Short-term results of a randomized clinical trial comparing Lichtenstein open repair with totally extraperitoneal laparoscopic inguinal hernia repair

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Background: Laparoscopic herniorrhaphy has emerged as a recognized operative method for inguinal hernia repair. This study compared the short-term results of two tension-free methods of repair: totally extraperitoneal (TEP) laparoscopic patch repair and the open Lichtenstein mesh technique.

Methods: A total of 1513 men from 11 hospitals who presented with a primary unilateral inguinal hernia were randomized to one of the two methods. Operating time, short-term complications, reoperations, postoperative pain, consumption of analgesics, sick leave and time to resumption of normal physical activities were recorded.

Results: Some 1371 of the 1513 men underwent surgery, 665 in the TEP group and 706 in the Lichtenstein group. The median duration of operation was 55 min for both procedures and 91.0 per cent of the patients in both groups were discharged on the day of operation. Patients in the TEP group experienced less postoperative pain ($P < 0.001$), consumed fewer analgesics ($P < 0.001$), had a shorter period of sick leave (7 versus 12 days; $P < 0.001$) and a shorter time to resumption of normal physical activity (20 versus 31 days; $P < 0.001$).

Conclusion: The TEP technique took no longer to perform, and was associated with less postoperative pain, a shorter period of sick leave and a faster recovery, compared with open Lichtenstein hernia repair.

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Introduction

The Lichtenstein hernia repair (open, tension-free mesh technique) is a simple and safe method for treatment of inguinal hernia. The recurrence rate is low, both in the hands of experts and for the average surgeon^{1–3}. There has been a gradual increase in the number of Lichtenstein repairs performed in Sweden, with a corresponding decrease in the number of conventional sutured repairs⁴.

Simultaneously, early reports from non-randomized studies of laparoscopic hernia repair techniques showed a possible advantage of the totally extraperitoneal (TEP) patch technique over the transabdominal preperitoneal (TAPP) patch technique, with lower recurrence rates

and fewer operative complications because the abdominal cavity is not entered^{5–7}.

In 1993 the Swedish Multicentre trial of Inguinal hernia repair by Laparoscopy (SMIL) study group was formed to evaluate the possible benefits of laparoscopic hernia repair compared with open techniques. Early results from the SMIL-1 trial, a randomized study comparing the TAPP technique with Shouldice repair, showed benefits for the laparoscopic operation in terms of less postoperative pain, shorter sick leave and shorter time to return to normal physical activities⁸.

Encouraged by these results it was decided to undertake a study comparing an open tension-free mesh technique (Lichtenstein) with a laparoscopic mesh repair (TEP). This study was designed to compare the recurrence rate at 5 years as the primary endpoint. Secondary endpoints

The Editors have satisfied themselves that all authors have contributed significantly to this publication

were operative complications, postoperative recovery and complaints at 5 years. This article presents the short-term results up to 3 months after surgery.

Patients and methods

Eleven hospitals participated: two university, six regional and three county hospitals. The study was approved by the local ethics committees.

Patients

Patients eligible for inclusion were men aged 30–70 years referred to hospital with an inguinal hernia. Exclusion criteria were recurrent hernia, scrotal or bilateral hernia, and previous lower abdominal surgery, such as Pfannenstiel, lower midline and other abdominal incisions below the umbilicus on the side of the hernia. Patients who were considered unable to participate in the postoperative follow-up owing to drug misuse, psychiatric disorders and language difficulties were also excluded. A high operative risk (American Society of Anesthesiologists (ASA) fitness grade more than III) or bleeding diathesis were considered contraindications from an anaesthetic point of view. All operations were planned as day cases. Instructions were given to all patients to resume normal daily activities and return to work as soon as possible, irrespective of the operative method. After giving informed consent, patients were randomized in blocks of 20, which were computer-generated and stratified for each centre, using numbered envelopes. The study was planned in accordance with the intention-to-treat principle.

