

Surgical approach for recurrent inguinal hernias: a Nationwide Cohort Study

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Abstract

Purpose Guidelines recommend that the reoperation of a recurrent inguinal hernia should be by the opposite approach (anterior–posterior) than the primary repair. However, the level of evidence supporting the guidelines is partially low. The purpose of this study was to compare re-operation rates between repairs performed according to the guidelines with the ones performed against it.

Methods This cohort study was based on the Danish Hernia Database, including 4344 patients with two inguinal hernia repairs in the same groin. Four groups were compared as follows: Lichtenstein–Lichtenstein vs. Lichtenstein–Laparoscopy, and Laparoscopy–Laparoscopy vs. Laparoscopy–Lichtenstein. The outcome was re-operation rates, which were compared by crude rates, cumulated rates, and hazard ratios.

Results There was no difference in the re-operation rates when the primary repair was laparoscopic, regardless of the type of reoperation. However, Lichtenstein–Lichtenstein had a significantly higher re-operation rate compared with Lichtenstein–Laparoscopy (crude rate 8.7 vs. 3.1 %, p value <0.0005; Hazard Ratio 2.46, 95 % CI 1.76–3.43). Further analysis showed that the higher risk of re-operation for Lichtenstein–Lichtenstein was only seen if the primary hernia was medial.

Conclusions A primary Lichtenstein repair of a primary medial hernia should be reoperated with a laparoscopic

repair. A primary Lichtenstein repair of a primary lateral hernia can be reoperated with either a Lichtenstein or a laparoscopic repair according to surgeon's choice. For a primary laparoscopic operation, the method of repair of a recurrent hernia did not affect the re-operation rate.

Keywords Inguinal hernia · Re-operation rate · Guidelines · Lichtenstein · Laparoscopic repair · Type of hernia

Introduction

Inguinal hernia is a common condition, especially among men, and the surgical treatment is effective with relatively few recurrences [1]. The surgical repair of an inguinal hernia can be performed through an anterior or a posterior approach and should include a mesh to ensure a low recurrence rate [2]. The open anterior approach is often performed by the Lichtenstein technique, and the posterior approach can be performed by endoscopic technique [totally extraperitoneal repair (TEP) or transabdominal preperitoneal repair (TAPP)] or by an open posterior approach. The current guidelines state that if the primary operation was by an anterior approach, the reoperation for a recurrence should be by a posterior approach, and the other way around if the primary operation was posterior [2–5]. In Denmark, where the majority of repairs are conducted as either Lichtenstein or TAPP repairs, the guidelines thus recommend that a recurrence after Lichtenstein should have a laparoscopic repair and that a recurrence after laparoscopic repair should have a Lichtenstein. However, the recommendations regarding repair of recurrences are only partly based on high-level evidence [2–5].

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The purpose of this study was to compare re-reoperation rates between different combinations of anterior and posterior repairs.

Methods

This study is a cohort study reported according to the STROBE statement [6]. The study is based on the Danish Hernia Database, where data are collected prospectively [7]. It is mandatory for all public and private hospitals in Denmark to register all inguinal hernia operations. The database has existed since 1998, and we have extracted data from the period 1998 until the end of 2014. Available variables in the database are patient related (age and sex), information about the procedure, such as date, type of operation, mesh type and mesh fixation, acute/elective operation, etc., and information about the groin hernia, such as type of hernia, and on which side the procedure was performed.

Participants with two registered inguinal hernia operations in the same groin were included. If two repairs in the same groin were registered on the same day, they were excluded. Types of included hernias were medial, lateral, pantaloon and “not specified”. Femoral hernias were excluded. Both primary repair and the reoperation should have been by a Lichtenstein or a laparoscopic method. A primary hernia was defined as the first inguinal hernia registered in the database. Reoperation was defined as a subsequent surgery for an inguinal hernia in the same side as the primary repair. Re-reoperation was defined as a third surgery for an inguinal hernia in the same groin as the reoperation. Since the included patients should have had two repairs in the same groin, there were four possible combinations. There were two combinations in accordance with the guidelines: a laparoscopic repair followed by a Lichtenstein reoperation (Laparoscopy–Lichtenstein) and a Lichtenstein followed by a laparoscopic reoperation (Lichtenstein–Laparoscopy). There were also two combinations that contradicted the guidelines: Lichtenstein–Lichtenstein and Laparoscopy–Laparoscopy.

