

**A Comparative Study between TAPP vs TEP Inguinal Hernia Repair****S Sussmitha<sup>1</sup>, Dewangan Manish<sup>2</sup>, Gupta Parag<sup>3</sup>, Sharma Dhiraj<sup>4</sup>**<sup>1</sup>Department of General Surgery, JLNH&RC, Bhilai, Chhattisgarh, India<sup>2</sup>MS (General Surgery), Department of General Surgery, JLNH&RC, Bhilai, Chhattisgarh, India<sup>3</sup>DNB (General Surgery), Department of General Surgery, JLNH&RC, Bhilai, Chhattisgarh, India<sup>4</sup>MS (General Surgery), Department of General Surgery, JLNH&RC, Bhilai, Chhattisgarh, India

Received: 25-09-2024 / Revised: 23-10-2024 / Accepted: 26-11-2024

Corresponding Author: Dr. S Sussmitha

Conflict of interest: Nil

**Abstract:**

**Background:** Transabdominal preperitoneal (TAPP) and totally extraperitoneal (TEP) mesh repair are the two common minimal invasive procedures for inguinal hernias. We are routinely practising both the techniques in our institution. We decided to compare these two techniques in our set up. This retrospective study is aimed to compare these two, TAPP and TEP laparoscopic approaches for inguinal hernia repair in terms of various outcomes.

**Aim:** To compare both laparoscopic TAPP vs TEP inguinal hernia repair in our hospital.

**Materials and Methods:** Total of 255 patients who presented with inguinal hernias in the time period of 5 years from October 2018 to September 2023, fit for general anaesthesia were operated. Out of which 130 patients underwent laparoscopic TAPP repair and 125 underwent laparoscopic TEP repair.

**Results:** Both TEP and TAPP mesh repair techniques were comparable in terms of operative time, intraoperative complications, and conversion to open, post-operative pain, time to resume normal activity, and recurrence. Duration of hospital stay was significantly more in TAPP group than TEP group.

**Conclusion:** Laparoscopic repair of inguinal hernias is associated with comparable results in both techniques (TAPP and TEP) and choice between TAPP and TEP is a personal choice of the operating surgeon.

**Keywords:** TAPP, TEP, Laparoscopic Hernia Repair.

This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.

**Introduction**

Groin hernia repair is one of the most common surgery performed globally, with more than 20 million procedures per year. Majority of hernia repair is performed by open technique [1]. Minimally invasive surgery was introduced in hernia surgery in early nineties with first Laparoscopic hernia repair performed by Ger et al. in 1990 [2]. Various minimally invasive surgical (MIS) techniques are being practised worldwide to perform hernia repair like transabdominal preperitoneal (TAPP), totally extraperitoneal (TEP), or robotic TAPP.

All techniques have the basic principle of placing a synthetic mesh in the preperitoneal space [3-5]. As per the European Hernia Surgery guidelines, Laparoscopic repair is recommended for the repair of primary and recurrent inguinal hernias provided that a surgeon with specific expertise and sufficient resources are available. [6,7] Laparoscopic inguinal hernia repair addresses the defects and deficiencies around the myopectineal orifice as a whole. The other advantage of the laparoscopic method over open technique lies in its ability to approach the contra lateral groin and other occult hernias

simultaneously through the same incisions as required for repair of a unilateral hernia. Thus, a single unified access to the entire preperitoneal space can be obtained aiding in detection of occult hernias, in addition to the attributed benefits of minimally invasive surgery i.e., less pain, early recovery and cosmesis, which are important outcomes in the laparoscopic repair of inguinal hernias. In addition, it is also said to incur less operative time and cost [8,9]. Since one accepted technique, suitable for all inguinal hernias, does not exist, it is recommended that surgeons/surgical services provide both an anterior and a posterior approach option.

We are practising both the techniques in our setup. We are routinely performing TAPP and TEP as minimally assess technique for inguinal hernia repair. The natural question which comes to our mind is which procedure is superior to the other and what are the advantages/disadvantages of both the techniques, if any? The aim of this study is to compare laparoscopic techniques of inguinal hernia repair i.e. TEP and TAPP, with respect to Recurrence, Conversion, Intraoperative and Early

Postoperative Complications, post-Operative Pain, Operative Time, Duration of Hospital Stay.

