of repair. Laparoscopic hernia repair in UK has additional cost of 300 pounds over open repair, because of more operating time, time in hospital and use of specialized equipments and obligatory need for general anaesthesia. The argument that the additional cost of lap hernia is offset by an earlier return of activity has been questioned [14].

Another analysis concluded that laparoscopic repair was not cost effective in terms of cost per



recurrence avoided. In a study by Jacobs which compared institutional costs in laparoscopic TEP versus open repair of inguinal hernia, procedure related cost to the hospital was found to be higher for laparoscopic repair in comparison to open repair but still laparoscopic repair was economical to hospital because of higher rate of reimbursement for laparoscopic repair by insurance companies [32].

Laparoscopic inguinal hernia repair is a more complex procedure with a steeper learning curve than open repair. It requires different skills and a familiarity with preperitoneal anatomy. Two large series concluded that 250-300 cases are required to achieve expertise. Jacobs in his study suggested that laparoscopic hernia repair should only be carried out in specialist centers [32]. All most all studies have concluded that laparoscopic hernia repair should be carried out by a surgeon who has a specialized training in performing this procedure [14].

Quality of life measured in terms of post-operative pain, quick return to normal activity physical role, general health & emotional role was found to be significantly better in TEP repair in comparison to open mesh repair in the published randomized control trial by Myers et al., [33].

In De Jonge et al., review of the literature published in 2008 this study reviews the existing literature examining chronic pain and Health-Related Quality of Life (HRQL) outcomes in hernia repair. The majority of studies used the Visual Analogue Scale (VAS) for pain measurement and the Medical Outcomes Study Short-Form 36 (SF-36) for the measurement of HRQL and concluded that the HRQL domains most often affected by pain (social functioning/mental health). The prevalence of chronic pain and discomfort following IHR vary widely between studies. This is probably a reflection of the range of methods used for measuring pain, many of which do not have established psychometric properties. And that review suggests that a proportion of patients experience chronic pain and discomfort, which has a significant impact on HRQL. However, the current instruments used in the evaluation of chronic pain after IHR are not comparable and standardization is required [34].

The SF-36 questionnaire is a standardized procedure for the assessment of health-related quality of life developed from the RAND Corporation Medical Outcomes Study (RAND Health, Santa Monica, CA, USA) which analyzes 8 domains of quality of life: Body function, satisfaction of body

and emotional roles, social function, pain, psychological status, vitality as well as individual perception of the patient's global health.

Till date no clear cut scientific data is there in published literature which reflects incidence / etiology of sexual dysfunction after groin hernia surgery. However in some of the patients it may be purely psychic or due to chronic inguinodynia they may experience some difficulty in sexual intercourse [14].

In the retrospective study included 216 patients operated for inguinal hernia in 2006 using tension free mesh repair procedures: Lichtenstein or laparoscopy (TAPP) procedure, the quality of life analysis of the operated patients, using short form questionnaire (SF-36) There were no statistically significant differences between the patients operated with Lichtenstein's procedure and the patients operated with laparoscopic procedure (TAPP) in any of eight categories analyzed with SF-36 questionnaire. The results were slightly better for laparoscopy. These patients had better physical functioning, less post-operative fatigue and loss of energy, less pain and better general health but without statistically significant differences compare to Lichtenstein's repair [35].

#### *Conclusion:*

Laparoscopic hernia repair is more costly; difficult to learn with a steep learning curve, our results provide evidence that after a laparoscopic repair return to usual activity is faster and persisting pain is reduced. However, operation times are longer and there appears to be a higher rate of serious complication rate in respect of visceral and vascular injuries. The complication rate reduces as the surgeons become more experienced in this procedure comparable with that of open repair. Laparoscopic repair is associated with less post-operative morbidity and faster recovery and satisfaction as documented by less post-operative pain, earlier mobilization and discharge from the hospital, as well as early return to work.

Open mesh repair is economical, easy to teach and learn without any steep learning curve. Open hernia repair does not need any specialized training and results are same in both specialist and non-specialist center. Open hernia repair does not carry any risk of serious visceral or bowel injuries. Open inguinal hernia repair is ideal for day-care surgery, especially under local anesthesia. The final word on management of inguinal hernia is still to be written. Our data support the concept of individu-

alizing hernia repair for the best results and cost effectiveness.

