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First Term Outcomes of a Young Surgeon in Inguinal Hernia Repair: Lichtenstein, TAPP, and TEP

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Abstract

Objective: In this study, we aimed to compare the early outcomes of inguinal hernia repairs performed by a young general surgeon with Lichtenstein, trans abdominal pre-peritoneal (TAPP), and total extraperitoneal (TEP) techniques.

Methods: Ninety patients who were operated on by a single surgeon with the diagnosis of inguinal hernia in Avcılar State Hospital between March 2018 and March 2020 were evaluated retrospectively. The patients were divided into 3 groups as Lichtenstein, TAPP, and TEP. Duration of operation, length of hospital stay, perioperative complications, chronic pain, and recurrence parameters were compared.

Results: Eighty-one of the patients were male and 9 were female. Lichtenstein, TAPP, and TEP groups included 30, 31, and 29 patients, respectively. The distribution of hernia localization, hernia type, and the number of recurrence cases of the groups was similar. No significant differences were found between the groups in terms of operation time and length of hospital stay ($P > .05$). There were no significant differences between the intraoperative and postoperative complication rates of the groups ($P = .799$ and $P = .594$, respectively). The rate of postoperative chronic pain was 5.5% in all cases and 6.45%, 3.44%, and 6.66% in the TAPP, TEP, and Lichtenstein groups, respectively ($P = .999$). Recurrence was observed in 5 cases in Lichtenstein, 2 in TEP, and 1 in TAPP ($P = .164$).

Conclusion: Operation time, length of hospital stay, perioperative complications, and recurrence rates are similar in open and laparoscopic inguinal hernia repairs. Laparoscopic techniques are also safe and useful for young surgeons with surgical competence.

Keywords: Inguinal hernia, Lichteinstein, TAPP, TEP

Bir Genç Cerrahın Kasık Fıtığı Onarımında İlk Dönem Sonuçları: Lichtenstein, TAPP ve TEP

Öz

Amaç: Bu çalışmamızda genç bir genel cerrahi uzmanının Lichteinstein, TAPP ve TEP teknikleri ile uyguladığı inguinal herni tamirlerinin erken dönem sonuçlarını karşılaştırmayı amaçladık.

Yöntemler: Avcılar Devlet Hastanesi'nde Mart 2018-Mart 2020 arasında inguinal herni tanısıyla tek cerrah tarafından opere edilmiş 90 hasta retrospektif olarak değerlendirildi. Hastalar Lichteinstein, TAPP ve TEP olmak üzere 3 gruba ayrıldı. Operasyon süresi, hastanede yatış süresi, peroperatif komplikasyonlar, kronik ağrı, rekürrens parametreleri kaydedildi.

Bulgular: Hastaların 81'i erkek, 9'u kadındı. Lichteinstein, TAPP ve TEP gruplarında sırasıyla 30,31 ve 29 hasta vardı. Grupların fıtık lokalizasyonu, fıtık tipi ve nüks vaka sayısı dağılımları benzerdi.Gruplar arasında operasyon süresi ve hastanede yatış süresi açısından anlamlı fark saptanmadı ($P > ,05$). Grupların intraoperatif ve postoperatif komplikasyon oranları arasında anlamlı fark yoktu (sırasıyla; $P = ,799$, $P = ,594$). Postoperatif kronik ağrı oranı tüm olgularda %5.5 ve TAPP, TEP, Lichteinstein gruplarında sırasıyla %6.45, %3.44 ve %6.66 idi ($P = ,999$). Lichteinstein grubunda 5, TEP'te 2, TAPP'ta ise 1 olguda rekürrens gözlendi ($P = ,164$).

Sonuç: Operasyon süresi, hastanede yatış süresi, perioperatif komplikasyonlar ve rekürrens oranları açık ve laparoskopik inguinal herni tamirlerinde benzerdir. Laparoskopik teknikler de cerrahi yeterliliği olan genç cerrahlar için güvenli ve kullanışlıdır.

