



# Surgical techniques and convalescence recommendations vary greatly in laparoscopic groin hernia repair: a nationwide survey among experienced hernia surgeons

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## Abstract

**Background** Laparoscopic groin hernia repair has become increasingly popular. In Denmark, all groin hernia repairs are registered in the Danish Hernia Database. However, many surgical technical parameters are not registered in neither the hernia database nor in other national registries or the patient files. Our aim was to characterize differences in surgical techniques and variations in convalescence recommendations in laparoscopic groin hernia repair that are not available elsewhere.

**Methods** A questionnaire was sent to all surgeons in Denmark regularly performing unsupervised laparoscopic groin hernia repair. The questionnaire was developed in collaboration with an experienced chief surgeon and face-validated on the target group. It contained demographic details and items on surgical parameters such as the creation of pneumoperitoneum, size of the optic, choice of closure methods, preoperative information, and postoperative recommendation of convalescence.

**Results** A total of 71 surgeons were eligible for inclusion, and 61 (86%) responded. We found large variations in almost all surgical parameters, i.e. there was no uniform way of performing laparoscopic groin hernia repair. The variation was not due to the level of experience. The median recommended convalescence period was 1.5 (range 0–28) days for activities of daily living, 4.5 (range 0–28) days for light physical activity, and 14 (range 0–35) days for hard physical activity. Three percent of surgeons routinely informed patients about the risk of sexual dysfunction prior to operation, and 98% informed about the risk of chronic pain.

**Conclusions** Surgical technical parameters and convalescence recommendations in laparoscopic groin hernia surgery vary widely in a national cohort of experienced hernia surgeons.

**Keywords** Inguinal hernia · Laparoscopy · Surgical training · Questionnaire · Standardization

Inguinal hernia repairs are one of the most common surgical procedures [1] with more than 20 million operations performed worldwide each year [2]. Since its introduction in 1991, the laparoscopic approach in groin hernia repair has become increasingly popular [3, 4]. According to international guidelines, the indications for laparoscopic surgery are primary bilateral hernias, recurrent hernias first repaired with open technique, and groin hernias in female patients. In addition to that, the most recent international guideline [5] also recommends a laparoscopic approach as the optimal

treatment of a primary unilateral hernia in men provided that the surgeon has sufficient expertise and no contraindications are present. In Denmark, the use of laparoscopic repair in groin hernia surgery has increased rapidly, now comprising more than 50% of all groin hernia repairs [6]. Nearly all laparoscopic procedures in Denmark are performed with the transabdominal preperitoneal technique [7].

In Denmark, all groin hernia repairs are registered in the Danish Hernia Database, which has been described elsewhere [8]. The database provides high-quality data and is unique since it is the only hernia database in the world to qualify as a genuine national registry [9]. Yet, there are still a lot of interesting parameters in groin hernia repair that are not registered in either the hernia database, other national registries or medical records of the patients. Some perioperative data cannot be accessed elsewhere such as peritoneal access, size of the optic, choice of suture for closing trocar

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sites, closure of skin incision, management of a contralateral asymptomatic hernia, preoperative information of risks and complications, and recommendations for post-surgical convalescence.

The aim was to characterize differences in surgical techniques and variations in convalescence recommendations in laparoscopic groin hernia repair with information not available in national registries or patient files.

## Methods

This study was a nationwide questionnaire survey in a national cohort of experienced groin hernia surgeons. It was reported according to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines [10]. Eligible participants were surgeons regularly performing unsupervised laparoscopic groin hernia repair in Denmark at both private and public institutions. A list of all private and public surgical departments reporting to the Danish Hernia Database was obtained, i.e. departments or clinics performing hernia surgery. We contacted the head of the department or the department's hernia database administrator, requesting names and contact information of surgeons meeting the eligibility criteria. In March 2018, an email was sent to all eligible surgeons containing an individual link to an electronic questionnaire, which was created in the REDCap electronic data capture tools hosted at our institution [11]. Two subsequent reminders were sent by email after 7 and 14 days to non-responders. Surgeons that had not responded after two reminders were phoned one day after the second reminder and, thereafter, every 4–5 days until contact was made. Those that had not been reached by telephone or email 4 weeks after the first call, received one last reminder via email. Collection of data was finished in May 2018.

