Laparoscopic transabdominal preperitoneal inguinal hernia repair using tackers versus sutures

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Background
Mesh fixation is an important step in laparoscopic transabdominal preperitoneal (TAPP) hernia repair because it reduces the risk of mesh migration. However, it is thought to carry a higher risk of acute and chronic pain than nonfixation, and leaving the mesh unfixed could result in a high recurrence rate.
Objective
To compare the effectiveness of sutured repair using tackers or sutures in laparoscopic TAPP surgical mesh fixation for inguinal hernia repair.
Patients and methods
At Damanhour Teaching Hospital in El-Beheira, Egypt, from September 2018 to November 2022, 60 patients who were eligible for laparoscopic TAPP unilateral inguinal hernia repair under general anesthesia participated in this randomized clinical trial. Two equal groups of patients were randomly assigned: group A had titanium tacks used to secure the mesh, whereas group B had polypropylene 2/0 sutures to achieve the same.
Results
Between the two groups, there were no statistically significant differences in terms of demographics, intraoperative problems, or postoperative complications. The length of the operation and the hospital stay were statistically considerably shorter for group A than for group B.
Conclusion
Although laparoscopic TAPP inguinal hernia repair greatly reduces postoperative discomfort, painkiller use, and delays return to normal activity, its limited use is owing to the rise in hospital expenditures brought on by the use of tackers. The results of sutured repair are identical to those of tacker repair, but they need longer hospital stay with longer operative time.

Keywords:
laparoscopic transabdominal preperitoneal, titanium tackers, totally sutured mesh

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Introduction

One of the most frequent general surgical procedures is inguinal hernia repair, which has resulted in a heavy financial and morbidity burden globally [1]. Previous research showed that compared with open hernia surgery, laparoscopic hernia repair has certain advantages in terms of postoperative pain scores, length of hospital stays, morbidity, early return to work, and healing [2]. The most popular laparoscopic procedures include completely extraperitoneal hernia repair and laparoscopic transabdominal preperitoneal (TAPP) [3]. The TAPP method's mesh fixation stage is crucial for maintaining the ideal repair location and strength as well as lowering the risk of mesh migration and recurrence [4]. Furthermore, the main factor contributing to persistent discomfort and hernia recurrence is insufficient and/or improper mesh fixation [5]. The most frequent and well-liked approach for mesh attachment is the use of tackers [4], although there have been reports of persistent discomfort and neuralgia brought on by nerve entrapment in tackers [6,7]. Unfortunately, owing to its lengthy learning curve and greater price, laparoscopic TAPP inguinal hernia repair is still not widely used among surgeons [8]. This study compared the effectiveness and safety of tacking mesh fixation against suturing during laparoscopic TAPP inguinal hernia repair.

Patients and methods

Each patient gave their written agreement to take part in the trial once the local ethics committee approved it. At the Damanhour Teaching Hospital in El-Beheira, Egypt, between September 2018 and November 2022, 60 patients who had a unilateral inguinal hernia and

