



Comparison of enhanced view-totally extraperitoneal technique and totally extraperitoneal technique in S1 scrotal hernia repair

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ABSTRACT

Objective: The treatment of scrotal hernias may vary according to the surgeon's experience. Although open anterior approaches are mostly preferred, specialized hernia surgeons prefer laparoscopic approaches. The study evaluated the safety and efficacy of the laparoscopic enhanced view-totally extraperitoneal (eTEP) technique and the laparoscopic totally extraperitoneal (TEP) technique in treating scrotal hernias.

Material and Methods: The retrospective cohort study compared patients with unilateral scrotal hernia who underwent eTEP or TEP from November 2022 to October 2023. The two groups were compared in demographic characteristics and operative and postoperative data. The main result of this study was the recurrence rate.

Results: A study analyzed 54 patients: 30 underwent the eTEP technique, and 24 underwent the TEP technique. No significant difference was observed between the groups regarding recurrence rates, incidence of chronic pain, time of the surgical procedure, length of stay, time taken to resume daily activities, pneumoperitoneum occurrence, and complications, particularly hematoma and seroma formation. Patients were followed up for an average of 19 months (± 5.2).

Conclusion: The comparison of the eTEP technique to traditional TEP for scrotal hernia repair has not demonstrated any conclusive evidence of the superiority of eTEP. The outcomes associated with the eTEP technique were found to be comparable to those of TEP, with an average follow-up period of 19 months. Similar to TEP, the eTEP technique demonstrates both safety and feasibility in the management of scrotal hernias. Furthermore, it is necessary for prospective randomized studies to compare these two techniques directly, specifically in the realm of scrotal hernia repair.

Keywords: Laparoscopic scrotal hernia repair, scrotal hernia, enhanced view-totally extraperitoneal

INTRODUCTION

A scrotal hernia is defined as an inguinal hernia that has migrated into the scrotum. Köckerling et al. (1) found a 2.7% rate of scrotal hernia in 98,321 inguinal hernia patients. Whether the scrotal hernia is reduced or whether the hernia is giant can pose a challenge for the surgeon (2). Although open techniques are mostly preferred in scrotal hernia repairs, laparoscopic techniques can also be used (3).

Köckerling et al. (1) reported higher rates of postoperative complications after scrotal hernia repair, complication-related reoperations, and overall complications such as bleeding/seroma formation, ileus, wound site infections, and bowel injury (1). The management of scrotal hernias is recommended to be managed by teams, including specialized abdominal wall hernia surgeons, due to the high complications and complexity of scrotal hernias (3).

Total extraperitoneal (TEP) and transabdominal preperitoneal (TAPP) are the most commonly performed laparoscopic techniques for scrotal hernia repair. If laparoscopic repair of the scrotal hernia is to be performed, Bansal et al. (4) recommended TEP if the hernia can be reduced; otherwise, they recommended TAPP. The primary advantage of TEP repair is the reduced risk of intraperitoneal organ injury and the formation of intra-abdominal adhesions. Additionally, unlike TAPP repair, TEP does not necessitate the use of a peritoneal flap for closure (5,6). Laparoscopic scrotal hernia repairs can also be performed with the enhanced view-totally extraperitoneal (eTEP) method described by Daes (7). With the eTEP technique, the extraperitoneal space appears

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larger, the working ports are more ergonomic, and accidental pneumoperitoneum can be tolerated more easily. Daes (8) has indicated that the eTEP technique offers significant advantages in the repair of large hernias and scrotal hernias, highlighting its potential effectiveness in this surgical procedure. However, there is no literature study comparing the eTEP technique with other laparoscopic techniques in scrotal hernias. Based on this point, we compared the eTEP technique with the TEP technique in scrotal hernias. This is the first study comparing eTEP and TEP techniques for scrotal hernia repairs.

MATERIAL and METHODS

A retrospective cohort study was conducted at a single-center. A flow diagram is shown in Figure 1. The study included patients with unilateral scrotal hernia after anterior repair who underwent eTEP or TEP between November 2022 and October 2023. Data were collected retrospectively from medical records and entered into a database. Following data collection, a comparative analysis of the results of the two techniques was performed. Patients are divided into the eTEP group and the TEP group. We recorded and compared demographic characteristics such as age, gender, ASA scores, body mass index (BMI), and smoking habits across both groups. Operative and postoperative data were recorded and compared in both groups.