### Materials and Methods

This retrospective study was conducted on patients operated for laparoscopic inguinal hernia repair from October 2019 to September 2023 in the department of surgery in Jawaharlal Nehru Hospital and Research Centre, which is a tertiary industrial hospital in Bhilai, Chhattisgarh. All surgeries were done by two team of surgeons. All surgeons were proficient in both basic and advanced laparoscopic techniques. Patients >18 years of age presenting with inguinal hernia were placed in two groups, one group (TAPP) includes patients who were operated by TAPP technique, the other group (TEP) includes patients who were operated by TEP technique. Patients having uncomplicated inguinal hernia and fit for general anaesthesia were included in this study. Following were the exclusion criteria: complicated inguinal hernia (irreducible, obstructed, and strangulated). After surgery patients were followed up for post-operative clinical evaluation at 1, 3 & 6 months after surgery. All intraoperative and post-operative complications were recorded. All surgeries were performed under general anaesthesia. The patients were placed in supine position, both arms kept by the side of patient. Head was tilted down 10-20° so that small bowel falls away from pelvis and temporarily reduces the hernia, video monitor placed at foot end of the operation table. The Surgeon stands on side of the patient, opposite to hernia and assistant stands beside the surgeon. A single dose injection of Cefuroxime 1.5 g after test dose was given intravenously as antibiotic prophylaxis pre-operatively. In both techniques a polypropylene mesh of size atleast 12×15cm was used to cover the myopectineal orifice, which was anchored by tacks/sutures.

**TAPP inguinal hernia repair:** A 11-12mm incision made in supraumbilical region. Peritoneal access obtained by veress needle. A 10mm trochar was placed 5mm above umbilicus. Pneumoperitoneum was created up to 12mmHg with CO<sub>2</sub>. A 10mm 30° telescope was inserted and whole peritoneal cavity was examined. Two other 5 mm trochar were inserted under vision on either side of umbilicus at the lateral border of rectus abdominus muscles. The content of the hernia if any, were reduced. The peritoneum was incised transversely approximately 2cm above deep inguinal ring, extending medially until the medial

umbilical ligament and lateral limit correspond to the anterior superior iliac spin. Peritoneal flap was raised and inguinal ligament, spermatic cord, space of Ritzius, space of Bogros and lateral wall of urinary bladder were identified. Adequate peritoneal space was created to accommodate atleast 12×15 cm polypropylene mesh. Mesh was fixed to the Cooper's ligament and anterior abdominal wall with tacks/sutures. Peritoneal flap was closed with continuous suture with vicryl 2/0.

**TEP inguinal hernia repair:** In this technique all three port were made in the midline. A 11-12 mm incision was made below the umbilicus, off the midline, on the side of hernia, for 10 mm 30° telescope. The anterior rectus sheath was incised and the rectus muscles were retracted laterally. Recto-rectus space created by pneumatic balloon dilator. The space was insufflated with CO<sub>2</sub>. Other two 5 mm trochar was inserted in the midline, one just above the pubic symphysis and other between the pubic symphysis and umbilical port. Continue dissection laterally from pubic symphysis, identifying the inferior epigastric vessels, further laterally. The peritoneum was teased down as low as possible. The hernial sac was reduced. The at least 12x15 cm polypropylene mesh was introduced through umbilical port, and placed properly covering the deep inguinal ring, femoral ring and Hasselbach's triangle. The mesh was fixed with tackers and peritoneum was released.

All data were analysed statistically by SPSS program for Windows version 20.0. Continuous variables will be presented as mean ± SD, and categorical variables will presented as absolute numbers and percentages. Data will checked for normality before statistical analysis. Normally distributed continuous variables will be compared using the unpaired t test, whereas the Mann-Whitney U test will be used for those variables that will not be normally distributed. Categorical variables will be analysed using either the chi-square test or Fisher's exact test. P>0.05 is considered not significant. P<0.05 is considered significant. P<0.01 is considered highly significant.