The primary outcome, being the rate of a third repair in the same groin, the re-reoperation rate, was calculated as crude rates and cumulated rates by the use of Kaplan–Meier plot. The re-reoperation rates were compared between the groups with the same primary operation: Lichtenstein–Laparoscopy compared with Lichtenstein–Lichtenstein, and Laparoscopy–Lichtenstein compared with Laparoscopy–Laparoscopy. The re-reoperation rate comparison between the groups was also subdivided on type of primary hernia, where only primary medial and lateral hernias were included.

Chi-squared test was used to compare crude re-reoperation rates, and Kaplan–Meier plot was used to calculate

the cumulated re-reoperation rates for the four groups [8]. Kaplan–Meier takes the follow-up time into account, which was defined as time from reoperation until the patients had re-reoperations or until December 31, 2014, whichever came first. The log rank test was used to compare the cumulated re-reoperation rates between the groups [9]. To further analyse the re-reoperation rates, we used a multi-variable regression model—the Cox proportional hazard analysis [10]. The Cox regression model was fitted with several covariates, which potentially may have influenced the outcome: type of primary hernia (medial, lateral, pantaloon and not specified), follow-up time, age, sex, and acute or planned repair. We calculated hazard ratios (HR), *p* values, and 95 % confidence interval (95 % CI). $P \leq 0.05$ was interpreted as statistically significant. For statistical analyses, SPSS version 22.0 (IBM, Armonk, NY, USA) was used.

This study was approved by the Danish Data Protection Agency (Journal number: 03582, ID: HEH-2015-021). The study did not need ethical approval according to Danish law.

Results

In total, 4344 participants were included, and details for each of the four groups and the patient characteristics are presented in Table 1. The majority of the inguinal hernia repairs were performed in accordance with the guidelines, i.e., the reoperation was of another approach than the primary repair. For primary laparoscopic repairs with a subsequent reoperation, 80.8 % had a Lichtenstein reoperation, and for primary Lichtenstein, 79.3 % had a laparoscopic reoperation. For the laparoscopic reoperations, 98 % were performed by the TAPP technique. The mesh fixation for the laparoscopic reoperations partly differs. If the primary operation was Lichtenstein, then during the laparoscopic reoperations, the mesh was fixated as follows: 3.8 % of the fixation was by glue, 58.2 % was by tackers, and 11.8 % was by clips. For patients having two laparoscopic repairs, the mesh in the reoperations was fixated by glue in 5.3 %, by tackers in 59.2 %, and by clips in 5.3 %. The remaining was by other mesh fixations. Significantly more in the Lichtenstein–Laparoscopy group had clip fixation compared with patients in the Laparoscopy–Laparoscopy group ($p = 0.01$). However, Laparoscopy–Laparoscopy had a significantly higher number of unreported mesh fixations (p value 0.02). Furthermore, six patients with a laparoscopic reoperation were registered as having local or spinal anesthesia, which might be incorrect registrations.

The crude re-reoperation rate for each of the four groups at the end of the study is presented in Table 2. When

Table 1 Patient-related characteristics

	Lap–Lich	Lap–Lap	Lich–Lap	Lich–Lich	Total
No.	712	169	2747	716	4344
Age, years, mean (SD)	60 (13)	60 (13)	60 (14)	63 (15)	–
Sex <i>n</i> (%)					
Female	15 (2.1)	8 (4.7)	107 (3.9)	39 (5.4)	169 (3.9)
Male	697 (97.9)	161 (95.3)	2640 (96.1)	677 (94.6)	4175 (96.1)
Anesthesia (reoperation), <i>n</i> (%)					
GA	613 (86.1)	169 (100)	2741 (99.8)	581 (81.1)	4104 (94.5)
LA	89 (12.5)	0 (0)	1 (0.04)	94 (13.1)	184 (4.2)
Spinal	10 (1.4)	0 (0)	5 (0.2)	41 (5.7)	56 (1.3)
Surgery <i>n</i> (%)					
Planned	696 (97.8)	154 (91.1)	2702 (98.4)	662 (92.5)	4214 (97.0)
Acute	16 (2.2)	15 (8.9)	45 (1.6)	54 (7.5)	130 (3.0)
Follow-up ^a in months, median (IQR)	39.5 (16.3–77.6)	57.1 (25.2–89.9)	52.1 (23.1–87.3)	91.7 (46.0–134.5)	–

Lap Laparoscopy, Lich Lichtenstein, GA general anesthesia, LA local anesthesia, IQR interquartile range

^a Time from second repair in the groin until third operation or closing of the database

