

Review

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Surgical risk factors for recurrence in inguinal hernia repair – a review of the literature

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Abstract: Despite all the progress made in inguinal hernia surgery driven by the development of meshes and laparoendoscopic operative techniques, the proportion of recurrent inguinal hernias is still from 12% to 13%. Recurrences can present very soon after primary inguinal hernia repair generally because of technical failure. However, they can also develop much later after the primary operation probably due to patient-specific factors. Supported by evidence-based data, this review presents the surgical risk factors for recurrent inguinal hernia after the primary operation. The following factors are implicated here: choice of operative technique and mesh, mesh fixation technique, mesh size, management of medial and lateral hernia sac, sliding hernia, lipoma in the inguinal canal, operating time, type of anesthesia, participation in a register database, femoral hernia, postoperative complications, as well as the center and surgeon volume. If these surgical risk factors are taken into account when performing primary inguinal hernia repair, a good outcome can be expected for the patient. Therefore, they should definitely be observed.

Keywords: case load; inguinal hernia; mesh fixation; mesh size; mesh; recurrence.

Introduction

Despite all the progress made in inguinal hernia surgery (meshes and laparoendoscopic operative techniques), the proportion of recurrent inguinal hernias among the total patient collective with inguinal hernias is still from 12% to

13% [1, 2]. Depending on its cause, a recurrence can occur very soon after the primary operation or it can also develop much later on [3, 4]. There is a discrepancy in the literature between the low recurrence rates reported in individual studies and the still relatively high recurrence rates identified in a nonselective total patient collective in registers. This is mainly due to the fact that many studies have a maximum follow-up time of only 1–5 years, during which only about 40% of recurrences present [3], whereas the register studies with nonselective patient collectives also include those recurrences developing later [3]. Therefore, patients with inguinal hernia repair should be followed up for a long time. The literature reports on numerous surgical factors for the recurrence of inguinal hernia. While citing evidence-based data, this present systematic review aims to identify the most important surgical factors implicated in the development of recurrence. Because the new “World Guidelines for Groin Hernia Management” no longer recommend but the mesh-based operative techniques Lichtenstein, totally extraperitoneal (TEP), and transabdominal preperitoneal (TAPP) [5], the following analyses are confined to these surgical techniques.

Materials and methods

Searches were performed in PubMed and Medline as well as in the reference lists of all included publications for relevant studies. The search terms were “inguinal hernia and recurrence”, “recurrent inguinal hernia”, “hernia recurrence”, and “recurrent inguinal hernia”. A total of 1660 publications were identified and screened. Finally, 80 articles were relevant for this review.

Results

Use of meshes

Supported by the highest level of evidence, the guidelines on the treatment of inguinal hernia state that the

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use of meshes results in a lower recurrence rate. Hence, nonmesh techniques are no longer recommended, except when the patient declines the use of a mesh or no mesh is available [5–10]. This recommendation is substantiated by several meta-analyses of prospective randomized studies (Level 1 A as per the Oxford criteria) [11–14] as well as by register data [15, 16].

Lichtenstein vs. TEP/TAPP

The meta-analyses comparing the recurrence rate after open-mesh repair (Lichtenstein) to laparoendoscopic mesh repair (TEP/TAPP) in some cases identified lower recurrence rates for the Lichtenstein operation [17–21]. This finding was the focus of an update of its guidelines by the European Hernia Society, which carried out its own meta-analysis [9]. The difference in the long-term recurrence rate between Lichtenstein and endoscopic surgery was not significant [9]. Nor did the analysis of the recurrence rates after TEP/TAPP vs. Lichtenstein of randomized controlled trials (RCTs) of exclusively male patients with primary unilateral inguinal hernia in the worldwide Guidelines of the HerniaSurge Group [5] identify any significant difference.

TEP vs. TAPP

In several meta-analyses, no difference was found in the recurrence rate between TAPP and TEP [22–25]. Nor did a literature analysis in the “World Guidelines for Groin Hernia Treatment” detect any significant difference in the recurrence rate between TEP and TAPP [5].

Heavyweight vs. lightweight meshes in Lichtenstein operation

Four meta-analyses revealed that the use of “lightweight, large-pore meshes” in Lichtenstein operation did not lead to a higher recurrence rate [26–29]. Likewise, in one meta-analysis, the use of an extremely lightweight and large-pore mesh (Vypro II) for inguinal hernia repair was not found to result in a higher recurrence rate [30]. Furthermore, a meta-analysis of nine studies with 3133 inguinal hernia operations found that lightweight, large-pore, and partially absorbable meshes did not result in a higher recurrence rate compared to nonabsorbable meshes [31].

Heavyweight vs. lightweight meshes in laparoendoscopic operations (TEP/TAPP)

Similarly, a meta-analysis of eight studies with 1592 patients demonstrated that, for the laparoendoscopic techniques TEP and TAPP, the use of lightweight and large-pore meshes did not increase the recurrence rate [32].