### Results

**Age:** Most of the patients in both TAPP and TEP group were in the age group of 50-60 years. The mean age of patients in TAPP group was 58.38 ± 15.40 years and that of TEP was 55.9 ± 17.73 years. . There was no statistically significant difference between the two groups in terms of age (P value = 0.11 NS)

Table 1:

TAPP	TEP	P value
58.38±15.40	55.9±17.73	0.11

**Sex:** There was 6 female patient with an inguinal hernia in TAPP group and 1 female in TEP group. There was no statistically significant difference between the two groups in terms of sex distribution (P = 0.062 NS).

**Table 2:**

Sex Distribution	TAPP	TEP
Male	124	124
Female	6	1
p = 0.062 NS		

45 patients of TAPP group had bilateral hernias and 85 patients had unilateral hernias. 45 patients of TEP group had bilateral hernias and 80 patients had

unilateral hernias. The difference between the two groups was statistically not significant (P = 0.82).

**Side of hernia****Table 3:**

	TAPP	%	TEP	%
Unilateral	85	65.38	80	64
Bilateral	45	34.62	45	36
p = 0.82 NS				

**Extent of hernia:** 45 patients in TAPP group had complete hernia and 85 patients had incomplete hernias. Whereas 9 patients in TEP group had complete hernia and 116 had incomplete hernias. The value was statistically highly significant (p<0.01 HS).

**Table 4:**

	TAPP ( N = 130 )				TEP ( N = 125 )			
	Bilateral		Unilateral		Bilateral		Unilateral	
	N	%	N	%	N	%	N	%
Complete	13	28.89	32	37.65	2	4.44	7	8.75
Incomplete	32	71.11	53	62.35	43	95.56	73	91.25
p = < 0.01 HS								

**Duration of surgery:** In our study the duration of surgery was higher in bilateral TAPP is 110.16 minutes compared to bilateral TEP 96.67 minutes which was statistically insignificant. The duration of surgery for unilateral TAPP is 80.24 minutes compared to unilateral TEP 75.09 minutes which was statistically insignificant.

**Table 5:**

Duration of Surgery	U/L	B/L
TAPP	80.24	110.16
TEP	75.09	96.67
P value	0.37	0.44

**Postoperative pain:** In our study the post-operative pain was measured in visual analogue score (VAS) scoring system. The pain score was measured at 6 hours where the score was slightly

higher in TAPP of score 6 and score 5 in TEP. At 24 hours the score was comparable of 3. At the time of discharge it was 2. At 1 week, at 1 month, at 3 months the score was comparable and was 1.

**Table 6:**

Pain score (VAS)	After 6 hrs	After 24 hrs	On discharge	After 1 week	After 1 month	After 3 months
TAPP	6	3	2	1	1	1
TEP	5	3	2	1	1	1
P value	0.4	0.34	0.33	0.45	0.45	0.45

**Post-operative complications:** In our study the post-operative complications were very minor and that included urinary retention in 1 case of TAPP and no patients in TEP group. Ecchymosis were

noted in 3 patients in TAPP group and 5 patients in TEP group. Seroma was noted in 10 patients in TAPP group and 15 Patients in TEP group. 1 case of port site hernia was noted in TAPP group.

Table 7:

	Visceral injury	Vascular injury	Vas deferens injury	Urinary retention	Ecchymosis	Seroma	Hematoma	SSI	Mesh infection	Port site hernia
TAPP	0	0	0	1	3	10	0	0	0	1
TEP	0	0	0	0	5	15	0	0	0	0
P value	0	0	0	0.3	0.44	0.25	0	0	0	1.3

**Hospital stay:** In our study the duration of hospital stay was 2.46 days for TAPP group and 2.34 days for TEP group which was comparable and was statistically insignificant.

Table 8:

Duration of Hospital Stay	
TAPP	2.46
TEP	2.34
P value = 0.45 NS	

**Conversion rate:** In our study there was 3 case in TAPP group were converted to open repair whereas 2 cases in TEP group.

Table 9:

Conversion Rate	
TAPP	3
TEP	2
P value = 0.44	

**Recurrence:** There were no recurrence in 6 months follow-up

### Discussion

Inguinal hernia repair is one of the common elective procedures in general surgery. The main goal of any hernia repair include minimizing intraoperative and postoperative complications, achieving effective repair, lowest possible recurrence, early return to normal life, cost effective and better cosmetic results. To successfully achieve these goals, the technique of hernioplasty has progressed from open to various laparoscopic techniques. TAPP and TEP repairs are currently most common inguinal hernia repairs performed by experienced laparoscopic surgeons [10].