The questionnaire was developed in collaboration with an experienced chief surgeon with > 2000 herniorrhaphies and > 20 years of experience in groin hernia surgery. Furthermore, the questionnaire was face-validated by a different chief surgeon. The questionnaire consisted of two parts. The first part included demographic details, including job position, geographic location, and surgical experience. Surgical experience was measured as number of years performing hernia surgery, and the total number of herniorrhaphies in the surgeon's career. The second part of the questionnaire contained items on surgical parameters such as peritoneal access, size of the optic, mesh fixation, choice of suture, handling of a contralateral asymptomatic hernia, preoperative information of risks and complications, and recommendations for post-surgical convalescence. Most items had a list of answer possibilities, and all items had a free-text field for elaboration. The surgeons had to provide an answer to all

items to complete the online questionnaire. If a questionnaire was incomplete due to missing response of only one item/question, it was considered complete and thereby eligible for inclusion. The items with missing responses have been clearly specified in the results. To minimize a potential risk of bias due to local work procedures, we included surgeons from all hernia departments in both public and private institutions in Denmark. Since each surgeon contributed equally to the survey, only surgeons performing unsupervised laparoscopic groin hernia surgery on a regular basis were included.

For statistical analyses, the surgeons were divided into two groups based on above and below the median level of experience. We performed separate analyses where the level of experience was either defined as years performing laparoscopic hernia surgery, or total number of herniorrhaphies in the surgeon's career. Other continuous parameters (such as recommended days of convalescence) were also categorized into two groups above and below the median value. We analyzed data using Microsoft Excel (Microsoft Corp., Redmond, WA) and SPSS version 22 (SPSS Inc., Chicago, USA). Results are displayed as frequencies and/or percentages. Categorical variables were compared using the Chi-squared test or the Fishers exact test. A  $p \leq 0.05$  was considered statistically significant.

This study was approved by the Danish Data Protection Agency (Journal No. 2012-58-0004). According to Danish law, no approval from The Ethics Committee was required for this study type.

## Results

A total of 71 surgeons from 21 surgical departments were eligible for inclusion, and 61 (86%) provided a complete response to the questionnaire. Of the ten surgeons not completing the questionnaire, one was on a longer vacation, two did not wish to participate, six did not reply to either email or phone calls, and one provided an incomplete response with more than one missing item, and was therefore excluded. Participant demographics are presented in Table 1. There were 46 males and 15 females with a median (range) age of 48 (35–70) years. All but three surgeons were specialized in gastrointestinal surgery.

Outcome data are presented in Table 2. To create pneumoperitoneum, surgeons mainly used umbilical access, either by direct placement of trocar (with insufflation after insertion of trocar) or via Veress needle (with insufflation before insertion of trocar). The most common size of the optic was 10 mm. When using a 5 mm optic, most surgeons used a combination with one 10–12 mm entry and two 5 mm entries. Only four surgeons (11%) used the smallest combination of entry points, i.e. three 5 mm entries, when using a

**Table 1** Surgeon demographics

Demographics	<i>n</i> = 61
Characteristics of responders	
Male:female, <i>n</i> : <i>n</i> (%:%)	46:15 (75:25)
Age, years, median (range)	48 (35–70)
Job position, <i>n</i> (%)	
Chief surgeon	40 (66)
Staff specialist	18 (29)
Senior resident	2 (3)
Other	1 (2)
Experience, median (range)	
Years performing hernia surgery	6.5 (0 to > 20)
Herniorrhaphies in total career <sup>a</sup>	275 (15–3500)
Herniorrhaphies the past 12 months <sup>a</sup>	60 (10–400)

For surgeons providing an answer of “at least” a certain number of herniorrhaphies, this minimum number was used

<sup>a</sup>Two surgeons could not remember number of herniorrhaphies

5 mm optic. Of the 17 surgeons that used both optic sizes, almost three quarters changed at least one 5 mm entry to a bigger 10–12 mm when using a larger optic; even though they already had a 10–12 mm entry point with the small optic. Figure 1A–D illustrate the distribution of methods most commonly used by each surgeon for mesh fixation, closure of peritoneal defect, suture of fascia, and closure of skin incisions. Tacks were most often used for mesh fixation, followed by glue and self-fixating mesh. All surgeons sutured the abdominal fascia in 10–12 mm entry points, i.e. none left the fascia open.

We asked the surgeons how they usually managed a suspect/enlarged gland in the surgical area. Almost half of the surgeons removed the gland and sent it for histological examination. However, many elaborated in the free-text field that they never or very seldom had come across such a gland. When asked how they managed a situation where full peritoneal coverage of the mesh was not possible, the clear majority replied that they dissected more peritoneum to obtain coverage. No surgeons left polyester/polypropylene mesh uncovered.