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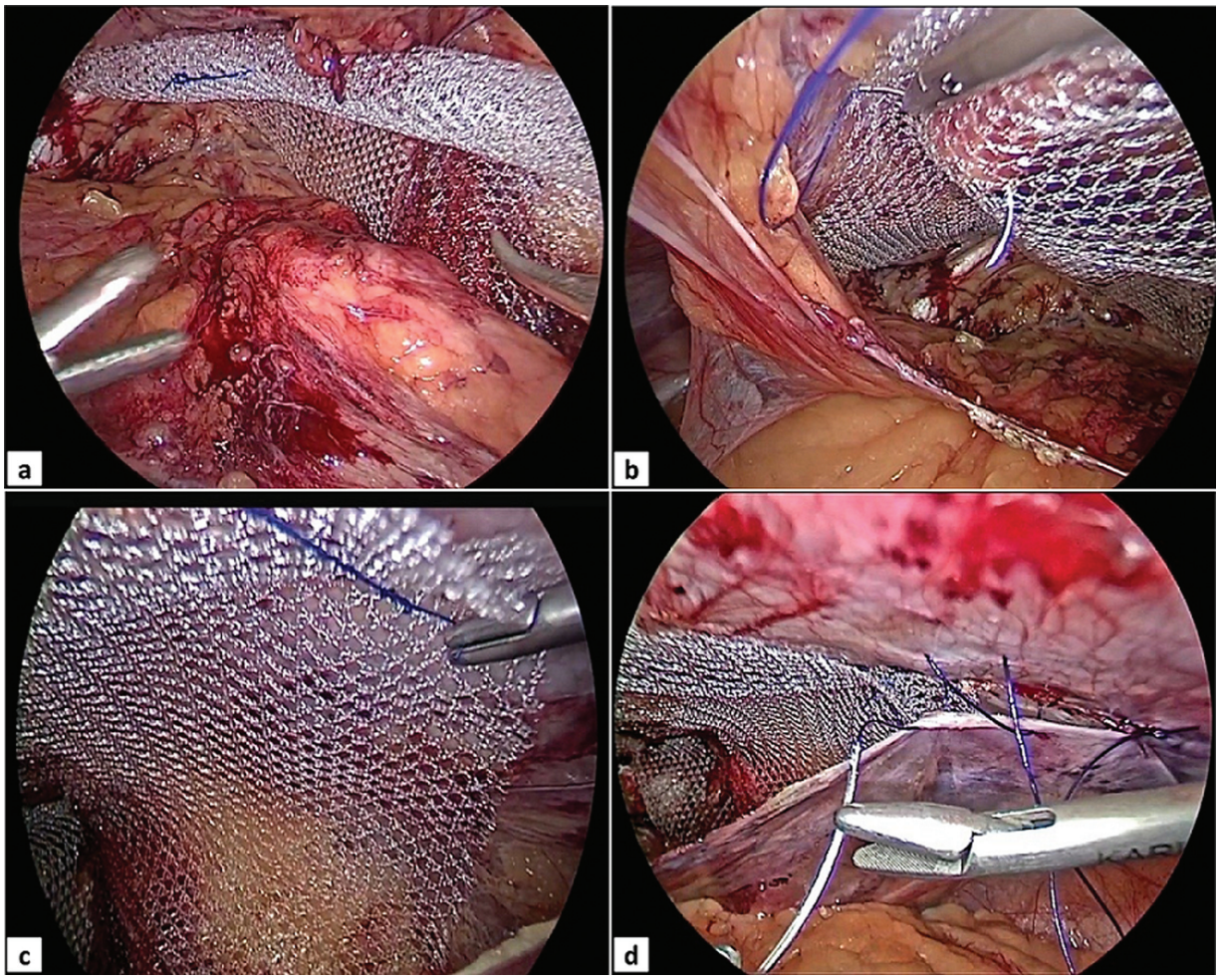
qualified for laparoscopic TAPP hernia repair under general anesthesia participated in this prospective, randomized trial. ClinicalTrials.gov recorded the trial (NCT05574751). Patients for this study were chosen based on clinical diagnosis, ultrasonographic results, and laboratory findings and recruited from the surgical department's outpatient clinic. Age of 21 years, a BMI of 35 kg/m^2, an American Society of Anesthesiologists score of I or II, and a unilateral inguinal hernia were the inclusion criteria. Bilateral inguinal hernias, massive inguinoscrotal hernias, incarcerated hernias, recurring hernias, strangulated hernias, prostatic illnesses, morbid obesity, and any conditions that would make general anesthesia unsafe were among the exclusion criteria. The patients were divided into two equal groups at random, with 30 patients each. Group A's mesh was fastened using titanium tackers, whereas group B's mesh was completely sutured with polypropylene 2/0. All cases were done as a day-case surgery procedure and were operated on by the same surgeon with 12 years of experience with laparoscopic surgery.