Table 2 Number of reoperations and crude re-operation rates

Operation–reoperation	No. of reoperations	Rate of re-reoperations (no.)	<i>p</i> value*
Lap–Lich	712	3.5 % (25)	0.15
Lap–Lap	169	5.9 % (10)	
Lich–Lap	2747	3.1 % (86)	<0.0005
Lich–Lich	716	8.7 % (62)	

Lap Laparoscopy, Lich Lichtenstein, no. number

* Chi-squared test

comparing the two groups having a primary laparoscopic repair, there was no statistical difference in the re-reoperation rates. However, for the two groups with a primary Lichtenstein repair, a significantly higher crude re-reoperation rate of 8.7 % was seen for the combination Lichtenstein–Lichtenstein, compared with 3.1 % for Lichtenstein–Laparoscopy, $p < 0.0005$.

The cumulated re-reoperation rates for the four groups are presented in Fig. 1a. Lichtenstein followed by laparoscopy had a significantly lower cumulated re-reoperation rate of 5.1 % compared with 10.1 % for Lichtenstein–Lichtenstein ($p < 0.0005$). For primary laparoscopic repairs, the rates were 6.2 % for Laparoscopy–Lichtenstein and 7.5 % for Laparoscopy–Laparoscopy ($p = 0.228$).

Table 3 presents the results from the Cox proportional hazard analysis, comparing the risk of re-reoperation between the two groups with the same primary operation. Thus, Lichtenstein–Lichtenstein resulted in a significantly higher risk of a re-reoperation compared with Lichtenstein–Laparoscopy with an HR of 2.46 (95 % CI: 1.76–3.43). No statistically significant difference was seen when the primary repair was laparoscopic, irrespective of the type of reoperation, where Laparoscopy–Lichtenstein

compared with Laparoscopy–Laparoscopy had an HR of 0.72 (95 % CI: 0.34–1.54). For the primary laparoscopic operations, acute surgery at the time of the reoperation increased the risk of re-reoperation compared with planned surgery.

For the groups with a primary Lichtenstein operation, 94.5 % of the primary hernias were medial or lateral, which was the case for 91.2 % of the primary laparoscopic repairs. The remaining hernias were pantaloons or not specified. For patients with a primary medial hernia and a primary Lichtenstein operation, the Lichtenstein–Lichtenstein repairs had a significantly higher cumulated re-reoperation rate of 13.3 % compared with a rate of 5.0 % for Lichtenstein–Laparoscopy, $p < 0.0005$ (Fig. 1b). We found no difference in the cumulated re-reoperation rate when the primary hernia was lateral and repaired with a Lichtenstein operation, regardless of the reoperations (Fig. 1c). There was also no significant difference for the primary laparoscopic operations, regardless of the primary hernia type.

We also compared the risk of having a re-reoperation between the groups in a Cox proportional hazard analysis, subdivided on the primary hernia type. Similar to the above