### Age and sex

Many studies support the fact that the inguinal hernias are more common in males and middle aged people are the commonly seen age group involved [11]. In our study, 248 out of total 255 patients were males and more common in the middle age group (55-60 years). This could further be justified by the fact that men have more tendency to inherent weakness along the inguinal canal due to different anatomical features. Usually, in the early postnatal period, the inguinal canal closes almost completely but due to some

congenital abnormality or due to idiopathic reasons sometimes it does not close properly, leaving a weakened area especially in males. In females, there is less chance that the inguinal canal will not close after birth [12].

### Type of hernia

Depending on the relationship to inferior epigastric vessels, an inguinal hernia can be direct or indirect. In our study we have analysed and included direct, indirect, pantaloon and sliding type of inguinal hernias and observed that the indirect inguinal hernias seen in 28 patients in TAPP group, and 33 patients in TEP group. Direct hernia were observed in 35 patients in TAPP group, and 18 patients in TEP group. Pantaloon hernia were observed in 4 patients in TAPP group, and 9 patients in TEP group and 1 case of sliding hernia is noted in TAPP group.

**Duration of surgery:** Many studies have estimated duration of operation to be 40-70 min for TAPP and 55-95 min for TEP [13-18]. The mean operating time in our study in bilateral TAPP group was 110.16 mins while as in TEP repair mean was 96.67 mins. The increase in duration of surgery in TAPP is due to suturing of peritoneal flap and most of the cases being complete hernias in this study which requires slightly higher time to dissect. The increased duration of surgery in TAPP as compared to TEP was statistically insignificant. While

comparing with the other studies the results obtained as follows:

**Table 10:**

Studies	U/I TAPP	B/I TAPP	U/L TEP	B/L TEP
Our	80.24 + 20.12	110.16 + 16.10	75.09 + 26.35	96.67 + 36
Saini et al, AIIMS 2023	66.33 + 4.59	91.40 + 7.00	65.14 + 3 3.01	86 + 7.20
Hamza ,et al (2010)	96.12 + 22.5		77.4 + 43.21	
More et al, (2010)	121 + 4.3		50.5 + 3.7	
Sharma, 2015		108.16 + 16.10		120.89 + 29.28
Hidalgo et al.2023		107.2		82.99

**Conversion rate:** In our study, we found that 3 case each from TAPP and 2 cases of TEP were converted to open because of dense adhesions and we were not able to proceed in TAPP and large peritoneal rents in TEP. However, the difference was statistically insignificant ( $P = 0.49$ ). Many studies have compared the rates of conversion

between TAPP and TEP procedure with rates of 0% versus 4%, 0% versus 1.8%, and 5% versus 7%, respectively [19-20]. However, in the large case series the conversion rates between TAPP and TEP were very similar at 0.24% and 0.23% respectively [21]. A table showing comparison with other studies.

**Table 11:**

Study	TAPP	TEP
Our study	2.3%	1.6%
Prajapati et al, AIIMS,2023	2.4%	0
Goksoy,et al,2021	6%	6%
Gass M et al,2016	1.39%	2.15%
Hidalgo et al.2023	0	6%

**Post-operative complications:** In our study there was no intra-abdominal operative complication (bowel, vessels injury). A meta-analysis of TAPP and TEP versus open hernia repair reported very low incidence of intra-operative complication during laparoscopic approach [22]. After laparoscopic repair of inguinal hernia, scrotal oedema or hematoma is a common complication [23]. In present study seroma was the main complications which occurred in 10 patients of TAPP and 15 patients of TEP groups, these patients managed conservatively. Clinical factors associated

with the development of scrotal oedema are old age, large hernia defect, complete inguinal hernia, and the presence of distal indirect sac in a study conducted by Lau et al [24]. Other minor complications included ecchymosis which was present in 3 patients in TAPP group and 5 patients in TEP group.

Urinary retention were present in 1 patient in TAPP group. Port site hernia was noted in 1 case of TAPP group. Various other studies compared and the results are shown in the table below.