Self-gripping vs. sutured meshes in open inguinal hernia surgery

Five systematic reviews and meta-analyses compared the findings of open inguinal hernia operations for self-gripping to sutured meshes, with a maximum number of 1353 patients. No difference in the recurrence rates was identified in any of the studies [33–37]. The analysis of additional suture fixation of the self-gripping mesh for cases in the Herniated Hernia Register did not find any evidence that this impacted the recurrence rate [38].

Suture vs. glue fixation in open inguinal hernia repair

Four meta-analyses compared suture to glue mesh fixation in open inguinal hernia surgery [39–42]. Based on a total number of 1992 patients, it was demonstrated that there was no difference in the recurrence rates between these mesh fixation techniques.

A study from the Swedish Hernia Register assessed the effects of different mesh fixation suture materials on the risk of recurrence after Lichtenstein inguinal hernioplasty [43]. With regard to the recurrence risk, long-term absorbable sutures are an excellent alternative to permanent sutures for mesh fixation in Lichtenstein inguinal hernioplasty. Short-term absorbable sutures represent an independent risk factor for recurrence and should therefore be avoided [42].

Tacker vs. glue vs. no fixation in laparoendoscopic inguinal hernia repair

Three meta-analyses with a maximum of 1386 patients revealed that no mesh fixation in laparoendoscopic inguinal hernia surgery did not lead to a higher recurrence rate compared to mesh fixation [44–46]. That applied to TAPP for defects up to 3 cm. Therefore, the guidelines recommend nonfixation of the mesh in TAPP only for defects up to 3 cm [7, 10].

Tacker vs. glue fixation in laparoendoscopic inguinal hernia repair

Six meta-analyses with a maximum of nine studies and 1454 patients did not find any significant difference in the recurrence rate in the comparison of these rates for tacker to glue mesh fixation in laparoendoscopic inguinal hernia surgery [47–52]. Mesh fixation should be used in TAPP, in particular, for defects of more than 3 cm and for medial inguinal hernia [53]. Similarly, a register study of the Danish Hernia Database confirmed the equivalence of tacker and glue mesh fixation in TAPP [54].

Use of a slit mesh in TEP/TAPP

The Guidelines of the International Endohernia Society [7, 10] do not recommend mesh slitting for TEP and TAPP. A nonslitted mesh is not associated with a higher recurrence rate than a mesh that has been slitted and fitted around the spermatic cord structures. On the contrary, a slit mesh can present a higher risk of recurrence. In the Lichtenstein operation, the mesh must be slitted to permit the passage of the spermatic cord structures.

Mesh size

The standard mesh size recommended in the guidelines [5–10] for TEP and TAPP is 15 × 10 cm. Under no circumstances should a smaller mesh be used as this would result in a higher recurrence rate. For larger direct (>3–4 cm) and indirect (>4–5 cm) inguinal hernias, even larger meshes (12 × 17 cm) should be used [7, 10].

A systematic review and meta-analysis to determine the importance of mesh size in Lichtenstein repair found in 29 studies that a mesh larger than 90 cm² was used [55]. The most frequently preferred commercial mesh size was 7.5 × 15 cm. No paper mentioned the size of the mesh after trimming. The pooled proportion of recurrence for small meshes was 0.0019 [95% confidence interval (CI) = 0.007–0.0036], favoring larger meshes to reduce the chance of recurrence. Although there is no evidence, it seems that larger meshes reduce recurrence rates [55].

Management of the indirect sac

Wherever technical feasible in laparoendoscopic techniques, the hernia sac should be completely excised from the inguinal canal. According to the guidelines, a large

indirect sac may be ligated proximally and divided distally without the risk of a higher postoperative pain and recurrence rate but with an increased postoperative seroma rate [7, 10]. The complete reduction of the hernia sac may eliminate the occurrence of chronic seroma or pseudo-hydrocele [7, 10].

In a study of the Swedish Hernia Register, the 5-year cumulative incidence of reoperation for recurrence after open inguinal hernia repair was 1.7% for hernia sac excision, 1.7% for division, and 2.7% for invagination [56]. For indirect hernia repair, the relative risk of reoperation for recurrence was 0.63 (95% CI = 0.51–0.79) for excision of the sac and 0.72 (95% CI = 0.53–0.99) for division compared to invagination. Lichtenstein repair combined with hernia sac excision had a 5-year cumulative reoperation incidence for recurrence of only 1.0%. The authors concluded that excision of the indirect hernia sac in inguinal hernia repair is associated with a lower risk of hernia recurrence than division or invagination [56].

Management of the direct sac

Analyses of registers showed that the recurrence rate after the primary operation of direct inguinal hernia was significantly higher than after indirect inguinal hernia (5.2% vs. 2.7%; $p < 0.001$) [57–60]. Accordingly, extreme caution must be exercised for direct/medial inguinal hernia repair.