Surgical technique

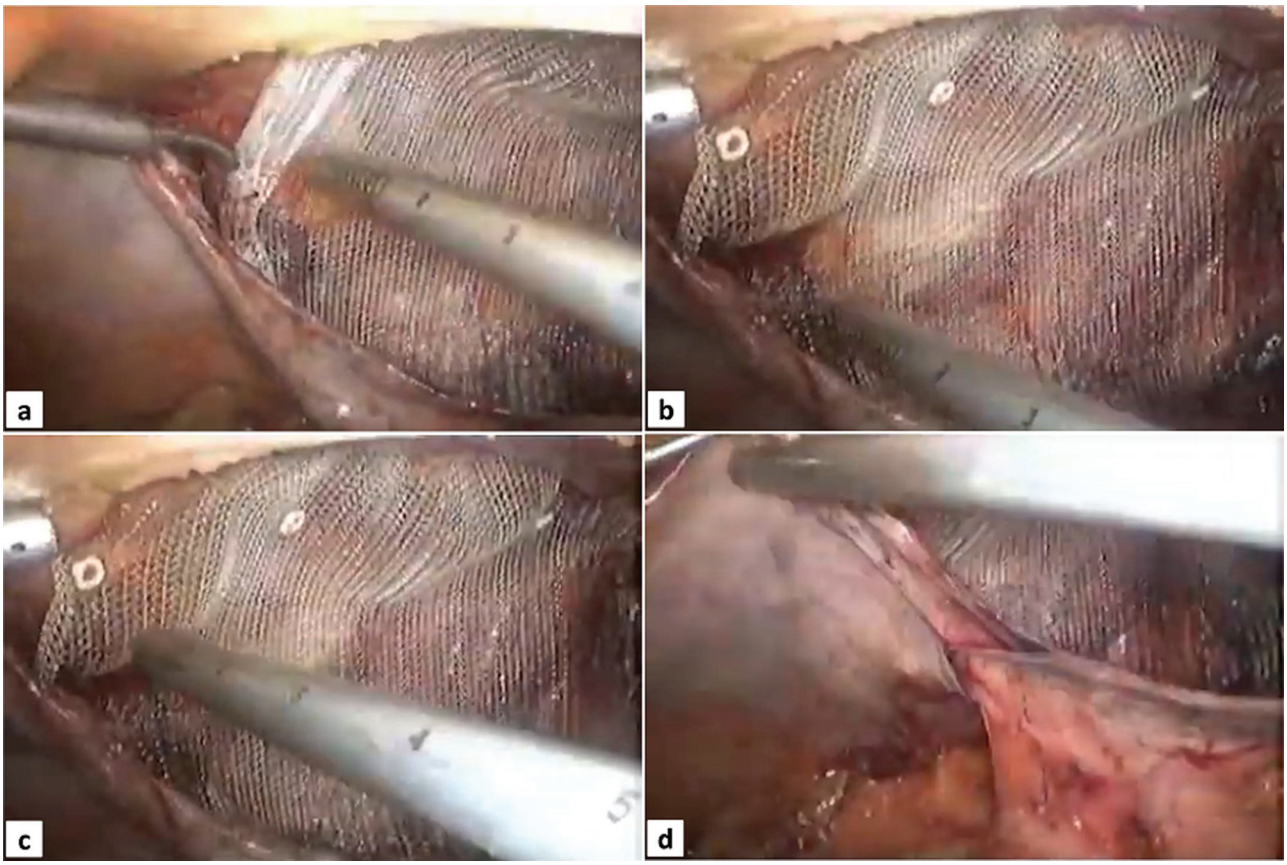
Before inducing anesthesia, 1 g of cefazolin was provided intravenously for preoperative antibiotic prophylaxis. CO_2 insufflation was carried out using the Veress needle via the umbilicus following the onset of general anesthesia and endotracheal intubation. A 10-mm trocar was inserted via the umbilicus once the patient was in the Trendelenburg position. To confirm the diagnosis, a laparoscope was inserted, and intraabdominal exploration was carried out. Under direct vision, two more 5-mm trocars were placed on either side of the rectus sheath at the umbilicus level. With a hock tool in the right hand and a grasper in the left, a formal dissection of the hernia area was carried out. A rolled size 10 15-cm synthetic polypropylene mesh was put after completely dissecting the hernia sac and making the peritoneal window (Fig. 1a). The mesh extended superiorly over 3–4 cm of the anterior abdominal wall, inferiorly down 1–2 cm below the pubis, laterally the iliopsoas muscle, and medially at least the pubic symphysis (Fig. 2a). Five titanium tackers were used to fix the mesh in group A on the