**Table 12:**

Study	TAPP	TEP
Our Study	7.6%	10%
Saini et al AIIMS ,2023	14.1%	16.4%
Yildiz ,et al 2022	3.1%	6.6%
Hidalgo et al .(2023)	17.9%	12.7%

**Post-operative pain:** One of the major advantages of laparoscopic repair of inguinal hernia is a substantial reduction in postoperative pain.

Most of the previous studies are in favour of similar pain scores in the immediate postoperative period in both the TEP and TAPP procedures [13,25]. This study also observed comparable pain

scores on VAS at 6 h and 12 h in both TEP and TAPP groups. In our study patients of both groups of TAPP and TEP had comparable pain which was a bit higher at 6 hrs and was statistically insignificant. Other studies were compared and the results to be almost similar as shown in the following table

Table 13:

Studies	6 hours TEP TAPP		24 hrs TEP TAPP		At dis- charge TEP TAPP	7 days TEP TAPP		1 month TEP TAPP		3 months TEP TAPP	
Our Study	5	6	3	3	2	2	1	1	1	1	1
Bansal (2013)	4.9	5.3	4.5	5.7			3	3.9	2.2	2.6	1.4
Gunal (2007)	5.5	6									
Hamza (2010)	4.8	5.8	4.8	5.8							
Sharma (2015)			3.89	3.4							
Hidalgo et al, (2023)			2.18	2.17							

**Duration of hospital stay:** Concerning the hospital stay, we found no significant difference between TAPP and TEP. That is consistent with the finding in other studies [26]. Comparable results were obtained in comparison with other studies.

Table 14:

Studies	TAPP	TEP
Our Study (days)	2.46	2.34
Saini et al AIIMS 2023	2(2-3)	2(2-3)
Hidalgo et al.2023	1.05 + 0.44	0.65 + 0.61
Choski et al	2.76 days	2.8
Gong (2011)	86.4	81.6
Wake et al(2008)	3.7 days	4.4 days

**Recurrence:** Recurrence is the most important end point of any hernia surgery [27]. For many years recurrence was the only criteria by which the quality of hernia repair was measured. It requires a proper and thorough knowledge of anatomy and a thorough technique of repair to keep the recurrence in laparoscopic repair to a minimum [28-30]. Heikkinen et al [31] reported that both TAPP and TEP have a low risk for hernia recurrence if proper mesh sides are used. Fitzgibbons et al [32],

concluded from his study that, the factors resulting in recurrence include inexperience surgeon, inadequate dissection, insufficient mesh size, insufficient prosthesis overlap of hernia defects, improper fixation of mesh, mesh folding or twisting, missed hernia and hematoma displacing the mesh. In our study there was no recurrence noted till date. Other studies were compared and shown below

Table 15:

Study	TAPP	TEP
Ours	0	0
Saini et al, AIIMS 2023	0	0
Hidalgo et al 2023	3.6%	7%
Yildiz, et al 2022	0	2.6%
Goksoy, et al, 2021	5.9%	4.3%

## Conclusions

TAPP and TEP have comparable postoperative outcomes.

There is no clear superiority of one procedure over the other with respect to postoperative pain, length of hospital stay, and resume of daily activities, post-operative complications like hematoma, seroma, surgical site infection, scrotal edema, port site hernia, bowel obstruction, mesh infection, and recurrence of hernia. However, operative time was slightly higher in TAPP as compared to TEP which was statistically insignificant. Choice of the procedure is by the personal choice of the operating surgeon depending upon his training, skill and knowledge.

## References

1. Hernia Surge Group. International guidelines for groin hernia management .Hernia 2018; 22:1–165.
2. Ger R, Monroe K, Duvivier R, Mishrick A. Management of indirect inguinal hernias by laparoscopic closure of the neck of the sac. The American Journal of Surgery. 1990 Apr 1; 159(4):370-3.
3. Neumayer L, Giobbie-Hurder A, Jonasson O, Fitzgibbons Jr R, Dunlop D, Gibbs J, Reda D, Henderson W. Open mesh versus laparoscopic mesh repair of inguinal hernia. New England journal of medicine. 2004 Apr 29; 350(18):1819-27.