Surgical procedures

The TEP technique used a three-port system: one 10-mm port close to the umbilicus for the 30° angled videoscope and two 5-mm working ports in the lower midline. A balloon dissector (PBD® 100; Origin Medsystem, Menlo Park, California, USA) was used to create a preperitoneal working space. The peritoneal space was dissected further using forceps and scissors to expose the inguinal region. Downward and medial dissection was extended several centimetres below the pubic bone and Cooper's ligament, exposing the spermatic vessels and the vas deferens. The extent of the lateral dissection was as far as the anterior–superior iliac spine. The hernia sac was generally invaginated into the preperitoneal space. In some patients with a large hernia the sac was transected. In these patients the peritoneum was closed to prevent the intestine from coming into contact with the mesh. A polypropylene

mesh (Atrium Medical, Hudson, New Hampshire, USA) measuring 12 by 15 cm was placed to cover the hernial orifice and the inside of Hesselbach's triangle. The mesh was fixed with staples (Origin-Tacker® 5 mm; Origin Medsystem) to Cooper's ligament and the abdominal wall above the iliopubic tract. Some 20 ml 0.5 per cent bupivacaine was usually instilled into the preperitoneal space before evacuation of the gas.

The open procedure was performed according to the Lichtenstein technique¹. The cremaster muscle together with external spermatic vessels and the genital branch of the genitofemoral nerve were divided at the internal ring. Indirect as well as direct hernia sacs were invaginated or resected. Before repair, the femoral canal was examined digitally for the presence of a possible femoral hernia. A dilated internal ring or a bulging posterior wall of the inguinal canal was reconstructed to facilitate placement of the mesh. Space was made by blunt dissection under the external aponeurosis in medial, cranial and lateral directions. A polypropylene mesh (Atrium Medical) measuring 7.5 by 12–15 cm was anchored with a running 2/0 polypropylene suture overlapping the pubic tubercle and then extending along the inguinal ligament inferiorly. Interrupted sutures were placed medially and superiorly. A slit was made laterally in the mesh to permit passage of the spermatic cord and the ilioinguinal nerve. Lateral to the cord the slit was closed by a suture through the lower rims of the two tails and the inguinal ligament. At the end of the operation the wound was infiltrated with 20 ml 0.5 per cent bupivacaine. In the open group a single prophylactic dose of cefuroxime was used. For patients with an allergy to penicillin or cephalosporins, clindamycin was employed instead.

Surgeons

Forty-eight board-certified surgeons participated in the trial, 22 in the laparoscopic group and 26 in the open group. The laparoscopic surgeons were experienced in laparoscopic surgery (cholecystectomy, appendectomy, fundoplication) and had performed at least 25 TEP operations before entering the study. The open surgeons were experienced with the Lichtenstein technique. No surgeon did both techniques.

Data collection and follow-up

Demographic data, predisposing factors and functional status were recorded before operation. Functional status was assessed by three tests: climbing stairs, squatting and rising from a bed. Unrestricted activity was graded as 1,

some restriction as 2, and great difficulty as 3 points. The tests were recorded by an independent observer (nurse) and combined into a functional index score (range 3–9 points), as used in a previous study⁸. The type of anaesthesia, duration of operation (skin to skin), type of hernia according to the Nyhus classification²⁷, operative complications, length of hospital stay and complications at discharge were recorded. Using a visual analogue scale (VAS; 0–100 mm) the patients recorded pain once daily during the first week after operation, and once a week thereafter for the next 11 weeks. Patients were asked to report their daily intake of oral analgesics during the first week after surgery. A combined drug, paracetamol 325 mg with dextropropoxyphene 32.5 mg, was prescribed. The day of complete recovery from the operation, when normal physical activities could be performed without difficulty, was registered by the patient. An independent observer examined each patient 1 week after surgery, assessed the functional status and decided whether further sick leave was necessary. At the same visit and after 3 months an independent surgeon examined the patient for the presence of complications, complaints or recurrence.

Statistical analysis

The sample size was calculated such that a 5 per cent difference ($\alpha = 0.05$) in recurrence rate at 5 years between the groups could be detected with a power of 0.9. This required a sample size of 1200 patients. Continuous data were presented as mean(s.d.) and compared using Student's

t test (two tailed). Non-parametric data were presented as median (range) and compared using the Mann–Whitney *U* test. Frequencies were compared by Pearson's χ^2 test and Fisher's exact test. Data analysis was carried out with SPSS[®] version 10.0 (SPSS, Chicago, Illinois, USA).