Figure 1



(a) Mesh positioning. (b and c) Mesh fixation using tackers. (d) Peritoneal window tacker closure.

Figure 2



(a) Insertion of a rolled 10×15 cm synthetic polypropylene mesh. (b and c) Mesh fixation using sutures. (d) Peritoneal window suture closure.

suprainguinal abdominal wall intersurface (ProTackTM 'Auto Suture' Fixation Device, 5 mm tacker with 30 helical fasteners; Covidien, Medtronic, United Kingdom) (Fig. 2b,c), whereas four polypropylene 2/0 sutures with rounded needles were used to fix the mesh in group B (Fig. 1b,c).

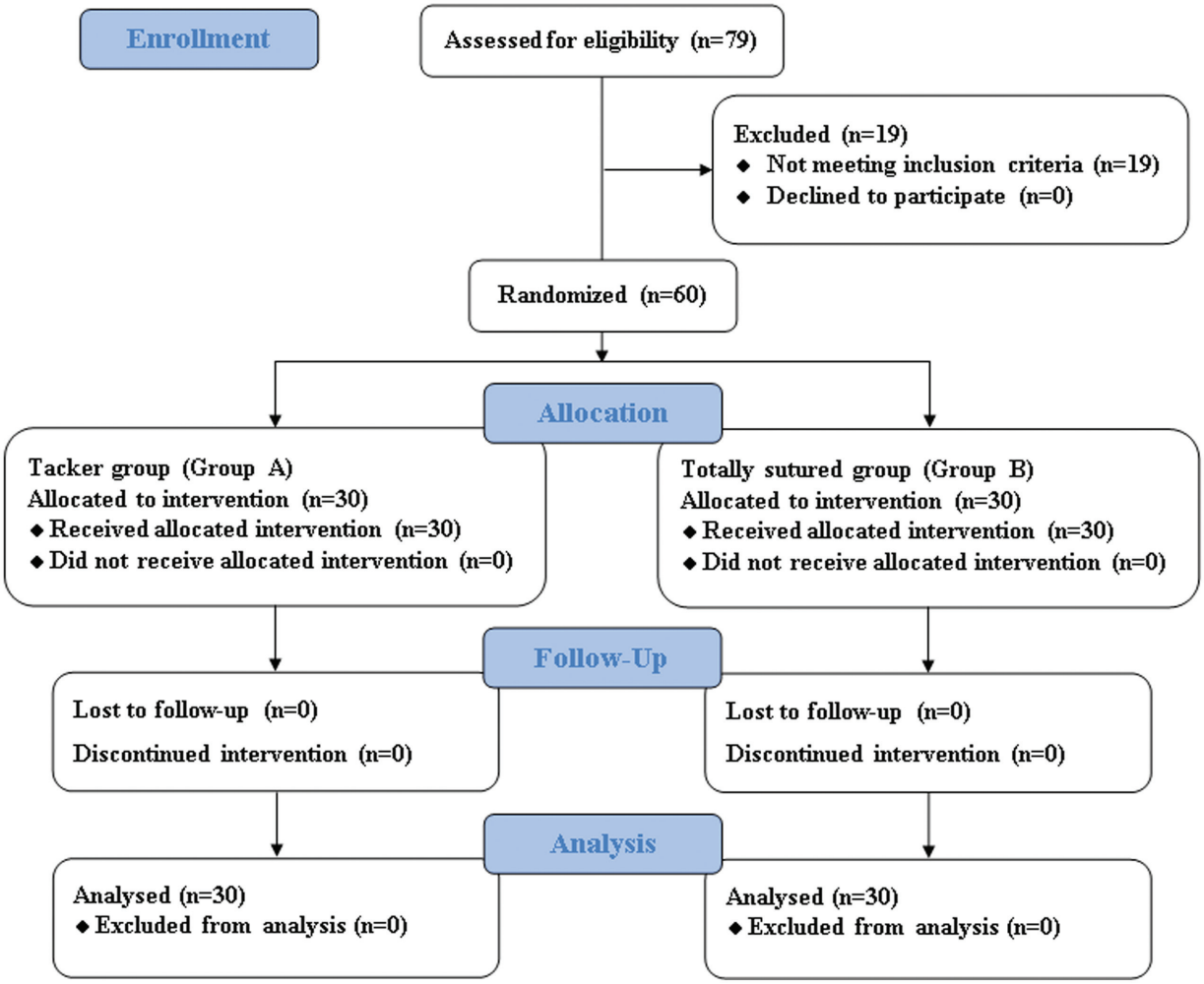
Precautions during mesh fixation

Avoiding bony structures, placing tackers or sutures above the pubic bone to reduce the chance of developing chronic osteitis, paying attention to the path of the inferior epigastric vessels, avoiding the triangles of doom and pain (2 cm above the iliopubic tract as a safety area), and only using five shots to secure the mesh are all recommended. After mesh fixation was complete, tackers were used in group A (Fig. 2d) to seal the peritoneal window (without leaving any gaps to avoid bowel or omentum adhesions) and polypropylene 2/0 sutures with rounded needles in group B (Fig. 1d). Gas from the inguinoscrotum and abdomen was removed, and trocars were withdrawn while being seen. Vicryl 3/0 was used to heal and seal the incisions made at the port site and the umbilical fascia. The patient was sent to the postanesthesia care unit after waking up from general anesthesia.

Postoperative period

Paracetamol 1 g intravenous infusions every 8 h and diclofenac sodium 75 mg intramuscular as required were used as postoperative analgesics during the first postoperative day. Early ambulation was encouraged following full anesthetic recovery, and oral reintake was permitted. Based on the visual analog scale (VAS), the patient's pain level was noted. If there were no complications during the procedure, the