4. Rodha MS, Meena SP, Premi K, Sharma N, Puranik A, Chaudhary R. Pain after transabdominal preperitoneal (TAPP) or totally extraperitoneal (TEP) technique for unilateral inguinal hernia: a randomized controlled trial. *Cureus*. 2022 Apr; 14(4).
5. Inguinal hernia: mastering the anatomy. Miller HJ. *Surg Clin North Am*. 2018; 98:607–621. [PubMed] [Google Scholar]
6. Miserez M, Peeters E, Aufenacker T, Bouillot JL, Campanelli G, Conze J, Fortelny R, Heikkinen T, Jorgensen LN, Kukleta J, Morales-Conde S. Update with level 1 studies of the European Hernia Society guidelines on the treatment of inguinal hernia in adult patients. *Hernia*. 2014 Apr; 18:151-63.
7. Simons MP, Aufenacker T, Bay-Nielsen M, Bouillot JL, Campanelli G, Conze J, De Lange D, Fortelny R, Heikkinen T, Kingsnorth A, Kukleta J. European Hernia Society guidelines on the treatment of inguinal hernia in adult patients. *Hernia*. 2009 Aug; 13:343-403.
8. McCormack K, Wake BL, Fraser C, Vale L, Perez J, Grant A. Transabdominal preperitoneal (TAPP) versus totally extraperitoneal (TEP) laparoscopic techniques for inguinal hernia repair: a systematic review. *Hernia*. 2005 May; 9:109-14.
9. Dulucq JL, Wintringer P, Mahajna A. Occult hernias detected by laparoscopic totally extraperitoneal inguinal hernia repair: a prospective study. *Hernia*. 2011 Aug; 15:399-402.
10. Neumayer L, Jonasson O, Fitzgibbons Jr R, Henderson W, Gibbs J, Carrico CJ, Itani K, Kim L, Pappas T, Reda D, Dunlop D. Tension-free inguinal hernia repair: the design of a trial to compare open and laparoscopic surgical techniques. *Journal of the American College of Surgeons*. 2003 May 1; 196(5):743-52.
11. Gong K, Zhang N, Lu Y, Zhu B, Zhang Z, Du D, Zhao X, Jiang H. Comparison of the open tension-free mesh-plug, transabdominal preperitoneal (TAPP), and totally extraperitoneal (TEP) laparoscopic techniques for primary unilateral inguinal hernia repair: a prospective randomized controlled trial. *Surgical endoscopy*. 2011 Jan; 25:234-9.
12. Bax T, Sheppard BC, Crass RA. Surgical options in the management of groin hernias. *American family physician*. 1999 Jan 1; 59(1):143-56.
13. Aeberhard P, Klaiber C, Meyenberg A, Osterwalder A, Tschudi J. Prospective audit of laparoscopic totally extraperitoneal inguinal hernia repair: a multicenter study of the Swiss Association for Laparoscopic and Thoracoscopic Surgery (SALTC). *Surgical endoscopy*. 1999 Nov; 13:1115-20.
14. Lau H, Patil NG, Yuen WK, Lee F. Learning curve for unilateral endoscopic totally extraperitoneal (TEP) inguinal hernioplasty. *Surgical Endoscopy and Other Interventional Techniques*. 2002 Dec; 16:1724-8.
15. Lau H, Patil NG, Yuen WK, Lee F. Learning curve for unilateral endoscopic totally extraperitoneal (TEP) inguinal hernioplasty. *Surgical Endoscopy and Other Interventional Techniques*. 2002 Dec; 16:1724-8.
16. 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. *The American journal of surgery*. 1996 Feb 1; 171(2):281-5.
17. Wright D, O'Dwyer PJ. The learning curve for laparoscopic hernia repair. In *Seminars in laparoscopic surgery* 1998 Dec (Vol. 5, No. 4, pp. 227-232). Sage CA: Thousand Oaks, CA: Sage Publications.
18. Cohen RV, Alvarez G, Roll S, Garcia ME, Kawahara N, Schiavon CA, Schaffa TD, Pereira B, Margarido NF, Rodrigues AJ. Transabdominal or totally extraperitoneal laparoscopic hernia repair? *Surgical Laparoscopy Endoscopy & Percutaneous Techniques*. 1998 Aug 1; 8(4):264-8.
19. Felix EL, Michas CA, Gonzalez MH. Laparoscopic hernioplasty: TAPP vs TEP. *Surgical endoscopy*. 1995 Sep; 9:984-9.
20. Hee RV, Goverde P, Hendrickx L, Schelling GV, Totte E. Laparoscopic transperitoneal versus extraperitoneal inguinal hernia repair: a prospective clinical trial. *ACTA Chirurgica Belgica*. 1998 Jun 1; 98(3):132-5.
21. Tamme C, Scheidbach H, Hampe C, Schneider C, Köckerling F. Totally extraperitoneal endoscopic inguinal hernia repair (TEP). *Surgical Endoscopy and Other Interventional Techniques*. 2003 Feb; 17:190-5.
22. Schmedt CG, Sauerland S, Bittner R. Comparison of endoscopic procedures vs Lichtenstein and other open mesh techniques for inguinal hernia repair: a meta-analysis of randomized controlled trials. *Surgical Endoscopy and Other Interventional Techniques*. 2005 Feb; 19:188-99.
23. Broin EO, Horner C, Mealy K, Kerin MJ, Gilen P, O'Brien M, Tanner WA. Meralgia paraesthetica following laparoscopic inguinal hernia repair: an anatomical analysis. *Surgical endoscopy*. 1995 Jan; 9:76-8.
24. Katkhouda N, Mavor E, Friedlander MH, Mason RJ, Kiyabu M, Grant SW, Achanta K, Kirkman EL, Narayanan K, Essani R. Use of fibrin sealant for prosthetic mesh fixation in laparoscopic extraperitoneal inguinal hernia repair. *Annals of surgery*. 2001 Jan 1; 233(1):18-25.
25. Lepere M, Benchetrit S, Debaert M, Detruit B, Dufilho A, Gaujoux D, Lagoutte J, Saint Leon