Results

Between November 1996 and August 2000 a total of 1513 men were randomized, 758 to the TEP group and 755 to the Lichtenstein group. For various reasons 142 patients (9.4 per cent) did not have surgery (*Fig. 1*). There were significantly more dropouts in the TEP group (93 *versus* 49; $P < 0.001$). After exclusion of the dropouts, 665 patients remained in the TEP group and 706 in the Lichtenstein group. There were no significant differences between groups in demographic data or type of hernia according to the Nyhus classification (*Table 1*). Most operations were performed under general anaesthesia (TEP, 99.7 per cent; Lichtenstein, 70.4 per cent). The mean number of operations per surgeon was 30 (range 6–57) for the TEP group compared with 27 (range 1–61) in the Lichtenstein group. The median duration of operation was 55 min in both groups, with a range of 12–180 min in the TEP group and 20–145 min for the Lichtenstein technique. The duration of operation in the TEP group decreased continuously throughout the study with an increasing number of operations ($r = 0.91$). In both groups, 91.0 per cent of the patients were discharged on the day of surgery; all patients in the TEP group and

Fig. 1 CONSORT diagram describing randomized comparison of totally extraperitoneal (TEP) laparoscopic repair with the Lichtenstein open technique of inguinal hernia repair. * $P < 0.001$ (χ^2 test), † $P < 0.002$ *versus* TEP (Fisher's exact test), ‡ $P = 0.004$ *versus* TEP (Fisher's exact test)

Table 1 Patient characteristics in 1371 men with a unilateral inguinal hernia

	TEP (n = 665)	Lichtenstein (n = 706)
Age (years)*	53(10)	52(10)
Weight (kg)*	80(10)	81(10)
Height (cm)*	179(6)	179(7)
Smoker	130 (19.5)	129 (18.3)
Chronic obstructive lung disease	16 (2.4)	13 (1.8)
Steroid medication	14 (2.1)	12 (1.7)
Size of hernia		
Visible	507 (76.2)	513 (72.7)
Palpable only	156 (23.5)	187 (26.5)
Unknown	2 (0.3)	6 (0.8)
ASA grade		
I	584 (87.8)	633 (89.7)
II	66 (9.9)	57 (8.1)
III	5 (0.8)	5 (0.7)
Unknown	10 (1.5)	11 (1.6)
Occupational exertion		
Light	206 (31.0)	233 (33.0)
Moderate	163 (24.5)	160 (22.7)
Heavy	169 (25.4)	176 (24.9)
Retired	102 (15.3)	93 (13.2)
Unemployed	21 (3.2)	39 (5.5)
Unspecified occupation	4 (0.6)	5 (0.7)
Nyhus classification		
II	213 (32.0)	195 (27.6)
IIla	222 (33.4)	237 (33.6)
IIlb	223 (33.5)	262 (37.1)
IIlc	2 (0.3)	3 (0.4)
Unknown	5 (0.8)	9 (1.3)

Values in parentheses are percentages unless indicated otherwise,
*mean(s.d.). TEP, totally extraperitoneal; ASA, American Society of
Anesthesiologists fitness score.

99.1 per cent in the Lichtenstein group were discharged home within 24 h.

Complications

The overall operative and early postoperative complication rate was 12.2 per cent for TEP repair and 12.3 per cent for Lichtenstein repair (Table 2). There were two major operative complications in each group. In the TEP group one patient was anaesthetized with a laryngeal mask and developed airway obstruction after 50 min of surgery. Endotracheal intubation was not possible and the operation was converted to an open procedure under local anaesthesia. The other patient needed reoperation within 24 h after initial surgery because of mechanical small bowel obstruction. This was caused by accidental fixation of the small bowel to the peritoneum during suture repair of a peritoneal tear. In the Lichtenstein group one patient had an anaesthetic complication with a short period of cardiac arrest at the beginning of the operation. This was probably a side-effect