patient tolerated the oral diet, and they were in good health, they were released the same day with a prescription for an analgesic (the dosage of the analgesic was the same for all patients): oral diclofenac sodium 50 mg tablets every 8 h. Patients were told to keep a pain diary at home using the VAS, and each patient completed a chart form with information provided at 12, 24, 48, 72, and 7 days following surgery. One week following the procedure, the filled paperwork had to be delivered to the follow-up appointment. An inspection of the inguinal area was performed during the first postoperative visit to look for any indications of hematoma or seroma development, surgical site infection [2], and the presence of neuralgia. A follow-up regimen included appointments for the week, 1 month, 3 months, and 1 year following

Figure 3



CONSORT flow diagram.

surgery. Additionally, patients were told to come in sooner if they had any complains. The surgeon looked for and noted the existence of seroma, cord edema, surgical site infection symptoms, inguinal anesthesia/hyperesthesia, and other conditions at each follow-up appointment, such as chronic pain (pain lasting for 3 months or more) and hernia recurrence.

Sample size calculation and randomization

After reviewing the literature for this randomized clinical trial [9], we discovered that at least 27 patients were needed in each group to use a two-tailed independent *t* test to detect a difference of 1 in the VAS (primary outcome variable) between groups with a standard deviation of 1, a significance level of 5%, a power of 95%, and an effect size of 1. We therefore used G*Power software (version 3.1.9.6, 2020; Institute für Experimentelle Psychologie, Heinrich-Heine-Universität, Düsseldorf, Germany), to compute the sample size. The internet tool 'https://www.randomizer.org/' was used for randomization to divide the patients equally into two groups.