Patients with reducible unilateral scrotal hernia, and aged 18-65, were included. As the European Hernia Society (EHS) recommended, S1 hernias were included, and S2 and S3 hernias were excluded (3). Patients under 18, and over 65 years of age,

individuals with complex inguinal hernias such as incarcerated, strangulated, or recurrent hernias, along with those having bilateral hernias, were excluded. Patients with obesity (BMI ≥ 30) and those who are pregnant were also excluded.

Hernia repair procedures were conducted by a single surgeon who specializes in laparoscopic inguinal hernia repair. This surgeon possesses extensive experience with the eTEP and TEP techniques, having successfully performed these methods in a minimum of 250 cases.

The Ethics Committee of the University of Health Sciences Türkiye, Van Training and Research Hospital approved the study (date: 29/11/2024, no: GOKAEK-2024-01-05), and written informed consent was obtained from the participants. All procedures conducted in studies involving human participants adhered to the ethical standards established by the institutional research committee, as well as the principles outlined in the 1964 Helsinki Declaration and its subsequent amendments or comparable ethical standards.

Surgical Methods

All patients underwent the surgical procedure under general anesthesia. Prior to the operation, each patient received an infusion of 1 gram of intravenous cefazolin as a prophylactic measure. In the postoperative period, to ensure effective pain management, a standardized intravenous dose of 1 gram of paracetamol, along with tramadol administered at a dosage of 1-2 mg/kg, was provided to each patient. In our study, urinary catheterization is not routinely performed in scrotal hernia repairs. Each patient underwent placement of a polypropylene mesh measuring 15x12x10 cm.

eTEP Procedure

Following the establishment of a sterile field and positioning of the patient in the supine orientation, an incision was made 4 cm lateral and 4 cm superior to the umbilicus on the contralateral side of the hernia. Upon completing the skin incision, the posterior rectus sheath was identified, and access to the retromuscular space was achieved using a 0-degree telescope in conjunction with an optical trocar. The 0-degree telescope was replaced with a 30-degree one. Insufflation was effectively established at a pressure of 12 mmHg, and telescopic blunt dissection was initiated with precision. A 5 mm secondary trocar was successfully inserted at the junction of the semilunar line and the arcuate line on the contralateral side of the hernia. The retrorectus space, particularly near the midline, was expertly dissected using an energy device. The posterior rectus sheath was thoroughly divided under clear visualization with laparoscopic scissors, starting from its medial attachment at the arcuate line and advancing to the umbilical level. Trocar placement and arcuate line division are shown in Figures 2, 3. In this way, the extraperitoneal area was further dissected with the energy device, and the field of view was widened. A third 5 mm

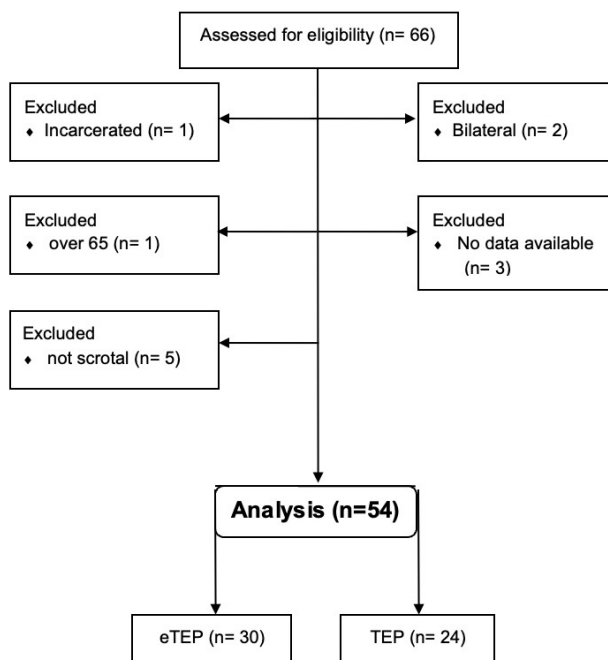


Figure 1. Flow diagram.

eTEP: Enhanced view-totally extraperitoneal, TEP: Totally extraperitoneal

trocar from the umbilicus was inserted into the extraperitoneal area. After trocars' insertion, the steps to establish a critical view of the myopectineal orifice were achieved (9). Preperitoneal dissection was achieved medially until 3-4 cm inferior to the pubic bone, and laterally or into the Bogros cavity until the psoas muscle was seen. The hernia sac was dissected from the cord, and its elements, and testicular vessels. The hernia sac was first opened in the middle part, revealing no structure inside, and was then transected. The proximal hernia sac was tied. The distal sac was left untouched. The peritoneal loop (10) was divided, and the peritoneum was dissected above the iliac vessels, and retracted. Thus, the iliac vessels, the cord with its structures, and the psoas muscle were better visualized. The polypropylene mesh was placed to overlap direct, indirect, and femoral hernia sites by at least 3-4 cm and at least 2-3 cm below the pubis. The mesh was not fixed. While performing desufflation under direct visualization, care was taken to prevent mesh displacement.