### References

- 1- WILLIAMS L.S. and HOPPER P.D.: *Understanding Medical-Surgical Nursing*, 5th ed.; F.A. Davis: Philadelphia, PA, USA, 2015; p. 7, 2015.
- 2- HENIFORD B.T.: *Hernia Handbook*, 1st ed.; Carolinas HealthCare System: Charlotte, NC, USA, 2015.
- 3- BAYLÓN K., CAMARILLO P.R., ZÚÑUIGA A.E., ELIZONDO J.A.D., GILKERSON R. and LOZANO K.: Past, Present and Future of Surgical Meshes: A Review. *Membranes*, 7: 47-69, 2017.
- 4- JANSEN P.L., MERTENS P.R., KLINGE U. and SCHUMPELICK V.: The biology of hernia formation. *Surgery*, 136 (1): 1-4, 2004.
- 5- HENRIKSEN N.A., JENSEN K.K. and JORGENSEN L.N.: The biology of hernia formation. In *Textbook of Hernia* (pp. 1-5). Springer, Cham, 2017.
- 6- ZÖLLER B., JI J., SUNDQUIST J. and SUNDQUIST K.: Shared and nonshared familial susceptibility to surgically treated inguinal hernia, femoral hernia, incisional hernia, epigastric hernia, and umbilical hernia. *Journal of the American College of Surgeons*, 217 (2): 289-99, 2013.
- 7- HENRIKSEN N.A., HELGSTRAND F., VOGT K.C., JORGENSEN L.N., BISGAARD T. and DATABASE D.H.: Risk factors for incisional hernia repair after aortic reconstructive surgery in a nationwide study. *Journal of Vascular Surgery*, 57 (6): 1524-30, 2013.
- 8- BURCHARTH J., POMMERGAARD H.C. and ROSENBERG J.: The inheritance of groin hernia: A systematic review. *Hernia*, 17 (2): 183-9, 2013.
- 9- WAGH P.V., LEVERICH A.P., SUN C.N., WHITE H.J. and READ R.C.: Direct inguinal herniation in men: A disease of collagen. *Journal of Surgical Research*, 17 (6): 425-33, 1974.
- 10- SZCZESNY W., GLOWACKA K., MARSZALEK A., GUMANSKI R., SZMYTKOWSKI J. and DABROWIECKI S.: The ultrastructure of the fascia lata in hernia patients and healthy controls. *Journal of Surgical Research*, 172 (1): e33-e7, 2012.
- 11- HENRIKSEN N.A., MORTENSEN J.H., SORENSEN L.T., BAY-JENSEN A.C., ÅGREN M.S., JORGENSEN L.N. and KARSDAL M.A.: The collagen turnover profile is altered in patients with inguinal and incisional hernia. *Surgery*, 157 (2): 312-21, 2015.
- 12- HENRIKSEN N.A., MORTENSEN J.H., LORENTZEN L., ÅGREN M.S., BAY-JENSEN A.C., JORGENSEN L.N. and KARSDAL M.A.: Abdominal wall hernias-A local manifestation of systemically impaired quality of the extracellular matrix. *Surgery*, 160 (1): 220-7, 2016.
- 13- HOPE W.W., COBB W.S., ADRALES G.L. (Eds.): *Textbook of hernia*. Springer International Publishing, 2017.
- 14- JAIN S.K., GUPTA A., KUMAR S. and KAZA R.C.M.: Laparoscopic vs. open inguinal hernia repair: A systematic review of literature. *Asian J. Med. Sci.*, 5 (3): 10-4, 2014.
- 15- MEMON M.A., COOPER N.J., MEMON B., MEMON M.I. and ABRAMS K.R.: Meta-analysis of randomized clinical trials comparing open and laparoscopic inguinal hernia repair. *Br. J. Surg.*, 90 (12): 1479-92, 2003.
- 16- BRINGMAN S., RAMEL S., HEIKKINEN T., ENGLUND T., WESTMAN B., ANDERBERG B., et al.: Tension free inguinal hernia repair. TEP versus mesh plug versus Lichtenstein (a prospective randomized clinical trial). *Ann. Surg.*, 237: 142-7, 2003.
- 17- MURTHY P.K. and RAVALIA D.: Assessment and comparison of laparoscopic hernia repair versus open hernia: A non-randomized study. *International Surgery Journal*, 5 (3): 1021-5, 2018.
- 18- SMINK D.S., PAQUETTE I.M., FINLAYSON S.R.: Utilization of laparoscopic and open inguinal hernia repair: A population-based analysis. *J. Laparoendosc. Adv. Surg. Tech. A*, 19 (6): 745-8, 2009.
- 19- KAVIC S.M.: Laparoscopic versus open repair: A superior approach to inguinal herniorrhaphy. *OA Minimally Invasive Surgery*, 1 (1): 1, 2013.
- 20- McCORMACK K., SCOTT N., GO P.M., ROSS S.J. and GRANT A.: Laparoscopic techniques versus open techniques for inguinal hernia repair. *Cochrane database of systematic reviews*, (1), 2003.
- 21- NEUMAYER L., GIOBBIE-HURDER A., JONASSON O., FITZGIBBONS R., DUNLOP D., GIBBS J., et al.: Open mesh versus laparoscopic mesh repair of inguinal hernia. *N. Engl. J. Med.*, 350 (18): 1819-27, 2004.
- 22- RAMSAY G., SCOTT N.W. and JANSEN J.O.: A 19 year population-based cohort study analysing reoperation for recurrence following laparoscopic and open inguinal hernia repairs. *Hernia*, 1-8, 2019.
- 23- VALE L., GRANT A., McCORMACK K. and SCOTT N.W.: EU Hernia trialist collaboration. Cost effectiveness of alternative methods of surgical repair of inguinal hernia. *Int. J. Technol. Assess. Health Care*, 20: 192-200, 2004.
- 24- CHAMPAULT G., RIZK N., CATHELIN J.M., BARRAT C., TURNER R. and BOUTELIER P.: Inguinal hernia repair. *Hernia*, 1 (1): 31-6, 1997.
- 25- VIDOVIC D., KIRAC I., GLAVAN E., CUGURA F.J., LEDINSKY M. and BESLIN B.M.: Laparoscopic Totally Extraperitoneal Hernia Repair Versus Open Lichtenstein Hernia Repair: Results and Complications. *J. Lap. & Ad Surg. Techniques*, 17: 585-90, 2007.
- 26- HALLAN M., BERGENFELZ A. and WESTERDAHL J.: Laparoscopic extraperitoneal inguinal hernia repair versus open mesh repair: Long-term follow-up of a randomized controlled trial. *Surgery*, 143 (3): 313-7, 2008.
- 27- LAL P., KAJLA R.K., CHANDER J., SAHA R. and RAMTEKE V.K.: Randomized controlled study of laparoscopic total extraperitoneal versus open Lichtenstein inguinal hernia repair. *Surgical Endoscopy*, 17 (6): 850, 2003.
- 28- WALL M.L., CHERIAN T. and LOTZ J.C.: Laparoscopic hernia repair: The best option? *Acta Chir. Belg.*, 108 (2): 186-91, 2008.
- 29- KARTHIKESALINGAM A., MARKAR S.R., HOLT P.J. and PRASEEDOM R.K.: Meta-analysis of randomized controlled trials comparing laparoscopic with open mesh