Anahtar Kelimeler: Kasık fıtığı, Lichteinstein, TAPP, TEP

Inguinal hernia is defined as the protrusion of abdominal cavity content or preperitoneal fat tissue from a hernia defect in the inguinal region. The probability of having an inguinal hernia during a person's lifetime is 27-43% for men and 3-6% for women.[1] Although patients most often complain of pain and swelling in the groin, they can also be presented with the ileus clinic. The only definitive treatment of inguinal hernias is surgical repair and there is no

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standard repair technique for all hernias. Today, the surgical techniques applied in the management of inguinal hernias are primary open repair, open tension-free repair with mesh, and laparoscopic repair with mesh.

Lichtenstein repair involves the implantation of a mesh prosthesis in front of the transverse fascia.[2] It also has advan-tages such as low cost and shorter learning curve even though the Lichtenstein technique has disadvantages such as nerve and testicular injury.[3] Recurrence rates have been reported to be below 1%.[4] According to meta-analysis and guidelines, postoperative chronic pain observed at an aver-age rate of 18% (range, 0.7-75%) in open hernia repairs is the most important morbidity of this technique.[4,5]

The most important advantages of laparoscopic ingui-nal hernia repairs, which have attracted great interest from surgeons in recent years, are faster recovery, less length of hospital stay, and less postoperative chronic pain rates com-pared to the open technique.[6,7] A mesh prosthesis is placed from the dorsal of the transversal fascia to the preperitoneal site in the transabdominal preperitoneal (TAPP) technique. Transabdominal preperitoneal offers the advantages of accurate diagnosis, repair of bilateral and recurrent hernias, and avoidance of injury to the spermatic cord.[7] The mesh is placed in the same site without entering the abdominal cavity in another laparoscopic approach, the total extraperi-toneal (TEP) technique. This reduces the risk of abdominal organ injury and the rate of trocar site hernia. The recurrence rate of TEP and perioperative complication rates of TAPP are higher compared to open surgery.[8]

There is a controversy about the approach for the ideal repair of inguinal hernia in the literature.[9,10] This study aims to compare the early results of inguinal hernia repairs per-formed by a young general surgeon with Lichtenstein, TAPP, and TEP techniques.

Methods

Ninety patients who were recently operated on by a surgeon with the diagnosis of inguinal hernia in Istanbul Avcılar State Hospital General Surgery Clinic between March 2018 and March 2020 were evaluated retrospectively. İstanbul University-Cerrahpaşa Ethics Committee approval was obtained for the study (Date: February 8, 2021, Number: 25848). Written informed consent was obtained from all patients prior to participating in this study. Patients over the age of 18 years who underwent elective surgery were included in the study. Patients under 18 years of age who were operated on due to urgent indications such as obstruction, incarceration, strangulation, were excluded from the study. In addition, the exclusion criteria for TAPP and TEP repair were age more than 80 years old, unstable angina or myocardial infarction, severe respiratory disease, and a history of previous lower abdominal surgery, except for appendectomy.

The patients were divided into 3 separate groups as Lichtenstein group, the TAPP group, and the TEP group. Age, gender, hernia localization, hernia type, operation time, intraoperative-postoperative complications, length of hospital stay, chronic pain, and recurrence parameters were recorded and compared between the groups.

All patients in the Lichtenstein group were operated on under spinal anesthesia while patients in the TAPP and TEP groups were operated on under general anesthesia. All patients underwent preoperative single-dose intravenous 1 g cefazolin prophylaxis.