- LM, d'Escurac XP, Rico E, Sorrentino J. A multicentric comparison of transabdominal versus totally extraperitoneal laparoscopic hernia repair using Parietex® meshes. *JSLs: Journal of the Society of Laparoendoscopic Surgeons*. 2000 Apr; 4(2):147.
26. Hamza Y, Gabr E, Hammadi H, Khalil R. Four-arm randomized trial comparing laparoscopic and open hernia repairs. *International Journal of Surgery*. 2010 Jan 1; 8(1):25-8.
27. Schrenk P, Woisetschlager R, Rieger R, Wayand W. Prospective randomized trial comparing postoperative pain and return to physical activity after transabdominal preperitoneal, total preperitoneal or Shouldice technique for inguinal hernia repair. *British journal of surgery*. 1996 Nov; 83(11):1563-6.
28. Moreno-Egea A, Aguayo JL, Canteras M. Intraoperative and postoperative complications of totally extraperitoneal laparoscopic inguinal hernioplasty. *Surgical Laparoscopy Endoscopy & Percutaneous Techniques*. 2000 Feb 1; 10(1):30-3.
29. Lau H, Patil NG, Yuen WK, Lee F. Prevalence and severity of chronic groin pain after endoscopic totally extraperitoneal inguinal hernioplasty. *Surgical Endoscopy and Other Interventional Techniques*. 2003 Oct; 17:1620-3.
30. Bringman S, Ek Å, Haglind E, Heikkinen T, Kald A, Kylberg F, Ramel S, Wallon C, Anderberg B. Is a dissection balloon beneficial in totally extraperitoneal endoscopic hernioplasty (TEP)? A randomized prospective multicenter study. *Surgical endoscopy*. 2001 May; 15:266-70.
31. Heikkinen T, Bringman S, Ohtonen P, Kuneilius P, Haukipuro K, Hulkko A. Five-year outcome of laparoscopic and Lichtenstein hernioplasties. *Surgical Endoscopy and Other Interventional Techniques*. 2004 Mar; 18:518-22.
32. Fitzgibbons Jr RJ, Puri V. Laparoscopic inguinal hernia repair. *The American Surgeon*. 2006 Mar; 72(3):197-206.