Almost all surgeons routinely inspected the contralateral groin during surgery even though no symptoms were present before the operation. Most surgeons always or often discussed with the patient how to manage a potential asymptomatic contralateral hernia before operation. The majority did not recommend treating an asymptomatic contralateral hernia. Many specified in the free-text that repairing a contralateral hernia depended on the preference and comorbidities of the patient. Two surgeons would only operate an asymptomatic contralateral hernia in women, and not in men. No surgeon would operate without having obtained the patient’s consent beforehand. Furthermore, most surgeons

would inform about the finding of an asymptomatic hernia after surgery. Complications and risks that surgeons most commonly informed about were chronic pain followed by recurrence and wound infection, see Fig. 2. Few surgeons preoperatively informed about testicular pain and sexual dysfunction. Convalescence for the activity of daily living was recommended to a median of 1.5 days, but ranged from 0 to 28 days. For light physical activity the median recommendation for convalescence was 4 (range 0–28) days and for hard physical activity 14 (range 0–35) days.

We compared differences in surgical parameters between the most experienced and the least experienced surgeons. We found no differences in any surgical parameters except that surgeons who had performed hernia surgery for <6.5 years informed more routinely about acute pain than surgeons with >6.5 years of experience,  $p = 0.027$ . This difference disappeared when dichotomizing surgeons after total number of herniorrhaphies in the career,  $p = 0.906$ . Furthermore, we found that surgeons who had performed >275 herniorrhaphies informed more routinely about mesh infection than surgeons who had performed  $\leq 275$  herniorrhaphies,  $p = 0.040$ . This difference disappeared when grouping surgeons according to years performing laparoscopic groin hernia repair,  $p = 0.869$ .

## Discussion

This was a nationwide survey among experienced groin hernia surgeons. The study provides details in laparoscopic groin hernia surgery not available elsewhere. There were wide variations in techniques, actions, and decisions in laparoscopic groin hernia surgery in Denmark, and these seemed to depend on the individual surgeon’s preferences. Furthermore, there was a range in the recommendations of convalescence for both normal daily activities and exercise.

Technical guidelines for laparoscopic repair of an inguinal hernia from the International Endohernia Society have addressed many of the surgical parameters described in our study [12, 13]. Most surgeons in this study used either Veress needle or direct insertion of a trocar through umbilicus to create pneumoperitoneum. This is in accordance with the updated guidelines from the International Endohernia Society that states that the direct trocar insertion can be used as a safe alternative to other methods if the patient’s risk factors are considered and the surgeon is appropriately trained [13]. In this study, all surgeons closed the peritoneal defect and half of the surgeons used suture for this. Other methods used were glue, tacks, and clips. Guidelines recommend that a thorough closure of the peritoneal defect should be done and that the peritoneal closure can be accomplished by running suture [12]. However, the level of recommendation for using running suture was based on inconsistent or

**Table 2** Outcome data

Item of questionnaire	n (%)
Creation of pneumoperitoneum	
Open access (Hasson technique)	4 (7)
Direct trocar insertion through umbilicus (insufflation after insertion of trocar)	25 (41)
Veress needle through umbilicus (insufflation before insertion of trocar)	25 (41)
Access through left upper quadrant (Palmer's point)	5 (8)
Other <sup>a</sup>	2 (3)
Size of optic and combination of entry-points	
5 mm only	19 (31)
10 mm only	25 (41)
Both 5 mm and 10 mm	17 (28)
Combination of entry points with 5 mm optic ( $n = 36$ ) <sup>b</sup>	
5/5/5 (three 5 mm entry points)	4 (11)
12/5/5 (one 10–12 mm entry point and two 5 mm entry points)	31 (86)
12/12/5 (two 10–12 mm entry points and one 5 mm entry point)	1 (3)
Combination of entry points with 10 mm optic ( $n = 42$ ) <sup>c</sup>	
12/5/5 (one 10–12 mm entry point and two 5 mm entry points)	9 (21)
12/12/5 (two 10–12 mm entry points and one 5 mm entry point)	30 (72)
12/12/12 (three 10–12 mm entry points)	3 (7)
Management of a suspect/enlarged gland	
Removal of the gland followed by histological examination	30 (49)
No removal of the gland but documentation in medical record	12 (20)
No further actions	5 (8)
Other <sup>d</sup>	14 (23)
Full peritoneal coverage of the mesh impossible after fixation <sup>e</sup>	
Dissect more peritoneum	48 (79)
Add coated mesh	10 (16)
Other	3 (5)
Management of a contralateral asymptomatic hernia	
Routine inspection of a contralateral asymptomatic hernia	
Yes	57 (93)
No	3 (5)
Other	1 (2)
Preoperative discussion with patient on how to manage a contralateral hernia	
Always	27 (44)
Often	21 (34)
Rare	10 (16)
Never	3 (5)
Preoperative recommendation to patient	
Repair of the contralateral hernia	11 (18)
No repair of the contralateral hernia	36 (59)
Other <sup>f</sup>	11 (18)
No preoperative recommendation	3 (5)
Management of contralateral hernia in case of no preoperative discussion <sup>g</sup>	
No repair of contralateral hernia and postoperative information	29 (48)
No repair of contralateral hernia without postoperative information	3 (5)
Other	2 (3)
Always preoperative discussion with patient	27 (44)
Convalescence recommendation, days, median (range)	
Activity of daily living	1.5 (0–28)
Light physical work <sup>h</sup>	4 (0–28)
Hard physical work <sup>i</sup>	14 (0–35)