Lichtenstein tension-free mesh repair was performed as described by Lichtenstein et al.[11] and Amid et al.[12] External aponeurosis was reached with a Bassini incision of 5-6 cm. Aponeurosis was opened. The spermatic cord was turned in men and preserved by being suspended with rubber drainage. The hernia sac was separated from the cord and the content of the sac was reduced to the abdomen after herniotomy. The hernia sac was sutured as purse string. A 15 × 10 cm polypropylene and poliglecaprone mesh was sutured to the fibroperiosteum of the pubis with a non-absorbable 2/0 suture (Prolene; Ethicon) and was fixed in a way that it continues laterally through the inguinal ligament. Then, the superior edge of the mesh was fixed with separated sutures on the tendon conjoint to form a new internal inguinal ring. Superficial fascia and skin were closed as usual.

Peritoneal insufflation was performed with a Veress needle with an intra-abdominal pressure of 12 mmHg in TAPP repairs. Patients were positioned in Trendelenburg position with the hernia side up. Then, the abdomen was entered with a total of 3 trocars of 10 mm just below the umbilicus and 2 trocars of 5 mm from the lateral of both rectus muscles. Umbilical trocar was used for laparoscopy and other trocars were used for dissection and mesh fixation. A polypropylene and poliglecaprone mesh used in all cases were placed to cover the potential sites for a hernia. The mesh was fixed to place the legs between the spermatic cord in males. The transverse aponeurotic arch Cooper's ligaments, pubis, and iliopubic tract were fixed with the spiral stapler (Tacker, Origin Medsystems, San Francisco, CA) after placing the mesh on the site. The opened peritoneum was closed with the help of a spiral stapler.

The posterior rectus sheath was reached by entering through a 12 mm incision under the umbilicus and the dissection balloon (PBD, Origin Medsystems, San Francisco, CA) was inserted from the site created by blunt dissection with fingers on the posterior sheath and advanced toward the pubis in TEP repair. Enough space was created by inflating the balloon. The balloon was removed after being held constant for 1 min for hemostasis and a trocar of 10 mm was inserted from the same incision. The extraperitoneal site was inflated up to 10 mmHg through this trocar. Afterward, 2 more trocars of 5 mm were placed at equal intervals on the linea alba between the umbilicus and the pubis. The mesh placed following dissection was fixed with a spiral stapler (Tacker, Origin Medsystems, San Francisco, CA).

A mixed polypropylene and poliglecaprone mesh (Ultrapro®, Johnson & Johnson International, Ethicon) type was used in all 3 techniques. This mesh is low density and partially absorbable, with a pore measuring over 3.0 mm, a weight of 28 g/m^2, and a tensile strength of 10 MPa.

Statistical analysis

Statistical analysis was performed with SPSS version 17.0 software. The suitability of the variables for normal distribution was examined with histogram graphs and the Kolmogorov-Smirnov test. Mean, standard deviation, and median were used to present descriptive analyses. Categorical variables were compared with Pearson's chi-square test. Kruskal-Wallis test was used to evaluate non-normally distributed (non-parametric) variables between the groups. $P < .05$ was considered statistically significant.

Results

A total of 90 patients, 81 men (90.00%) and 9 women (10.00%), were included in the study. Lichtenstein group included 30 patients, the TAPP group included 31 patients, and the TEP group included 29 patients. The mean age was higher in the TEP group (43.00 ± 11.78) compared to the TAPP group (36.00 ± 8.92) and Lichtenstein group (37.00±13.19) (*P* = .041). The proportion of males in the Lichtenstein group (76.67%) was lower compared to the TAPP group (96.77%) and the TEP group (96.55%) (*P* = .012). There were no significant differences between the groups in terms of hernia localization (unilateral/bilateral), hernia type, and recurrence (Table 1).

No significant differences were found between the groups in terms of operation time and hospital stay (*P* = .614 and *P* = .620, respectively) (Table 2). Intraoperative complications were observed in 4 patients and postoperative complications in 10 patients. The most common complication was hematoma (n = 4). There were no significant differences between the intraoperative and postoperative complication rates of the groups (*P* = .799 and *P* = .594, respectively).