- repair of recurrent inguinal hernia. Br. J. Surg., 97 (1): 4-11, 2010.
- 30- EKLUND A., MONTGOMERY A., BERGKVIST L. and RUDBERG C.: Swedish Multicentre Trial of Inguinal Hernia Repair by Laparoscopy (SMIL) study group: Chronic pain 5 years after randomized comparison of laparoscopic and lichtenstein inguinal hernia repair. Br. J. Surg., 97 (4): 600-8, 2010.
- 31- BIGNELL M., PARTRIDGE G., MAHON D. and RHODES M.: Prospective randomized trial of laparoscopic (transabdominal preperitoneal-TAPP) versus open (mesh) repair for bilateral and recurrent inguinal hernia: Incidence of chronic groin pain and impact on quality of life: Results of 10 year follow-up. Hernia, 16 (6): 635-40, 2012.
- 32- JACOBS V.R. and MORRISON J.E.: Comparison of institutional costs for laparoscopic pre-peritoneal inguinal ambulatory surgery center. Surg. Laparosc. Endosc. Percutan Tech., 18 (1): 70-4, 2008.
- 33- MYERS E., BROWNE K.M. and KAVANAGH D.O.: Laparoscopic (TEP) Versus Lichtenstein Inguinal Hernia Repair: A Comparison of Quality of Life Outcomes. WorldJ. Surg., 34 (12): 3059-64, 2010.
- 34- De JONGE P.V.H., LLOYD A., HORSFALL L., TAN R. and O'DWYER P.J.: The measurement of chronic pain and health-related quality of life following inguinal hernia repair: A review of the literature. Hernia, 12 (6): 561-9, 2008.
- 35- SR'SEN D., DRU'ZIJANIC' N., POGORELIC' Z., PERKO Z., JURICIC' J., KRALJEVIC' D. and MIMICA' Z.: Quality of life analysis after open and laparoscopic inguinal hernia repair: Retrospective study. Hepato-gastroenterology, 55 (88): 2112-5, 2008.