TEP Procedure

After establishing a sterile field and positioning the patient supine, an incision was made in the ipsilateral side of the hernia adjacent to the umbilicus. Following the initial skin incision, the rectus sheath was identified and subsequently incised. The rectus muscle was retracted laterally using a retractor, allowing visualization of the posterior rectus sheath. A 10 mm trocar was then introduced. Insufflation was achieved with 12 mmHg pressure, and telescopic blunt dissection was begun from the midline to the pubic bone. In the midline, the second trocar was positioned three fingerbreadths below the umbilicus, while the third trocar was placed three fingerbreadths below the second trocar under direct visualization. Following the insertion of the trocars, the procedure continued in the same manner as the eTEP technique.

Outcomes

All demographic data (age, gender, BMI of the patients, smoking history, and ASA scores) were recorded. Hernia size classification, use of tackers, the duration of the operation (from the incision through the skin closure), pneumoperitoneum (PP), and method of hernia sac division were recorded. Postoperative complications such as hematoma and seroma, length of hospitalization, time taken to resume daily activities, chronic pain, and recurrence were recorded.

Hernia classification was performed according to EHS (2).

Chronic pain is characterized as moderate pain persisting no less than three months, thereby impacting daily activities.

Time taken to resume daily activities is defined as returning to work for the employed person who does not do heavy work, and doing all household chores without any outside help for the person at home.

The primary objective of this study was to assess the recurrence of hernias, while the secondary objectives encompassed both operative and postoperative findings.

Statistical Analysis

Before conducting further analyses, the Kolmogorov-Smirnov and Shapiro-Wilk tests were employed to evaluate the normality of the variables. If the data were normally distributed, parametric tests were used. An independent sample t-test was used to compare parametric values. Subsequently, the Mann-Whitney U test was utilized to compare the non-parametric measurements between groups. The relationships or differences between groups concerning categorical variables were analyzed using

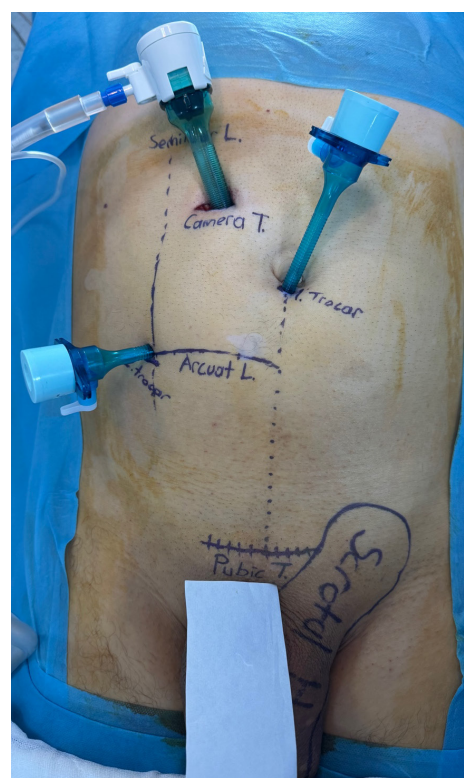


Figure 2. eTEP trocars.

eTEP: Enhanced view-totally extraperitoneal

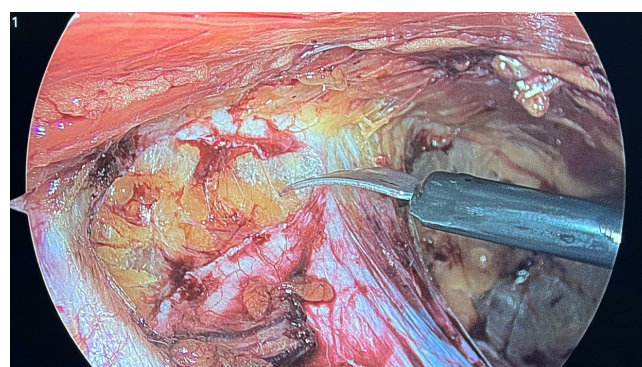


Figure 3. Arcuat division.

chi-square and Fisher's exact tests. Comparative results related to other demographic characteristics were presented as ratios of qualitative variables, while quantitative variables were reported as means accompanied by standard deviations. Statistical analysis was conducted using the Statistical Package for the Social Sciences (SPSS), version 22.0 (SPSS Inc., Chicago, IL, USA). In all analyses, a p-value of less than 0.05 was regarded as statistically significant.