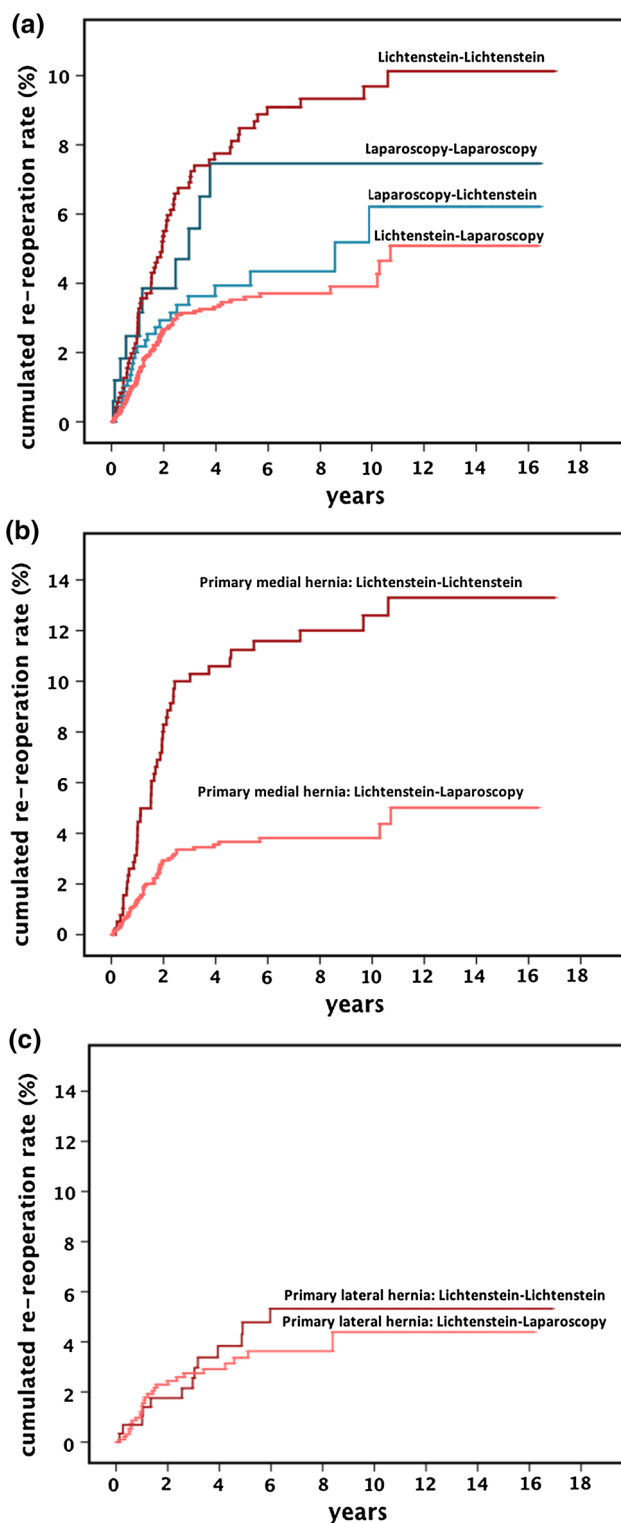


Fig. 1 **a** Kaplan–Meier on the four groups (Lichtenstein–Lichtenstein vs. Lichtenstein–Laparoscopy $p < 0.0005$, Laparoscopy–Laparoscopy vs. Laparoscopy–Lichtenstein $p = 0.228$); **b** Kaplan–Meier on primary medial hernias with Lichtenstein–Lichtenstein and primary medial hernias with Lichtenstein–Laparoscopy ($p < 0.0005$); **c** Kaplan–Meier on primary lateral hernias with Lichtenstein–Lichtenstein and primary lateral hernias with Lichtenstein–Laparoscopy ($p = 0.539$)

Table 3 Cox proportional hazard analysis comparing re-reoperation rates between groups with the same primary operation—type of primary hernia, sex, age, and type of surgery (planned/acute) were entered into the model

Operation–reoperation	<i>n</i>	HR (95 % CI)	<i>p</i> value
Lap–Lap	169	Ref 1.0	–
Lap–Lich	712	0.72 (0.34–1.54)	0.398
Male ^a /female		3.62 (0.78–16.77)	0.101
Age		0.99 (0.96–1.01)	0.311
Planned ^a /acute		3.46 (1.01–11.86)	0.048*
Primary hernia			
Not specified		Ref 1.0	–
Pantaloon		0.34 (0.04–3.29)	0.350
Medial		0.32 (0.04–2.40)	0.268
Lateral		0.18 (0.02–1.40)	0.101
Lich–Lap	2747	Ref 1.0	–
Lich–Lich	716	2.46 (1.76–3.43)	0.000*
Male ^a /female		1.21 (0.61–2.37)	0.587
Age		1.00 (0.99–1.01)	0.705
Planned ^a /acute		0.76 (0.28–2.07)	0.587
Primary hernia			
Not specified		Ref 1.0	–
Pantaloon		0.31 (0.06–1.51)	0.147
Medial		0.35 (0.09–1.45)	0.148
Lateral		0.23 (0.06–0.96)	0.044*

Lap Laparoscopy, Lich Lichtenstein, Ref reference group

* Statistically significant

^a Reference group with HR 1.0

results, when the primary operation was a Lichtenstein on a primary medial hernia, Lichtenstein–Lichtenstein resulted in a significantly higher risk of receiving a re-reoperation compared with Lichtenstein–Laparoscopy (HR of 3.08, 95 % CI: 2.06–4.60). There was no significant difference for the other combinations.

Discussion

The risk of re-reoperation after two Lichtenstein repairs in the same groin was significantly higher compared with a Lichtenstein repair followed by a laparoscopic repair, but only if the primary hernia was medial. There were no differences in re-reoperation rates for patients having a primary laparoscopic operation, regardless if the reoperation was a Lichtenstein or a laparoscopic repair.