**Table 2** (continued)

The surgeons' responses to each item of the questionnaire are presented

<sup>a</sup>Supraumbilical access-point

<sup>b</sup>Nineteen surgeons used only a 5 mm optic and 17 surgeons used both 5 mm and 10 mm optics, i.e. a total of 36 surgeons were capable of answering this question

<sup>c</sup>Twenty-five surgeons used only a 10-mm optic and 17 surgeons used both 5 mm and 10 mm optics, i.e. a total of 42 surgeons were capable of answering this question

<sup>d</sup>Most surgeons elaborated that they never or very rare had come across such gland

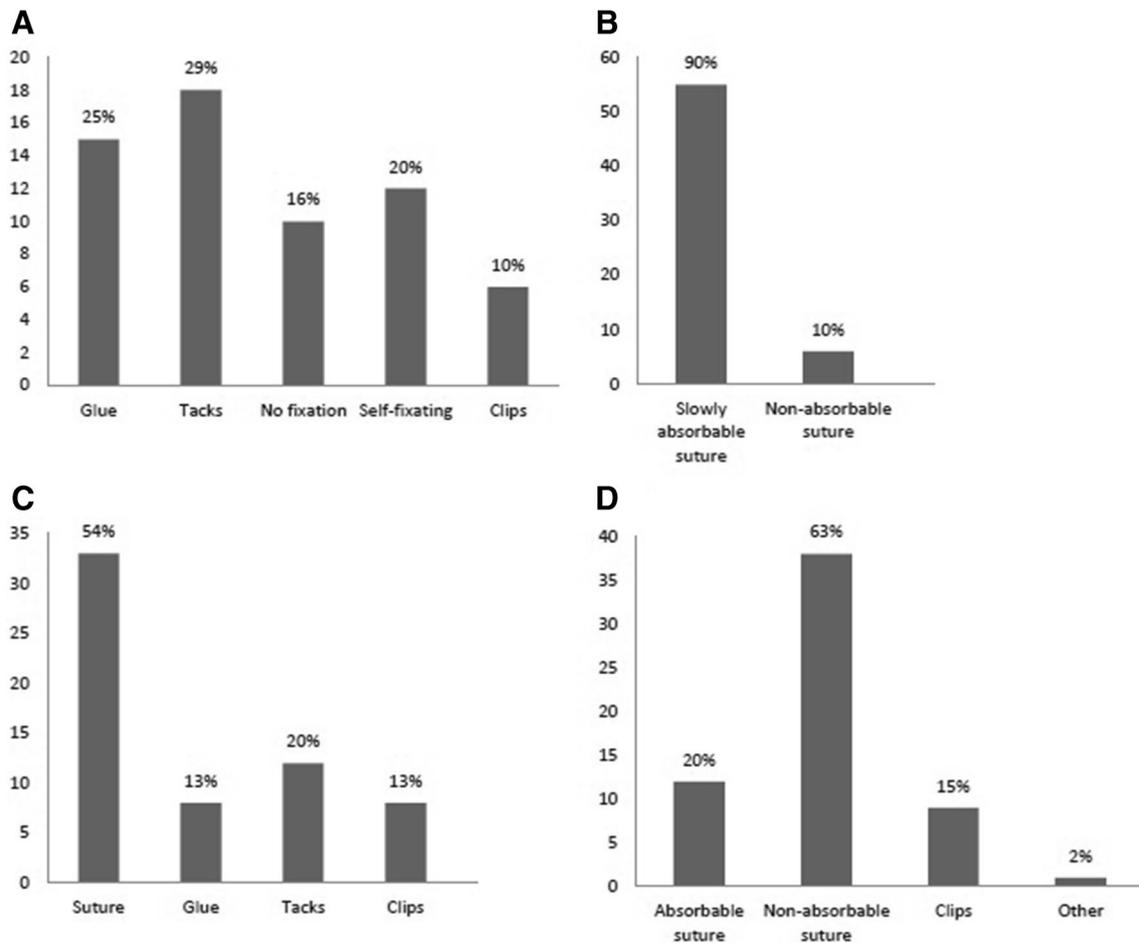
<sup>e</sup>No surgeons left uncovered polyester/polypropylene mesh