RESULTS

A total of 54 patients were analyzed. A flow diagram is shown in Figure 1. Thirty patients were in the eTEP group, and twenty-four patients were in the TEP group. The median age was 31.5 (range 20-64) in the eTEP group and 37 (range 18-64) in the TEP group ($p=0.95$). The ASA scores were similar in both groups ($p=0.92$). The mean BMI scores were 26.3 (± 3.5) in the eTEP group and 26.2 (± 2.6) in the TEP group ($p=0.47$). Smoking was similar in both groups ($p=0.54$). Demographic characteristics are shown in Table 1. In no patient was the surgical technique converted to TAPP or open repair.

The mean operative time was 55.3 (± 13.7) minutes for eTEP and 54 (± 15.2) minutes for TEP ($p=0.76$). Hernia classification was similar between the groups ($p=0.93$). In the eTEP group, L1 was 5 (16.7%), L2 was 21 (70%), and L3 was 4 (13.3%). In the TEP group, L1 was 5 (20.8%), L2 was 16 (66.7%), and L3 was 3 (12.5%). The use of a tackler was absent in both groups. Pneumoperitoneum was 100% in both groups. In the eTEP group, the hernia sac was divided using LigaSure™ in 5 (16.7%) patients and a pretied suture loop in 25 (83.3%) patients. In the TEP group, the LigaSure™ was

used to divide the hernia sac in 4 (16.7%) patients, and a pretied suture loop was utilized in 20 (83.3%) patients. Operative data are shown in Table 2.

All patients were followed up for a mean of 19 (± 5.2) months (eTEP group 19.9 ± 5 and TEP group 18.1 ± 5.5 , $p=0.22$). Postoperative complications were similar in both groups ($p=0.96$). Hematoma occurred in 4 cases (13.3%) in the eTEP group and 3 cases (12.5%) in the TEP group. Seroma was observed in 3 (10%) among the eTEP group and 3 (12.5%) among the TEP group. No patient reported complications such as inferior epigastric vessel injury, surgical emphysema, enterotomy/serosal injury, bladder injury, scrotal edema, cord edema, skin ecchymosis, urinary retention.

Chronic pain was seen in only 1 (3.3%) patient in the eTEP group. The length of stay was 1 day in both groups. The median time taken to resume daily activities was 7 (range 3-15) days in the eTEP group and 7 (range 3-14) days in the TEP group ($p=0.96$). No recurrence was noted in any patient in either group. Postoperative data are shown in Table 3.

	eTEP (n=30)	TEP (n=24)	p
Age median (range) *	31.5 (20-64)	37 (18-64)	0.95
Gender (male/female)	30/0	24/0	-
ASA n (%)			0.47
I	17 (56.7%)	10 (41.7%)	
II	12 (40%)	12 (50%)	
III	1 (3.3%)	2 (8.3%)	
BMI (kg/m ²) mean \pm SD **	26 (± 2.8)	24.6 (± 3.5)	0.11
Smoke n (%)	8 (26.7%)	7 (29.2%)	0.54
Hernia classification n (%)			0.93
L1	5 (16.7%)	5 (20.8%)	
L2	21 (70%)	16 (66.7%)	
L3	4 (13.3%)	3 (12.5%)	

ASA: American Society of Anaesthesiologists, BMI: Body mass index, *: Mann-Whitney U test was used, **: Independent sample t-test was used. SD: Standard deviation, eTEP: Enhanced view-totally extraperitoneal, TEP: Totally extraperitoneal

	eTEP (n=30)	TEP (n=24)	p
Use of tackler n (%)			-
Yes	0	0	
No	30 (100%)	24 (100%)	
PP n (%)	30 (100%)	24 (100%)	-
Sac division n (%)			0.64
LigaSure™	5 (16.7%)	4 (16.7%)	
Pretied suture loop	25 (83.3%)	20 (83.3%)	
Operation time (min.) mean \pm SD **	55.3 (± 13.7)	54 (± 15.2)	0.76