The rate of postoperative chronic pain was 5.5% (n = 5) in all cases and there was no difference between the groups in terms of chronic pain (*P* = .999). We have implemented a watchful waiting strategy in all cases that develop chronic pain. A few months of (3-5 months) nonsteroidal anti-inflammatory drugs were sufficient in 4 of the patients, and 1 patient benefited from gabapentinoids and tricyclic antidepressants.

The mean follow-up period of all cases was 14.7 months (range 12-18 months). Numerically more recurrence was observed in the Lichtenstein group; however, this difference was not statistically significant (*P* = .569).

Discussion

The main objectives in the repair of inguinal hernia are to prevent a recurrence, minimize the complication rate, and keep patient comfort at the highest level. For this purpose, surgeons have developed open techniques as well as laparoscopic methods. Even though laparoscopic methods are recommended in hernias with recurrence of unilateral, bilateral, and open repair in the literature and Lichtenstein repair is recommended in patients with previous pelvic or lower abdominal surgery who cannot tolerate general anesthesia, scrotal extension hernias, and recurrence of laparoscopy; there is no definitive rule in this regard.[13] Success in laparoscopic hernia repair is associated with the ability, training, and experience of the surgeon even though each technique has its own advantages and limitation.[14] Lichtenstein technique is known to have a shorter learning curve compared to TAPP and TEP techniques.[3,10] Surgeons may face further technical difficulties, especially when performing TEP, due to unusual pelvic anatomy and limited study space. This leads to prolonged learning curves and operation times of inexperienced surgeons. Therefore, the right patient selection plays an important role in the initial procedures. Schouten et al.[15] suggested that patients with small defects without a history of abdominal surgery should be preferred in the first patient selection in TEP. Open inguinal hernia repair has been reported to have shorter operative times compared to laparoscopic techniques in the literature.[2,16,17] On the contrary,

Table 1. The Evaluation of Demographic Characteristics, Hernia Localization, and Hernia Types of Groups

	TAPP Group		TEP Group		Lichteinstein Group		
	n	%	n	%	n	%	*P*
Age (year)	36.00 ± 8.92	35.00	43.00 ± 11.78	45.00	37.00 ± 13.19	37.00	**.041****
Gender							
Male	30	96.77	28	96.55	23	76.67	**.012***
Female	1	3.23	1	3.45	7	23.33	
Side of the hernia							
Bilateral	7	22.58	8	27.59	6	20.00	.795*
Right	9	29.03	11	37.93	12	40.00	
Left	15	48.39	10	34.48	12	40.00	
Type of the hernia							
Direct	12	38.71	12	41.38	7	23.33	.247*
İndirect	13	41.94	10	34.48	19	63.33	
Pantaloon	6	19.35	7	24.14	4	13.33	
Recurrent hernia							
Yes	1	3.23	2	6.90	3	10.00	.569*
No	30	96.77	27	93.10	27	90.00	

*Chi-square test, **Kruskal–Wallis test (mean ± SD instead of n; the median was given instead of %).

Table 2. Comparison of Peroperative and Postoperative Outcomes of Groups

	TAPP Group, n (%)	TEP Group, n (%)	Lichteinstein Group, n (%)	*P*
Operation time (min)	42.00 ± 16.2	46.00 ± 15.6	44.00 ± 12.9	.614**
Length of hospital stay (day)	1.06 ± 0.36	1.10 ± 0.4	1.36 ± 0.5	.620**
İntraoperative complication	2 (6.45)	1 (3.45)	1 (3.3)	.799*
Intraoperative hemorrhage	2 (6.4)	1 (3.4)	-	
Vas deferens injury	-	-	1 (3.3)	
Postoperative complication	2 (6.45)	4 (13.8)	4 (13.3)	.594*
Hematoma	1 (3.2)	2 (6.9)	1 (3.3)	
Seroma	-	1 (3.4)	2 (6.7)	
Epididymitis	-	1 (3.4)	-	
Loss of sensation due to femoral cutaneous nerve damage	1 (3.2)	-	1 (3.3)	
Chronic pain	2 (6.45)	1 (3.4)	2 (6.7)	.999*
Recurrens	1 (3.2)	2 (6.9)	3 (10.0)	.569*

*Chi-square test, **Kruskal–Wallis test (mean ± SD instead of n).

the operation times of the surgeon in all 3 techniques were similar in our study.