<sup>f</sup>Most surgeons replying "other" specified that simultaneous repair of a contralateral asymptomatic hernia depended on patient comorbidities

<sup>g</sup>No surgeon would operate a contralateral hernia without the patient's consent

<sup>h</sup>Light physical activity was defined as running and biking with moderate intensity, or other sport with minimal abdominal moving/twisting

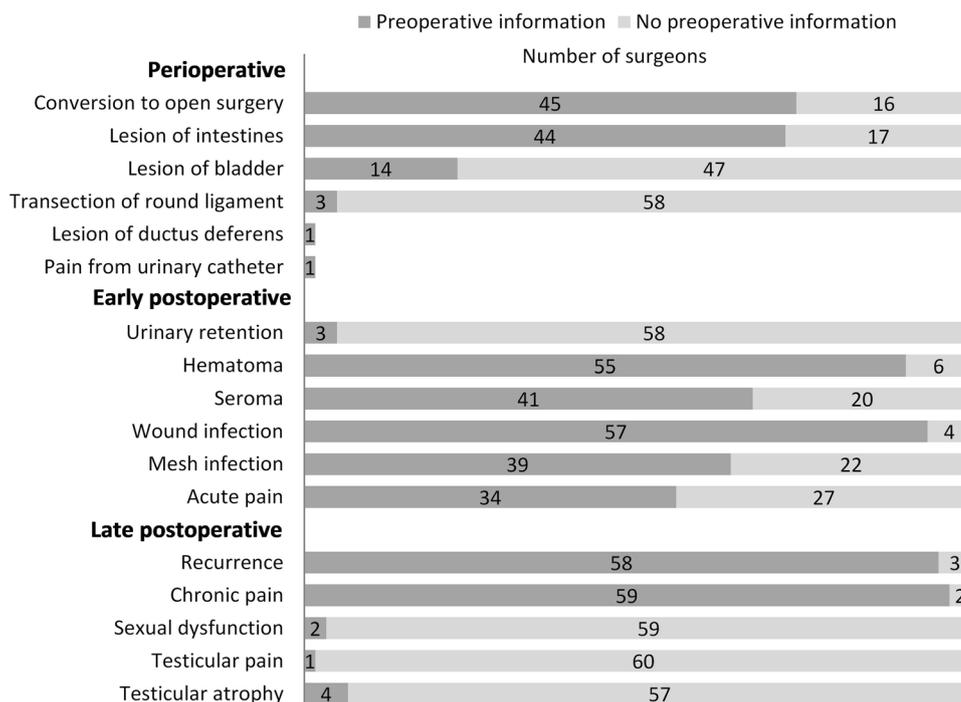
<sup>i</sup>Hard physical activity was defined as high-intensity sport/activity involving abdominal twisting/movement such as soccer and tennis



**Fig. 1** A–D Methods most commonly used by each surgeon for **A** mesh fixation ( $n=61$ ), **B** closure of peritoneal defect ( $n=61$ ), **C** closure of fascia after 10–12 mm entry points ( $n=61$ ), and **D** closure of skin incision ( $n=60$ ). The only surgeon that replied "other" used

leftover glue to close the skin incision. Self-fixating mesh was not an option in the questionnaire but was specified in the free-text by all surgeons answering "other"