PP: Pneumoperitoneum, **: Independent sample t-test was used. SD: Standard deviation, eTEP: Enhanced view-totally extraperitoneal, TEP: Totally extraperitoneal, SD: Standard deviation

	eTEP (n=30)	TEP (n=24)	p
Follow-up (month) mean \pm SD **	19.9 (± 5)	18.1 (± 5.5)	0.22
Complication n (%)			0.96
None	23 (76.7%)	18 (75%)	
Hematoma	4 (13.3%)	3 (12.5%)	
Seroma	3 (10%)	3 (12.5%)	
Chronic pain n (%)	1 (3.3%)	0 (0%)	0.56
Length of stay (day)	1	1	-
Time taken to daily activities (day) median (range) *	7 (3-15)	7 (3-14)	0.96
Recurrence	0	0	-

*: Mann-Whitney U test was used, **: Independent sample t-test was used. SD: Standard deviation, eTEP: Enhanced view-totally extraperitoneal, TEP: Totally extraperitoneal

DISCUSSION

In our study, the demographic characteristics of the patients in both groups exhibited a similar distribution, indicating that the patient groups were homogeneous (Table 1). During a mean follow-up of 19 months, the eTEP technique showed results similar to the TEP technique for scrotal hernia repair.

Open repairs for scrotal hernias are recommended when the hernia is irreducible or large (11). The specialized hernia surgeon can safely perform laparoscopic techniques for scrotal hernias (3). The advantages of minimally invasive techniques, such as faster recovery and cost-effectiveness, are also observed in scrotal hernias (11). The selection of the laparoscopic technique is determined by the surgeon's level of expertise and the specific characteristics of the scrotal hernia. Bansal et al. (4) recommended the TEP technique if the scrotal hernia can be reduced, with a 25% conversion rate to TAPP (4). Köckerling et al. (1) reported that TAPP is the safest technique for irreducible scrotal hernias. Daes (7) described an enhanced totally extraperitoneal (eTEP) technique for the management of large scrotal hernias. This approach involves the division of the hernia sac and the fixation of the distal end laterally to the posterior inguinal region, aimed at minimizing the risk of seroma formation (7).

There are very few studies comparing TEP and TAPP in scrotal hernias (1,4). There are also no studies in the literature comparing the eTEP technique with other laparoscopic techniques in scrotal hernias. Our study is the first. Laparoscopic scrotal hernia repair is mostly concerned with reducing seroma formation (7,12-14). Various techniques have been described in laparoscopic approaches to reducing seroma formation. Daes (7) described an eTEP technique in 6 patients with scrotal hernias, ligating the proximal end and pulling up the edges of the distal sac, which are then fixated lateral to the posterior inguinal canal 5-7 cm superior to the ilio-pubic tract to avoid seroma formation. This was assisted by lowering insufflation pressure, pulling the testis down, and external pressure to the ipsilateral scrotum, with care taken to avoid cord structures (7). A recent review revealed that transection of the indirect hernia sac is associated with a higher incidence of seroma but does not increase the occurrence of other complications (15). In our study, no intraoperative auxiliary techniques were used to reduce seroma.

The eTEP technique has many advantages over TEP. The eTEP technique has been found to be particularly advantageous in the management of scrotal hernias, bilateral hernias, incarcerated hernias, patients with obesity, and those with a short distance between the umbilicus and the pubic tubercle. In addition, the eTEP technique tolerates pneumoperitoneum very well, as it creates more extraperitoneal space, compared to TEP (8), which contributes to better tolerance. Considering the more ergonomic port placement and better-tolerated pneumoperitoneum,

however, the operation time was similar in both groups. The fact that demographic characteristics were similar, the classification of the scrotal hernia was the same (Table 1), the scrotal hernia was reducible, and the scrotal hernia was not giant (not S2, S3 in EHS classification) was associated with similar operation times in both groups.

Mesh fixation is still a controversial issue in inguinal hernias. Research indicates that the avoidance of mesh fixation may lead to a reduction in postoperative pain as well as a decrease in operative time in laparoscopic inguinal hernia repair (16). There are no studies evaluating mesh fixation, especially in scrotal hernias. According to the HerniaSurge Group International Guideline, mesh fixation is recommended only in large direct hernias in TAPP or TEP repair to reduce the possibility of recurrence (11). Considering that mesh fixation may increase chronic pain (17), in our study, no patient underwent mesh fixation because all patients had lateral hernias, even though some had large defects (L3).