Table 2 Operative and early postoperative results after hernia repair

	TEP	Lichtenstein	P*
Operative complications	32 (4.8)	15 (2.1)	0.006
Minor			
Bleeding from epigastric vessels	6 (0.9)	4 (0.6)	0.537
Technical problem	12 (1.8)	0 (0)	< 0.001
Nerve injury	0 (0)	9 (1.3)	0.004
Conversion	12 (1.8)	0 (0)	< 0.001
Major			
Haemorrhage	0 (0)	1 (0.1)	1.000
Anaesthetic related	1 (0.2)	1 (0.1)	1.000
Reoperation within 24 h	1 (0.2)	0 (0)	0.485
Complications at discharge	49 (7.4)	72 (10.2)	0.065
Urinary retention	28 (4.2)	53 (7.5)	0.010
Haematoma	10 (1.5)	10 (1.4)	0.893
Anaesthesia related	10 (1.5)	9 (1.3)	0.717
Other	1 (0.2)	0 (0)	0.485
Complications at 1 week	99 (17.3)	107 (17.5)	0.889
Haematoma ≥ 50 cm ²	60 (10.5)	79 (12.9)	0.184
Seroma	5 (0.9)	5 (0.8)	1.000
Superficial infection/cystitis	8 (1.4)	4 (0.7)	0.206
Urinary tract discomfort	5 (0.9)	6 (1.0)	1.000
Testicular discomfort	7 (1.2)	4 (0.7)	0.313
Pain	9 (1.6)	8 (1.3)	0.713
Reoperation	1 (0.2)	1 (0.2)	1.000
Other	4 (0.7)	0 (0)	0.055

Values in parentheses are percentages. TEP, totally extraperitoneal.

*Fisher's exact or χ^2 test.

of the drug used for the spinal anaesthesia, lidocaine. The operation was completed. The other patient had bleeding from the external iliac vein that was controlled by suturing.

In the TEP group the surgeons registered the problem of leakage of gas into the peritoneal cavity in 262 patients (39.4 per cent). In 109 (15.9 per cent) this was managed without any further intervention and in 111 patients (16.7 per cent) it was controlled using a Veress needle. In 31 patients (4.7 per cent) the peritoneal tear was closed, in seven patients (1.1 per cent) gas leakage led to conversion and in four patients (0.6 per cent) this information was missing. The incidence of gas leakage had a tendency to decrease with increasing surgical experience.

Altogether there were 12 TEP conversions (1.8 per cent), eight (1.2 per cent) to an open operation and four (0.6 per cent) to a TAPP procedure. The main reason for conversion from TEP to open operation was surgical difficulty (gas leakage, adhesions, bleeding and anatomical difficulties); in one patient anaesthetic problems led to conversion. Conversion from TEP to TAPP repair was because of gas leakage due to large peritoneal tears in three patients and bleeding in one.

Urinary retention was the most common complication at discharge in both groups and was more common in the

Lichtenstein group ($P = 0.010$). One patient in the TEP group had a nasal fracture after an accidental fall in the recovery room.

Some 86.5 per cent of the patients attended the 1-week check-up (5–10 days after surgery). The complication rate at 1 week was 17.3 per cent after TEP and 17.5 per cent after Lichtenstein repair. During the first week there were two reoperations: one in the Lichtenstein group because of neuralgia of the genitofemoral nerve, and one in the TEP group because of gangrene of the caecum that had herniated through a hole in the peritoneum. The latter patient had undergone conversion from TEP to Lichtenstein repair because of problems with intraperitoneal gas leakage. 'Other' complications in the TEP group included postoperative haematomas in two patients (0.3 per cent), who were managed conservatively as inpatients for 5 and 7 days, stroke on the fifth day after surgery and thrombophlebitis in the right arm. There were no perioperative or postoperative deaths.

Postoperative recovery

Patients in the TEP group experienced less pain after operation than those in the Lichtenstein group at each time point. Pain, recorded as a cumulative median (range) VAS score registered during the first postoperative week (days 1, 2, 3, 5 and 7), was 105 (0–440) mm in the TEP group and 175 (0–440) mm in the Lichtenstein group (Fig. 2). Fewer analgesics were consumed in the TEP group (Fig. 3). At weeks 4, 6 and 8 there was a small but significant difference in pain in favour of the TEP group ($P = 0.002$). This difference remained at 12 weeks ($P = 0.011$).

Before operation the median (range) combined functional index score was 3 (3–9) in the TEP group and 3 (3–7) in the Lichtenstein group. At 1 week the score was 3 (3–9) in both groups, but more patients in the Lichtenstein group than the TEP group had a score above 3 ($P < 0.001$) (Fig. 4).