Three of the current guidelines on how to repair a recurrent inguinal hernia recommend the reoperation to be of a different approach than the first repair. However, only part of the statements has data to support them. The guideline from the European Hernia Society states that

there is a theoretical advantage to operate in an area that is intact, both to ease the dissection, mesh implantation, and to reduce per- and postoperative complications [2]. An update of the guidelines included a meta-analysis, which assessed the preferable surgical approach after a primary anterior repair, including four randomized controlled trials (RCTs) (with three of the RCTs for the outcome chronic pain) [5]. Endoscopic repair was the preferable reoperation after a primary anterior repair because of less postoperative pain, a shorter convalescence period, and less chronic pain, without a difference in recurrence rates. However, they did not have data to support the statement that an endoscopic repair should be reoperated by an anterior approach. The guideline from the European Association for Endoscopic Surgery is based on a consensus conference, where the authors stated that a recurrence after an open repair should be reoperated by endoscopic surgery [3]. They had no evidence to support the statement that an endoscopic repair should be reoperated by an anterior approach and they concluded that repeated endoscopic repairs only should be performed by highly experienced surgeons. A previous Danish study supports our findings that a primary Lichtenstein reoperated by a laparoscopic repair had a lower cumulated re-reoperation rate than if having two Lichtenstein repairs [11]. However, the authors found no difference between a primary laparoscopic operation reoperated by a Lichtenstein or a laparoscopic repair. This study did not calculate HR, nor did they subdivide re-reoperation rates on type of primary hernia.

Overall, the guidelines are lacking data to support the statement that a posterior approach should be followed by an anterior approach, and the opposite statement is partly based on high-level evidence.

This study can be compared with another Scandinavian study [12], but unlike our study, the authors subdivided posterior approach into laparoscopic repairs and open posterior repair, and the study only included 815 hernias compared with 4344 in this study. While the outcome in this study was re-reoperations, their outcome was re-recurrence [12], but since reoperation can be used as a surrogate for recurrence [13], we expect the outcomes to be comparable. When comparing the results of the Cox proportional hazard analysis, the Swedish study assessed the risk of re-recurrence after the reoperation, which was adjusted for the primary operation. Their results supported the guidelines [2–5] that the reoperation should be of another approach than the primary repair. In our study, we compared the combinations of operations with the same primary repair, and fitted the model for potential confounders. Our results only support the guidelines if the primary repair was Lichtenstein and the primary hernia type was medial, which should have a laparoscopic reoperation to ensure the lowest re-reoperation rate. The

reasons for the different results may be because we included only standardized mesh repairs, fitted the Cox proportional hazard analysis for various variables, and also analysed if the type of primary hernia influenced the outcome.

A recently published case series [14] assessed outcomes after anterior repairs followed by tailored anterior mesh repairs in a high-volume department. They concluded that an inguinal hernia recurrence first repaired by an anterior approach can be reoperated by the same approach if the surgeons are experienced. However, based on the re-reoperation rates, we generally recommend different approaches when the primary hernia was medial, since our results also included low-volume centres and surgeons with variable experiences.

The strengths of this study were that the patients were found among the entire Danish inguinal hernia population for the last 17 years, which gave high external validity with results reflecting the outcomes in non-specialized centres as well. The risk of reporting bias was negligible, since it is mandatory to report all inguinal hernia operations in the central database. A limitation of the study was that there were more primary Lichtenstein repairs than laparoscopic repairs, which potentially may have influenced the results. The main outcome in the study was re-reoperation rates as a proxy for re-recurrence rates, but we expect no effect of this on the overall results. Even though it would be interesting to also analyse recurrences and chronic pain for the same population, we were unable to do so, since results from follow-up consultations are not registered in the database.

One of the reasons why surgeons choose the combination Laparoscopy–Lichtenstein instead of Laparoscopy–Laparoscopy may be because of the fear to cause serious perioperative complications when using the laparoscopic technique twice. However, data on perioperative complications are not included in the database, and we were, therefore, unable to make analysis on morbidity parameters. Furthermore, the surgeon's level of experience is not registered in the database, but one can expect that the combination Laparoscopy–Laparoscopy has been performed by experienced surgeons, which may not to the same extent be true for the other combinations. Therefore, the results for primary laparoscopic repairs, that surgeons may freely choose the reoperation technique, may only be true for experienced surgeons. For the patients with two laparoscopic operations, the reason for a low recurrence rate may also be due to a favourable patient selection, but to assess this parameter, it would be necessary to study the patient records.