In our study, pneumoperitoneum was present in all patients in both groups (Table 2). The hernia sac was divided after it was partially opened, and its contents were clearly seen. The hernia sac division was usually performed in its narrowest part. The hernia sac division performed in our study is similar to the Primary Abandon-of-the-Sac technique (12) applied in the extraperitoneal space. In both groups, the hernia sac division was performed using a pretied suture loop (18) and LigaSure™. LigaSure™ was shown to be effective in an experimental rat study (19) and is useful for peritoneal defect closure. Both methods were applicable and effective in a short time.

Regardless of whether the surgical approach is open or laparoscopic, the incidence of complications is elevated in cases involving scrotal hernias compared to non-scrotal hernias (1,3). Transection of the hernia sac may increase seroma formation in the scrotal hernia (20). A randomized study found that sac transection or reduction did not increase seroma formation (21). Leibl et al. (22) reported that approximately 10% of seromas form in aspirates from scrotal hernias. Nikolian et al. (23) found hematoma/seroma formation in 23.9% of the participants in their prospective study and reported spontaneous healing without aspiration. In our study, hematoma/seroma formation was similar between groups, and the rate was similar to that of the studies in the literature. After 3 months of follow-up, hematoma/seroma healed without intervention in both groups.

The risk of complications was higher in scrotal hernias than in non-scrotal hernias, but chronic pain did not fall into this category. Chronic pain at 1 year was less in patients with scrotal hernias compared to those with other types of hernias (3). Considering the advantage of laparoscopy in reducing chronic pain and enabling rapid recovery, laparoscopic repair

of scrotal hernias, chronic pain is expected to be very low. Our study supports this finding. Chronic pain occurred in one patient in our study, and this finding is similar to observations to observations in scrotal hernia studies in the literature (13,21). The range of lengths of stay for scrotal hernias is 0.93 to 5.5 days (20). Significant complications, including injuries to organs and vascular structures, have a direct impact on the duration of hospitalization. Since our patient population included reduced scrotal hernias and S1 hernias (not S2 and S3 in EHS classification) with very low complication rates, the length of stay was one day in both case groups.

Laparoscopic repairs are known to result in an earlier return to work than open repairs (11). However, no literature study compares laparoscopic repairs in scrotal hernias, in terms of return to work. It is believed that patients with uncomplicated scrotal hernias return to work earlier than those with complicated hernias. In our study, since patients had uncomplicated scrotal hernias (S1, reducible and not recurrent), the time taken to resume daily activities was similar in both groups.

Although the recurrence rate of scrotal hernias is higher than non-scrotal hernias, no recurrence occurred in our study subsequent to an average follow-up duration of 19 months. The most important reason for the absence of recurrence was that all steps of critical view of the myopectineal orifice, which must be performed in laparoscopic hernia repair, were completed. The mesh size was adequate and overlapped 3-4 cm above all potential hernia areas. A specialized hernia surgeon performed all cases. It was observed that the peritoneum covered the mesh during CO₂ desufflation to prevent mesh folding or displacement.

Study Limitations

Our study's major limitation is that it is retrospective. This field is open to surgeons interested in laparoscopic scrotal hernia repair, and prospective studies will significantly contribute to the literature. Another limitation is that 19 months is a short follow-up period for hernia recurrence. However, scrotal hernia repairs with short follow-up periods have also been observed in the literature. The follow-up period was sufficient to evaluate the feasibility of eTEP and TEP techniques in scrotal hernias.

CONCLUSION

The eTEP technique showed results similar to those of the TEP technique in scrotal hernias. Both eTEP and TEP techniques are safe and feasible. In addition, prospective randomized studies are clearly needed for laparoscopic repairs of scrotal hernias.

Ethics

Ethics Committee Approval: The Ethics Committee of the University of Health Sciences Türkiye, Van Training and Research Hospital approved the study (date: 29/11/2024, no: GOKAEK-2024-01-05).

Informed Consent: Informed consent was obtained from all participants who were included in this study.

Footnotes

Author Contributions

Concept - A.H.Y.; Fundings - A.H.Y.; Materials - M.E.U.; Supervision- A.H.Y.; Design - A.H.Y.; Data Collection or Processing - M.E.U.; Analysis or Interpretation - A.H.Y.; Literature Search - M.E.U.; Critical Review- A.H.Y.; Writing - A.H.Y.

Conflict of Interest: No conflict of interest was declared by the authors.

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