## مقارنة بين إصلاح الفتق الإربي بالمنظار والفتح الجراحي

مقدمة: إصلاح الفتق الإربي واحدة من أكثر العمليات الجراحية شيوعاً. لكن السؤال حول أي من التقنيات هي المناسبة لازال محيراً لمجتمع الجراحين. الطريقة القياسية لإصلاح الفتق الإربي تغيرت على مدار مائة عام إلى أن تم إدخال الشبكة الإصطناعية في إصلاح الفتق، هذه الشبكة يمكن وضعها أما من خلال الفتح الجراحي أو باستخدام تقنية المنظار. التقنيين الأكثر شيوعاً للمنظار هما : ١- إصلاح الفتق الإربي بالمنظار داخل البطن. ٢- إصلاح الفتق الإربي خارج الغشاء البريتوني تماماً، في التقنية الأولى الجراح يفتح التجويف البريتوني ويتم وضع الشبكة من خلال فتحة في البريتون وتثبت الشبكة على أماكن خروج الفتق، أما التقنية الثانية فهي مختلفة إذ أن التجويف البريتوني لا يفتح وتوضع الشبكة من خارج الغشاء الذي يغطي الأمعاء وباقي أعضاء البطن.

الهدف من البحث: كان الغرض من هذه المراجعة مقارنة بين إصلاح الفتق الإربي بالمنظار والفتح الجراحي مع استخدام شبكة.

المرضى والطرق: كانت جميع التجارب العشوائية والغير عشوائية التوزيع المنشورة، والتحليل البعدي، وإرشادات المعهد الوطني للتميز الإكلينيكي التي تقارن إصلاح الفتق الإربي بالمنظار مع إصلاح الفتق بالفتح الجراحي، مؤهلة للإشتمال. تم تضمين الرسائل المنشورة باللغة الإنجليزية، كان المشاركون بالغين تم تشخيص إصابتهم بالفتق الإربي سواء من الذكور أو الإناث. تم البحث عن عناصر البيانات التالية لجميع التجارب: مدة العملية (دقيقة)، إصابة الأوعية الدموية، إصابة الحشوية، مدة الإقامة في المستشفى (أيام)، وقت العودة إلى العمل (أيام)، ألم ما بعد الجراحة، ألم إربي مزمّن مستمر (يعرف بأنه ألم إربي من أي شدة بعد ١٢ شهراً تقريباً من العملية قدر الإمكان بشرط أن يكون ذلك بعد ٣ أشهر على الأقل)، تكرار الفتق، فعالية التكلفة، منحنى التعلم، جودة الحياة.

النتائج: بشكل عام، كانت معدلات التكرار أعلى بين المرضى الذين تم إصلاح فتقهم باستخدام تقنية المنظار (٣.٦٪) مقارنة بالمجموعة المفتوحة (١.٩٪). في خمس دراسات تتعلق بعلاج الفتق المتكرر، تراوح معدل التكرار بين ٠.٤٪ و ٨.٣٪ لتقنيات المنظار وبين ١٪ و ١٥.٦٪ لإجراء ليختنشتاين. ومع ذلك، فإن معدل التكرار يختلف إختلافاً كبيراً بين المستشفيات والجراحين الفرديين، خاصة لأولئك الذين يقومون بإجراءات منظار البطن. بالنسبة لأولئك الذين اجتازوا برنامجاً تعليمياً فيما يتعلق بمنظار البطن، يكون معدل التكرار منخفضاً. إصلاح الشبكة المفتوحة إقتصادي، ويسهل تعليمه وتعلمه دون أي منحنى تعليمي حاد. لا يحتاج إصلاح الفتق بالفتح الجراحي إلى أي تدريب متخصص والنتائج هي نفسها في كل من المركز المتخصص وغير المتخصص. لا ينطوي إصلاح الفتق المفتوح على أي مخاطر لحدوث إصابات خطيرة في الأمعاء أو الأمعاء. من ناحية أخرى أحد أكبر مزايا المنظار هو أنه أقل في الألم ما بعد العملية ومما يترتب على ذلك من سرعة التعافي والعودة إلى النشاطات العادية، وسرعة التحرك والخروج من المستشفى وسرعة العودة إلى العمل.

الخاتمة: المنظار تقنية معقدة ذات معدل أعلى نسبياً في تكرار حدوث الفتق وحدث مضاعفات أثناء العملية بجانب أنها أكثر تكلفة في حين أن الفتح الجراحي تقنية سهلة التعلم ذات معدل أقل في تكرار حدوث الفتق والمضاعفات وأقل في التكلفة.