Fig. 2 Median pain scores measured on a visual analogue scale (VAS) after inguinal hernia repair. * $P < 0.001$ versus totally extraperitoneal (TEP) repair (Mann–Whitney U test)

Fig. 3 Mean analgesic consumption after inguinal hernia repair. * $P < 0.001$ versus totally extraperitoneal (TEP) repair (Mann–Whitney U test)

Fig. 4 Functional index scores 1 week after inguinal hernia repair. TEP, totally extraperitoneal hernia repair (χ^2 test)

Details regarding sick leave for 96.5 per cent of patients receiving working compensation were analysed. The

median (range) sick leave was 7 (0–77) days in the TEP group and 12 (0–55) days in the Lichtenstein group ($P < 0.001$). Subgroup analysis showed that there was a difference in sick leave for occupations involving light *versus* moderate and moderate *versus* heavy exertion for both groups ($P < 0.001$). Irrespective of occupational exertion, sick leave was shorter in the TEP group (Table 3). The self-reported time to full recovery was a median (range) of 20 (0–179) days in the TEP group and 31 (0–163) days in the Lichtenstein group ($P < 0.001$).

Follow-up at 3 months

The 3-month follow-up appointment (2–5 months after surgery) was attended by 88.0 per cent of the patients. The complaint rate was 14.1 per cent in the TEP group and 16.3 per cent in the Lichtenstein group (Table 4). Five late infections were reported. One patient in the TEP group had a soft tissue abscess 4 weeks after surgery that required percutaneous drainage as an inpatient for 14 days. The mesh was not affected. The other four infections were in the Lichtenstein group, but these were superficial and only one patient required oral antibiotics. There were two reoperations, both in the TEP group. One patient had pain from a staple (the most superior and lateral staple), which was removed under local anaesthesia 20 days after the initial operation. The other patient underwent laparoscopic adhesiolysis 5 weeks after the initial procedure because of small bowel obstruction. This was caused by a short adhesion between the small bowel and the mesh. Five recurrences were reported at the 3-month follow-up, all in the TEP group (0.8 per cent). During the 3 months of follow-up there were 11 major complications (operative complications, reoperations and readmissions), eight (1.2 per cent) among 665 patients in the TEP group and three (0.4 per cent) among 706 in the open group ($P = 0.030$).

Table 3 Sick leave

	Sick leave (days)		P^*
	TEP	Lichtenstein	
Occupational exertion			
Light	4.5 (0–77) ($n = 192$)	7 (0–37) ($n = 228$)	< 0.001
Moderate	8 (0–39) ($n = 159$)	13 (0–55) ($n = 151$)	< 0.001
Heavy	12 (0–62) ($n = 166$)	17 (0–54) ($n = 171$)	< 0.001

Values are median (range). TEP, totally extraperitoneal.

*Mann–Whitney U test.

Table 4 Complaints at 3 months after hernia repair

	TEP ($n = 589$)	Lichtenstein ($n = 618$)	P^*
Pain or discomfort	45 (7.6)	51 (8.3)	0.694
Seroma	4 (0.7)	1 (0.2)	0.207
Numbness	3 (0.5)	22 (3.6)	< 0.001
Neuralgia	3 (0.5)	8 (1.3)	0.151
Scrotal discomfort	16 (2.7)	6 (1.0)	0.023
Orchitis	0 (0)	2 (0.3)	0.500
Sex-related complaints	1 (0.2)	2 (0.3)	1.000
Infection	1 (0.2)	4 (0.6)	0.375
Reoperation	2 (0.3)	0 (0)	0.238
Other	8 (1.4)	5 (0.8)	0.356
Total	83 (14.1)	101 (16.3)	0.277

Values in parentheses are percentages. TEP, totally extraperitoneal.

*Fisher's exact or χ^2 test.

Discussion

This randomized multicentre study compared the short-term results of two well recognized tension-free mesh techniques for inguinal hernia repair: the laparoscopic TEP technique and the open Lichtenstein technique. The latter is regarded as the 'gold standard' for inguinal hernia repair in Sweden today⁹.

The major strength of this study was the large number of patients and the study design. The operative methods in the two groups were well defined and only patients with primary unilateral inguinal hernias were included. Other studies have mixed patients with primary and recurrent hernias, and various types of open repair. The argument for this is that it reflects everyday clinical work outside specialized centres^{10,11}, but it leads to difficulties when interpreting the results.

One possible weakness with this study was the surgeons' relative inexperience with the TEP operation. The laparoscopic group also had more dropouts, and there were two main reasons for this. First, for laparoscopic procedures the surgeons were more concerned about previous lower abdominal surgery and whether the hernia extended into the scrotum. For the open procedure, these factors could more easily be overlooked. Second, the anaesthetists were more reluctant to administer general anaesthesia to patients with a high ASA grade for a planned laparoscopic operation. This merely reflects the limitations of laparoscopic hernia repair, but it does not bias the results of this comparison of TEP and Lichtenstein repair when it was possible to use the laparoscopic technique. A further problem was that the patients did not always use the prescribed analgesic drug after surgery; some used other regular analgesic agents. This practice was observed in both groups and so this

finding was deemed to be an independent factor that did not influence the overall results.