Statistical analysis

Microsoft Excel 2019 MSO, 64-bit (Redmond, Washington, USA), was used to create the charts. Statistical Package for the Social Sciences tool (IBM SPSS Statistics for Windows 2019, Version 26.0, 64-bit; IBM Corp., Armonk, New York, USA) was used to statistically analyze the data. Data were analyzed using Student *t* tests to compare continuous variables (reported as mean±SD) and Pearson's χ^2 tests to compare nominal or dichotomous variables (represented as number of patients) (percentage). *P* values below 0.05 were regarded as statistically significant, and those below 0.001 as highly significant.

Results

A total of 60 patients who were eligible for randomization were chosen from 79 patients who

were candidates for laparoscopic TAPP hernia repair. Overall, 19 individuals were eliminated. All 60 randomly assigned individuals finished the trial and were analyzed (Fig. 3). Regarding age, sex, weight, height, BMI, patients' complaints, the kind of hernia, and postoperative pain level, there were no statistically significant differences between the two study groups. In group A, the operation lasted for 62.67±7.739 min, which was than in group B (101.17±11.194 min). This difference between the two groups was highly statistically significant (P=0.001) (Table 1). Regarding intraoperative complications, there were no statistically significant differences between the two study groups for vas deference damage, bleeding from the pubic plexus, or injury to the inferior epigastric arteries. There were no bowel, bladder, or severe blood vascular damage (Table 2). The hospital stay in group A was shorter than that in group B (14.017±4.733 h), with a very statistically significant difference between the two groups (P=0.001). Group A had a larger cost for mesh fixation than did group B, with a highly statistically significant difference between the two groups (P=0.001) (Table 1). After 1 week (first follow-up visit), six patients had developed seroma, with three (10%) cases in each group, who were managed by inguinoscrotal support and medical treatment, and the symptoms resolved in 4–7 days. Five patients had developed cord edema, comprising three (10%) cases in group A and two (6.7%) cases in group B, and were managed by inguinoscrotal support and medical treatment. Five patients had experienced inguinal anesthesia/hyperesthesia, with three (10%) cases in group A and two (6.7%) cases in group B. There were no statistically significant differences between both studied groups regarding early postoperative complications. Follow-up after 3 months showed three cases had chronic groin pain, comprising two (6.7%) cases in group A and one (3.3%)

Table 1 Demographic data, duration of surgery (min), and length of hospital stay (days) of the two studied groups

Variables	Group A (N=30) (mean±SD)	Group B (N=30) (mean±SD)	Test	P
Age (years)	39.83±12.962	40.80±9.70	t=−0.327*	0.745
Weight (kg)	83.85±7.545	82.33±5.825	t=0.871*	0.387
Height (m)	1.70±0.026	1.71±0.027	t=−0.827*	0.411
BMI (kg/m^2)	28.69±2.404	28.00.0±2.077	t=1.185*	0.241
Sex (F/M) [n (%)]	2 (6.7)/28 (93.3)	3 (10)/27 (90)	χ^2=0.218†	0.640
ASA PS (I/II) [n (%)]	18 (60)/12 (40)	23 (76.7)/7 (23.3)	χ^2=1.926†	0.165
Duration of surgery (min)	62.67±7.739	101.17±11.194	t=−15.495*	<0.001‡
Length of hospital stay (h)	8.083±1.815	14.017±4.733	t=−6.411*	<0.001‡
Pain score (VAS)	2.60±1.070	2.67±1.213	t=−0.226*	0.822
Fixation method cost (EGP)	10 500±0.0	42.67±6.915	t=8283.131*	<0.001‡
Patient complains				
Swelling/pain	30 (100)/11 (36.7)	30 (100)/13 (43.3)	χ^2=0.278†	0.698
Type of inguinal hernia				
Direct/indirect/both	3 (10)/24 (80)/3 (10)	6 (20)/23 (76.7)/1 (3.3)	χ^2=2.021†	0.364

ASA PS, American Society of Anesthesiologists Physical Status; F, female; M, male; VAS, visual analog scale. *Independent samples Student t test. †Pearson χ^2 test. ‡Highly significant.