Many recent studies have reported that laparoscopic hernia repair has a shorter length of hospital stay compared to the open technique.[2,16] Köckerling et al.[18] found that TEP was superior to TAPP in terms of length of hospital stay whereas other researchers observed that there was no significant difference between the 2 techniques in terms of length of hospital stay.[17,19] The most important factor determining the return to work is postoperative pain and many studies have reported a shorter return to work time in laparoscopic methods.[16,17] However, TAPP has also been reported to be superior to TEP in terms of early recovery and return to work.[20] It was seen in our study that the length of hospital stay of all 3 techniques was similar.

The most important intraoperative complications in the repair of inguinal hernia are vas deferens, gonadal veins, other adjacent veins such as iliac and epigastric artery/vein, and nerve injury in our study.[7] Nerve injuries may not be noticed intraoperatively and this may present as chronic pain or loss of sensation in the postoperative period. The fact that there is a more limited field of operation and unknown anatomy in the TEP technique and entering the abdominal cavity in the TAPP technique appear to be riskier for young surgeons in terms of susceptibility to complications compared to open repair; however, studies show that laparoscopic techniques are clearly superior in terms of intraoperative complications.[18,21] The intraoperative complication rates of TAPP and TEP have proven to be similar.[17,18] We found the intraoperative complication rates in all 3 groups to be similar in our study.

The most common early postoperative complications after inguinal hernia repair are hematoma, seroma, urinary retention, and wound site infection. There are different results in the literature on the postoperative complication rates of the 3 techniques we compared in our study. A prospectively designed registry-based study comparing Lichtenstein and TEP repairs showed that TEP was superior regarding postoperative complications.[22] However, it was reported that the seroma rate was higher in the TEP technique compared to Lichtenstein and other complication rates were similar.[23]

Chronic pain is defined as pain that exceeds 3 months and affects daily activity. Chronic pain occurs in 10-12% of all inguinal hernia repair cases and 6% of laparoscopic repairs (range 1-16%).[5,13] The use of mesh seems to reduce the risk of chronic pain. Lichtenstein has been reported to cause higher chronic pain and disability requiring 1-3% treatment compared to laparoscopic techniques.[21,24] Strong risk factors for chronic pain are female gender, young age, operation for a recurrent hernia, open repair technique, and high early postoperative pain intensity.[5] Other risk factors for chronic postoperative inguinal pain (CPIP) with a low level of evidence include lower preoperative optimism, inadequate use of sutures, staples, and clips, nerve-ignoring operation technique, mesh type (heavyweight mesh in open repair), less experienced surgeon, sensory dysfunction in the groin, and postoperative complications (hematoma, infection).[5] The total chronic pain rate was 5.5% and there were no significant differences between the 3 techniques in our study. However, the fact that the risk factors that may cause chronic pain in the cases in our study could not be adequately analyzed is a limitation.

The optimal management of chronic pain following inguinal hernia surgery should begin with a thorough clinical examination to rule out other causes of chronic pain and to rule out a recurrence. Initially, watchful waiting can be tried if it can be tolerated by the patient, and then systemic pain killers, escalating to blocks, radiofrequency treatment, and

surgery as the final option.[25] Surgery should include mesh removal and triple neurectomy following anterior approaches or mesh and tack removal following a posterior approach. These procedures should be performed by experienced hernia surgeons. In our study, nonsteroidal anti-inflammatory drugs, gabapentinoids, and tricyclic antidepressants were sufficient in the management of chronic pain.