The laparoscopic technique has been criticized because of the need for general anaesthesia. In this study, however, most patients in the Lichtenstein group also had general anaesthesia. The reason for this was tradition, patient preference and, very occasionally, anaesthetic considerations. According to the Swedish hernia register⁹ there has been a shift from regional to general anaesthesia during the past 10 years. In a survey from Scotland, where 95 per cent of the patients had open hernia repair, 85 per cent of these patients had general anaesthesia¹².

Despite the use of general anaesthesia, the majority of patients in both groups were discharged from hospital on the day of surgery. Similar results with regard to discharge on the day of operation are found when using local anaesthesia for hernia repair¹³. Currently 70 per cent of all patients in Sweden, including those who have had emergency operations, are discharged on the day of surgery⁹.

The duration of operation was similar for both techniques, which is in accordance with other randomized studies^{14,15}. The incidence of peritoneal tears and intra-abdominal gas leakage is reported to be 40–47 per cent^{16,17}. This often complicates the TEP operation and can become a reason for conversion, which is reported in 5 per cent of procedures¹⁸. In this study intra-abdominal gas leakage was encountered relatively frequently and it is reasonable to assume that this was due to peritoneal tears. In spite of this the conversion rate was low. The use of a Veress needle to deflate the abdomen or the immediate repair of any peritoneal tear generally solved the problem.

The relatively high frequency of major complications in the TEP group is of concern. Postoperative haemorrhage has been reported in 0.4 per cent of 5203 TEP repairs¹⁹, which is in accordance with the present results. Intestinal complications are rare but well recognized during laparoscopic surgery^{19–21}. To avoid this serious and potentially dangerous complication, the surgeon must search for peritoneal tears and try to close them, taking care to avoid damaging the bowel.

Postoperative recovery was significantly better in the TEP group. These findings are in accordance with other studies^{10,20,22}. It is often stated that the duration of sick leave depends on tradition and the social insurance system, rather than the real need to be off work after surgery²³. The present data show clearly that the degree of occupational exertion influenced the length of sick leave. This, together with the fact that the TEP group in general had a shorter

period of sick leave, indicates that convalescence was directly related to the degree of surgical trauma.

The functional test indicates the patient's capacity for ordinary daily activities. In the present study the functional test after 1 week showed significantly less impairment in the laparoscopic group. Similar results were obtained by Berndsen *et al.*⁸, and also by Liem *et al.*²⁴ who compared curled sit-up and straight leg raising at 1 and 6 weeks after surgery.

Very little has been reported regarding pain at 3 months after surgery. One survey of 5509 patients after inguinal hernia repair, using various open and laparoscopic techniques, showed severe or very severe pain in 3.6 per cent and mild or moderate pain in 43 per cent²⁵. The overall rate of reported pain or discomfort (including neuralgia and scrotal discomfort) 3 months after surgery in the present study was just under 11 per cent in both groups. No patient reported severe pain and fewer patients than in the study by Courtney *et al.*²⁵ had mild to moderate pain.

Recurrence at 3 months is considered a technical failure. In this study all five recurrences at 3 months occurred in the TEP group. It should be noted that one surgeon was responsible for four of these recurrences. This surgeon performed 25 operations in this study and three of the recurrences were among the first 12 operations undertaken. A similar finding was encountered in another large randomized trial, in which a single institution had a disproportionately high number of recurrences¹⁰. The learning curve for laparoscopic hernia repair is reported as being between 30 and 250 operations^{18,26}. This is more than the 25 TEP repairs required before the surgeons could participate in the present study. Many of the surgeons in the laparoscopic group could still have been experiencing their learning curve. The findings of decreasing operating time and a tendency towards fewer patients with intra-abdominal gas as the study progressed support this conclusion. The fact that six of 22 surgeons in the TEP group were responsible for 83 per cent of the operative complications (conversions, reoperation, postoperative haemorrhage and recurrences) further supports this. Such a long learning curve might be considered to be a drawback of the laparoscopic method.

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