In conclusion, when considering the risk of re-reoperation, our results only partly support the current guidelines of how to reoperate a recurrent inguinal hernia. A primary

Lichtenstein repair of a primary medial hernia should be reoperated with a laparoscopic repair. However, if the primary hernia was lateral and repaired by Lichtenstein, then surgeons may freely choose type of reoperation in accordance with their preferences. If the primary operation was laparoscopic, the choice of reoperation technique does not affect the re-reoperation rates.

Compliance with ethical standards

Conflict of interest SÖ reports no potential conflicts of interest. KA reports personal fees from Bard outside the submitted work. JR reports grants from Johnson and Johnson, grants and personal fees from Bard, personal fees from Merck, outside the submitted work.

Ethical approval For this type of study, formal consent is not required.

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Informed consent This article does not contain any studies with human participants or animals performed by any of the authors.

References

- Fitzgibbons RJ Jr, Forse RA (2015) Clinical practice. Groin hernias in adults. *N Engl J Med* 372:756–763. doi:[10.1056/NEJMcp1404068](https://doi.org/10.1056/NEJMcp1404068)
- Simons MP, Aufenacker T, Bay-Nielsen M, Bouillot JL, Campanelli G, Conze J et al (2009) European Hernia Society guidelines on the treatment of inguinal hernia in adult patients. *Hernia* 13:343–403. doi:[10.1007/s10029-009-0529-7](https://doi.org/10.1007/s10029-009-0529-7)
- Poelman MM, van den Heuvel B, Deelder JD, Abis GS, Beudeker N, Bittner RR et al (2013) EAES consensus development conference on endoscopic repair of groin hernias. *Surg Endosc* 27:3505–3519. doi:[10.1007/s00464-013-3001-9](https://doi.org/10.1007/s00464-013-3001-9)
- Rosenberg J, Bisgaard T, Kehlet H, Wara P, Asmussen T, Juul P et al (2011) Danish Hernia Database recommendations for the management of inguinal and femoral hernia in adults. *Dan Med Bull* 58:C4243
- Miserez M, Peeters E, Aufenacker T, Bouillot JL, Campanelli G, Conze J et al (2014) Update with level 1 studies of the European Hernia Society guidelines on the treatment of inguinal hernia in adult patients. *Hernia* 18:151–163. doi:[10.1007/s10029-014-1236-6](https://doi.org/10.1007/s10029-014-1236-6)
- Vandenbroucke JP, von Elm E, Altman DG, Gotzsche PC, Mulrow CD, Pocock SJ et al (2014) Strengthening the Reporting of Observational Studies in Epidemiology (STROBE): explanation and elaboration. *Int J Surg* 12:1500–1524. doi:[10.1016/j.ijsu.2014.07.014](https://doi.org/10.1016/j.ijsu.2014.07.014)
- The Danish hernia database (2000) The first year. *Ugeskr Laeger* 162:1552–1555
- Bland JM, Altman DG (1998) Survival probabilities (the Kaplan–Meier method). *BMJ* 317:1572
- Bland JM, Altman DG (2004) The logrank test. *BMJ* 328:1073
- Bradburn MJ, Clark TG, Love SB, Altman DG (2003) Survival analysis part II: multivariate data analysis—an introduction to concepts and methods. *Br J Cancer* 89:431–436
- Bisgaard T, Bay-Nielsen M, Kehlet H (2008) Re-recurrence after operation for recurrent inguinal hernia. A nationwide 8-year follow-up study on the role of type of repair. *Ann Surg* 247:707–711. doi:[10.1097/SLA.0b013e31816b18e3](https://doi.org/10.1097/SLA.0b013e31816b18e3)
- Sevonius D, Sandblom G, Agger E, Smedberg S, Montgomery A (2015) The impact of type of mesh repair on 2nd recurrence after recurrent groin hernia surgery. *World J Surg* 39:315–322. doi:[10.1007/s00268-014-2921-4](https://doi.org/10.1007/s00268-014-2921-4)
- Kald A, Nilsson E, Anderberg B, Bragmark M, Engstrom P, Gunnarsson U et al (1998) Reoperation as surrogate endpoint in hernia surgery. A three year follow-up of 1565 herniorrhaphies. *Eur J Surg* 164:45–50
- Erdas E, Medas F, Gordini L, Licheri S, Pisano G, Nicolosi A (2016) Tailored anterior tension-free repair for the treatment of recurrent inguinal hernia previously repaired by anterior approach. *Hernia* 20:393–398. doi:[10.1007/s10029-016-1475-9](https://doi.org/10.1007/s10029-016-1475-9)