Today, the recurrence rate of inguinal hernia is still 11%.[26] A meta-analysis reported that there was no significant difference between open and laparoscopic techniques in terms of recurrence.[24,27,28] Total extraperitoneal was associated with an increased risk of recurrence relative to Lichtenstein whereas TAPP was not associated in a meta-analysis by O'Reilly et al.[8] Late recurrence hernia biology arises from aging and patient-related factors whereas early recurrence is usually caused by technical factors.[29] A 50-year follow-up is required to determine the actual recurrence rate after inguinal hernia repair.[26] The mean follow-up period was 14.7 months and there was no significant difference between the groups in terms of recurrence in our study.

It can be said that the surgeon felt more confident and safe thanks to the ease of intra-abdominal anatomical dissection, which they were familiar with at the beginning of the learning curve while performing TAPP considering that the surgeon who performed the surgery was experienced in Lichtenstein and had just completed the learning curve in laparoscopic methods. However, although he initially hesitated to TEP, we would like to note that his personal preference for TEP as an easy and practical method when the learning curve reaches the plateau.

When we compare the results of our study with the literature, it seems that the rates of the operation time, length of hospital stay, perioperative complication rate, postoperative pain, and recurrence for all 3 techniques are within the acceptable range.[17,24,28] It is encouraging that young surgeon can safely apply these 3 techniques in hernia repair even though the low number of patients is a limitation of our study.

Conclusion

Operation time, length of hospital stay, perioperative complications, and recurrence rates are similar in open and laparoscopic inguinal hernia repairs. Laparoscopic techniques are also safe and useful for young surgeons with surgical competence.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of İstanbul University-Cerrahpaşa (Date: February 8, 2021, Number: 25848).

Informed Consent: The written informed consent was obtained from all patients prior to participating in this study.

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References

1. Primatesta P, Goldacre MJ. Inguinal hernia repair: incidence of elective and emergency surgery, readmission, and mortality. *Int J Epidemiol*. 1996;25(4):835-839. [CrossRef]
2. Pahwa HS, Kumar A, Agarwal P, Agarwal AA. Current trends in laparoscopic groin hernia repair: a review. *World J Clin Cases*. 2015;3(9):789-792. [CrossRef]
3. Wellwood J, Sculpher MJ, Stoker D, et al. Randomised controlled trial of laparoscopic versus open mesh repair for inguinal hernia: outcome and cost. *BMJ*. 1998;317(7151):103-110. [CrossRef]
4. Simons MP, Aufenacker TJ, Berrevoet F, et al. World guidelines for groin hernia management. The Hernia Surge Group 2017.
5. Reinpold W. Risk factors of chronic pain after inguinal hernia repair: a systematic review. *Innov Surg Sci*. 2017;2(2):61-68. [CrossRef]
6. Berndsen F, Arvidsson D, Enander LK, et al. Postoperative convalescence after inguinal hernia surgery: prospective randomized multicenter study of laparoscopic versus shouldice inguinal hernia repair in 1042 patients. *Hernia*. 2002;6(2):56-61. [CrossRef]
7. Yasukawa D, Aisu Y, Hori T. Crucial anatomy and technical cues for laparoscopic transabdominal preperitoneal repair: advanced manipulation for groin hernias in adults. *World J Gastrointest Surg*. 2020;12(7):307-325. [CrossRef]
8. O'reilly EA, Burke JP, O'connell PR. A meta-analysis of surgical morbidity and recurrence after laparoscopic and open repair of primary unilateral inguinal hernia. *Ann Surg*. 2012;255(5):846-853. [CrossRef]
9. Scott NW, McCormack K, Graham P, et al. Open mesh versus non-mesh for repair of femoral and inguinal hernia. *Cochrane Database Syst Rev*. 2002;4(4):CD002197. [CrossRef]
10. Neumayer L, Giobbie-Hurder A, Jonasson O, et al. Open mesh versus laparoscopic mesh repair of inguinal hernia. *N Engl J Med*. 2004;350(18):1819-1827. [CrossRef]
11. Lichtenstein IL, Shulman AG, Amid PK, Montllor MM. The tensionfree hernioplasty. *Am J Surg*. 1989;157(2):188-193. [CrossRef]
12. Amid PK, Shulman AG, Lichtenstein IL. Open tensionfree repair of inguinal hernias: the Lichteinstein technique. *Eur J Surg*. 1996;162(6):447-453.
13. Köckerling F, Simons MP. Current concepts of inguinal hernia repair. *Visc Med*. 2018;34(2):145-150. [CrossRef]
14. Hernia Surge Group. International guidelines for groin hernia management. *Hernia*. 2018;22(1):1-165. [CrossRef]
15. Schouten N, Elshof JWM, Simmermacher RKJ, et al. Selecting patients during the "learning curve" of endoscopic Totally