Table 2 Intraoperative and postoperative complications of the two studied groups

Variables	Group A (N=30) [n (%)]	Group B (N=30) [n (%)]	χ^2 test*	P
Intraoperative				
Injury to the inferior epigastric artery	1 (3.3)	1 (3.3)	0.0	1.000
Bleeding of venous plexus around the pubic bone	1 (3.3)	2 (6.7)	0.351	0.554
Injury to vas deferens	0	1 (3.3)	1.017	0.313
Bowel injury	0	0	0.0	1.000
Urinary bladder injury	0	0	0.0	1.000
Injury to major vessels	0	0	0.0	1.000
Postoperative				
Cord edema	3 (10)	2 (6.7)	0.218	0.640
Seroma	3 (10)	3 (10)	0.0	1.000
Port site infection	1 (3.3)	2 (6.7)	0.351	0.554
Inguinal anesthesia/hyperesthesia	3 (10)	2 (6.7)	0.218	0.640
Chronic pain	2 (6.7)	1 (3.3)	0.351	0.554
Recurrence	0	0	0.0	1.000

*Pearson χ^2 test.

case in group B, with no statistically significant differences between both studied groups. No patient in either group had a recurrent hernia at the same operative site. Follow-up after 1 year showed that no patient in either group had a recurrent hernia at the same operative site or had chronic pain, and only one case in group B remained numb.

Discussion

The General Surgery Department frequently performs inguinal hernia repairs [10]. With improvements in laparoscopic surgery, inguinal hernia repair has acquired widespread acceptance among both surgeons and patients as it is linked with a quicker return to activity and a reduction in postoperative discomfort and wound infection [6,11,12]. Regarding the demographic information in this study, the majority of patients in both groups were men. Patients with indirect hernia were more numerous than direct hernia patients, although both groups had similarities in terms of age, sex, symptoms, and comorbidities. Many earlier research studies found results extremely similar to ours, which found that the prevalence of inguinal hernia in males is 12–25 times higher than that in females [13]. The highest incidence rate of inguinal hernias is seen in children and those over 50 years, but in this study, more cases were seen in people who were, on average, around 40 years old – an age associated with heavy and demanding employment [14]. In addition, indirect inguinal hernias occur at a rate that is two to three times greater than direct inguinal hernias [15]. In terms of surgical time, mesh fixation and peritoneal window closure with sutures took more time in group B than tackers fixing did in group A. With additional practice and instruction in this method, this time may be shortened. Mesh fixation, a crucial procedure step, carries the risk of major consequences such vascular or neurological damage and considerable patient morbidity. For the goal of mesh fixation, several techniques including sutures, fibrin glue, and autologous fibrin were used. Permanent fixation devices (tackers, staplers, and anchors) were also used [1,4,16]. The intersurface of the suprainguinal abdominal wall is where titanium tackers are most frequently used to attach mesh [16]. Laparoscopic inguinal hernia surgery problems are most dangerous in novice hands, although their frequency has decreased as expertise has developed and the technique has shown to be safe in the hands of skilled surgeons [9]. The intraoperative complications including hemorrhage from injury to inferior epigastric vessels, bleeding of venous plexus around the pubic bone, and injury to vas deferens were managed laparoscopically without conversion to open procedure. These complications happened during preperitoneal dissection, and mesh fixation methods were not responsible for it. It depends on the surgeon's experience and skills with different laparoscopic techniques with meticulous surgical practice, which is important in reducing complications. Considering postoperative complications such as seroma, cord edema, port site infection, chronic pain, neuralgia, and recurrence, again, it depends on meticulous surgical practice and the surgeon's laparoscopic skill, which is important in reducing complications [9]. One of the most frequent and inconvenient postoperative adverse effects of inguinal hernia surgery is pain. The effect of pain may be more problematic than recurrence, and the incidence of pain is higher than the recurrence rate [17]. When compared with nonfixation, tacker fixation is linked to a greater risk of both acute and chronic discomfort [13]. Complications such as nerve entrapment, erosion into the colon and other hollow viscera, and the development of thick adhesions have all been linked to it [18]. In addition to mesh fixation techniques, other variables such as heat damage, excessive needless dissection, and mesh stimulation have a significant effect in the short-term and long-term incidence of discomfort [9]. Alternative mesh fixation techniques, including absorbable tackers, human fibrin glue, synthetic sealants, and transfascial absorbable and nonabsorbable sutures, have been described by various authors [19,20]. According to reports, these techniques are linked to decreased postoperative pain and neuralgia [14,19]. The frequency of postoperative acute and chronic pain can be decreased by avoiding mesh fixation at the 'triangle of agony,' employing staples, or suturing for mesh fixation [18]. Pain occurs more frequently in the short term than it does in the long term [19]. During follow-up visits, short-term discomfort can be managed; however, in some individuals, the pain resolves on its own. According to this study, there was no significant difference in the levels of pain experienced by the two groups during the first week following surgery when comparing the means of the groups' postoperative acute pain ratings. According to a research by Kleidari *et al.* [19], there was no discernible difference between suture fixation and tacker fixation in terms of the in-hospital mean pain score recorded in the morning following surgery. In other trials, it was discovered that suture fixation caused much less early postoperative discomfort than tack fixation [4,9,15]. Depending on the reason, long-term pain requires the right therapy, and there are therapies including physical therapy, analgesics,