**Fig. 2** Preoperative information to patients about perioperative risks and postoperative complications after laparoscopic groin hernia repair. Lesion of ductus deferens and pain from urinary catheter were added by two surgeons in the free-text space of the questionnaire



inconclusive studies (grade D recommendation). All surgeons in our study closed the fascial defects of the 10 mm trocars, which is also recommended in the guidelines [13]. One study showed that larger entry points may increase the risk of trocar site hernias [14]. A total of 70% of surgeons in our study used a combination of larger entry points with the use of a larger optic. Since the camera and optic quality has improved markedly over the past years, surgeons could consider using a small optic if available. In this study, the mesh fixation technique varied (Fig. 1A). According to guidelines, non-fixation should be considered in inguinal hernias under 3 cm [12, 13].

A multicenter prospective questionnaire study showed that there were no association between recurrence and recommendation of short (1 day) convalescence [15]. In fact, guidelines from the HerniaSurge group [5] and the International Endohernia Society [13] state that no study has yet demonstrated that early return to activity of daily living and work increases the risk of recurrence or complications, i.e. patients should be encouraged to resume normal activities as soon as possible after uncomplicated inguinal hernia repair. One single-center prospective study showed that the preoperative expectation of convalescence from work was the only significant predictive factor of prolonged convalescence from work [16]. This indicates that a longer recommendation of convalescence may prolong the convalescence period unduly. Unnecessary sick leave has both personal and societal consequences and should be avoided if possible. Surgeons should reconsider the necessity of recommending long convalescence from daily activities and light physical

work. The convalescence period for high intense sport is sparsely investigated in the literature since it is difficult to perform clinical trials due to a small number of athlete patients. Many surgeons recommend short convalescence to work and light physical activities and longer convalescence to sport and hard physical activities.

The amount of preoperative information given to patients by surgeons varied. Only 3% of the surgeons routinely provided preoperative information of the risk of sexual dysfunction to patients. Studies have shown that long-term impairment of sexual function after laparoscopic groin hernia repair may occur in up to 9% of patients including pain, dysejaculation, and erectile dysfunction [17, 18]. However, other studies showed that sexually related pain were more common before surgery than after [19, 20]. Still, 2% of patients with no history of complaints preoperatively experienced moderate to severe painful sexual activity following totally extraperitoneal hernia repair [19]. Another well-known complication to groin hernia repair is decreased testicular circulation resulting in testicular ischemia and/or testicular atrophy which has been reported in 0–2% of patients [21, 22]. In our study, only 7% of the surgeons routinely informed patients about the risk of testicular atrophy.

The strengths of this study include the nationwide coverage of experienced hernia surgeons regularly performing laparoscopic groin hernia repair. We had a high response rate of 86%, which is far higher than the recommended 60% threshold [23]. The questionnaire was developed in collaboration with an experienced chief surgeon and face-validated on the target group. Limitations in our study include the

risk of recall bias which may have occurred in some items of the questionnaire, e.g. number of herniorrhaphies in the surgeon's career. Two public departments and a few private departments did not reply to our initial contact, and we may, therefore, have missed some surgeons. However, most surgeons who work in the private sector are also employed in public departments. Furthermore, the surgeons' estimated number of laparoscopic herniorrhaphies performed the past 12 months (4782 herniorrhaphies) corresponds to the actual number of laparoscopic herniorrhaphies (4442 herniorrhaphies) performed in Denmark in 2016 [6]. We, therefore, believe that the number of missed surgeons is minimal and this should not affect the results.

Our study showed that the laparoscopic approach in groin hernia repair was far from uniform. This is an important observation to have in mind when designing clinical intervention trials as well as surgical training in laparoscopic groin hernia surgery. For clinical trials, researchers should try to standardize non-intervention parameters as much as possible, and some of the parameters elucidated in the present survey should, therefore, be taken into account in the design of clinical trials depending on the outcome parameters. The variation in convalescence recommendations reflects the lack of conclusive data but some kind of uniform policy would be beneficial.

In conclusion, technical surgical parameters and convalescence recommendations in laparoscopic groin hernia surgery vary in a national cohort of experienced hernia surgeons and seem to depend on the individual surgeon's preferences.

### Compliance with ethical standards

**Disclosures** Author Andresen reports personal fees from C.R. Bard, Inc. outside the submitted work. Author Rosenberg reports personal fees from C.R. Bard, Inc. and Merck & Co., Inc. outside the submitted work. The authors Öberg and Schmidt have no conflicts of interest or financial ties to disclose.

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