Extraperitoneal (TEP) hernia repair. *Hernia*. 2013;17(6):737-743. [CrossRef]
16. Wu JJ, Way JA, Eslick GD, Cox MR. Transabdominal preperitoneal Versus open repair for primary unilateral inguinal hernia: a meta-analysis. *World J Surg*. 2018;42(5):1304-1311. [CrossRef]
17. Gong K, Zhang N, Lu Y, et al. 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. *Surg Endosc*. 2011;25(1):234-239. [CrossRef]
18. Köckerling F, Bittner R, Jacob DA, et al. TEP versus TAPP: comparison of the perioperative outcome in 17,587 patients with a primary unilateral inguinal hernia. *Surg Endosc*. 2015;29(12):3750-3760. [CrossRef]
19. Vărcuş F, Duţă C, Dobrescu A, et al. Laparoscopic repair of inguinal hernia TEP versus TAPP. *Chirurgia*. 2016;111(4):308-312.
20. Nguyen H. Laparoscopic inguinal herniorrhaphy. In: Cameron J, Cameron A., eds. *Current Surgical Therapy*. Philadelphia: Elsevier Saunders; 2014:1325-1334.
21. Łomnicki J, Leszko A, Kuliś D, Szura M. Current treatment of the inguinal hernia: the role of totally extraperitoneal (TEP) hernia repair. *Folia Med Cracov*. 2018;58(3):103-114. [CrossRef]
22. Köckerling F, Stechemesser B, Hukauf M, Kuthe A, Schug-Pass C. TEP versus Lichteinstein: which technique is better for the repair of primary unilateral inguinal hernias in men? *Surg Endosc*. 2016;30(8):3304-3313. [CrossRef]
23. Simons MP, Aufenacker T, Bay-Nielsen MB, et al. European Hernia Society guidelines on the treatment of inguinal hernia in adult patients. *Hernia*. 2009;13(4):343-403. [CrossRef]
24. 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. *Surg Endosc*. 2005;19(2):188-199. [CrossRef]
25. Andresen K, Rosenberg J. Management of chronic pain after hernia repair. *J Pain Res*. 2018;11:675-681. [CrossRef]
26. Köckerling F, Koch A, Lorenz R, et al. How long do we need to follow-up our hernia patients to find the real recurrence rate? *Front Surg*. 2015;2:24. [CrossRef]
27. EU Hernia Trialists Collaboration. Laparoscopic compared with open methods of groin hernia repair: systematic review of randomized controlled trials. *Br J Surg*. 2000;87(7):860-867. [CrossRef]
28. Memon MA, Cooper NJ, Memon B, Memon MI, Abrams KR. Meta-analysis of randomized clinical trials comparing open and laparoscopic inguinal hernia repair. *Br J Surg*. 2003;90(12):1479-1492. [CrossRef]
29. Sarosi GA, Jr, Ben-David K. Recurrent inguinal and femoral hernia. *UpToDate*. 2014. Available at: [CrossRef].