neurolysis, and resection [21]. In general, the complexities were reasonable and comparable to those in other series [4,20–22]. According to earlier research, 14% of hernia surgeries that employed titanium tackers resulted in persistent neuralgia [9,20,21]. The lateral cutaneous nerve of the thigh, the genitofemoral, the iliohypogastric, and the ilioinguinal nerves are the most susceptible nerves to damage during laparoscopic repair. Neuralgia was not reported in this trial with the polypropylene sutures. Actually, by placing sutures without tension and in certain, predetermined areas, the possibility of nerve entrapment was removed. Fixation costs more than nonfixation does. We fixed the mesh in the current study using polypropylene 2/0, which has certain advantages, including cheaper cost and availability. Cost study was carried out by Moreno-Egea *et al.* [20], and it took into account not only the price of endoscopic equipment but also that of hospitalization and operation (including anesthesia, time spent in the operating room, and materials). They discovered a mean cost increase of $517 for fixing the mesh, mostly as a result of the price of a stapling tool. When the procedure was carried out without fixation, Taylor *et al.* [18] and Ferzli *et al.* [22] reported a net saving of $245 and $120, respectively. Hernia recurrence is the final consequence that causes surgeons the most anxiety. At specialist facilities, recurrence happens in ~2% of both open and endoscopic surgeries [8], typically within the first year or two of repair [1,17]. Recurrence can occur for a variety of reasons, including inadequate surgical technique, mesh size, hernia size and type, surgeon expertise, and mesh fixation, which is a crucial step in preventing recurrence. However, late recurrence can also occur for a variety of causes [23]. Fortunately, there were no incidences of recurrence among the study population at the 1-year follow-up. These data place mesh fixation using sutures on par with tacker usage in avoiding mesh migration and recurrence. However, further research with longer follow-ups are thought to be beneficial due to the small number of patients in this study and the 1-year follow-up that was used.

Conclusion

TAPP hernia repair is the most frequently used laparoscopic procedure, but an increase in hospital costs due to tacker use is the main reason preventing its wider use. According to data obtained in this study, totally sutured laparoscopic TAAP hernia repair is as effective as tackers use in terms of intraoperative and postoperative complications, but there is a significant increase in the operative time owing to the time spent in suturing and length of hospital stay. The strength of this study is that only one surgeon was assigned to carry out all steps of the operations, so the surgical skill and the operative techniques of the surgeon did not act as an effect modifier. One-year follow-up revealed that there is no hernia recurrence with the totally sutured fixation method, which can be an alternative to the tacker mesh fixation method.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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