For larger direct/medial hernias in laparoendoscopic techniques, the fixed hernia sac should be reduced to prevent seromas and recurrences [7, 10]. Unlike an indirect inguinal hernia, which after excision of the hernia sac from the inguinal canal has a curtain-like closure, the direct hernia sac will persist unless further measures are taken, for example, it becomes filled with serous fluid, possibly giving rise to a “pseudo-recurrence”. Besides, there is a risk that because of pressure exerted on this area the mesh will be pushed in further, thus resulting in recurrence. Therefore, the transversalis fascia lining this region should be inverted and either sutured to Cooper’s ligament or ligated with a Roeder loop. This results in the complete reduction of the sac [7, 10], thus helping to prevent seroma formation and recurrence [7, 10].

The most plausible explanation for the development of a direct recurrence after Lichtenstein inguinal hernia repair is insufficient medial mesh fixation and overlap over the pubic tubercle [61]. It may be possible to reduce the recurrence rate after Lichtenstein repair by more than half by paying increased attention to this specific aspect of the operation [61].

Sliding inguinal hernia

Among male patients, the sliding inguinal hernias have a higher cumulative reoperation rate for recurrence compared to nonsliding inguinal hernias (6.0% vs. 4.2%; log-rank $p=0.001$) [62].

Lipomas in the inguinal canal

Special attention should be paid to preperitoneal lipoma as a possibly overlooked herniation or potential future pseudo-recurrence despite a nondislocated correctly positioned mesh [63–68]. Lipomas in the inguinal canal can be easily overlooked at the time of laparoendoscopic hernia repair, and this can lead to unsatisfactory results [63–68]. All lipomas should be reduced and excised whenever feasible. Awareness and appropriate management of the sliding lipoma will help to reduce the risk of recurrence after laparoendoscopic hernioplasty.

Operating time

In a study of the Swedish Hernia Register, the relative risk of reoperation for recurrence of all patients operated on in less than 36 min was 26% higher than that of all patients with an operating time of more than 66 min (1.26; 95% CI = 1.11–1.43) [69]. The authors concluded that a significant decrease in reoperation for recurrence with increasing operating time exhorts the hernia surgeon to avoid speed and to maintain thoroughness throughout the procedure [69].

Anesthesia

Data from the Swedish Hernia Register and the Danish Hernia Database show that groin hernia repair in local anesthesia is associated with a significantly increased risk of reoperations for recurrence [70, 71].

Register and quality improvement

The nationwide Danish Hernia Database and Collaboration with two annual meetings discussing its own results and those of others has led to more than 50% reduction in reoperation rates for recurrence [72].

Femoral hernia

A total of 3970 primary femoral hernia repairs from the Danish Hernia Database [73] were analyzed; 27.3% occurred in men. There were 2413 elective repairs (60.8%) and 1557 emergency procedures (39.2%). In a multivariate analysis, laparoendoscopic repair was found to result in reduced risk of reoperation for recurrence compared to open repair. The risk of reoperation for recurrence was higher in women. Furthermore, the laparoscopic approach seemed to reduce the risk of subsequent occurrence of an inguinal hernia in the same groin [73].

Postoperative complications

In a database study, complications were associated with recurrence (3.2% vs. 1.7%; $p < 0.05$) [74]. Complications did not significantly increase the risk of recurrence in open hernia repair [odds ratio (OR) = 1.49; 95% CI = 0.97–2.30; $p = 0.069$]. Complications after laparoscopic repair were significantly associated with increased risk of recurrence (OR = 7.86; 95% CI = 3.46–17.85; $p < 0.05$) [74].

Center volume

Centers reporting fewer than 50 procedures a year in the Danish Hernia Database had a significantly higher cumulative reoperation rate for recurrence compared to centers reporting more than 50 procedures a year (9.97% vs. 6.06%; $p < 0.001$) [75].

Surgeon volume

Surgeon volume of less than 25 cases per year for open inguinal hernia repair was independently associated with higher rates of reoperation for recurrence [76]. In the Herniamed Hernia Register, univariable analysis (1.03% vs. 0.73%; $p = 0.047$) and multivariable analysis (OR = 1.494; 95% CI = 1.065–2.115; $p = 0.023$) revealed that low-volume surgeons (<25 procedures per year) had a significantly higher recurrence rate after laparoendoscopic inguinal hernia repair (≥ 25 procedures per year) [77].

In the Swedish Hernia Register, there was a significantly higher rate of reoperations for recurrence in surgeons who carried out one to five repairs in a year than in surgeons who carried out more repairs [78].

Conclusion

Patient-specific risk factors for inguinal hernia recurrence have already been published in detailed reviews [57, 79, 80]. The present review focuses exclusively on the surgical risk factors for recurrence after primary inguinal hernia repair. This has identified several risk factors for inguinal hernia recurrence after the primary operation, which can be influenced by the surgeon and their expertise. This also includes factors related to the conduct of the operation. If the evidence-based influencing factors for inguinal hernia recurrence are taken into account, the surgeon can assure a good outcome for patients with regard to the recurrence rate. It can probably even be assumed that the surgical risk factors for recurrent inguinal hernia after the primary operation play a greater role than the patient-specific factors. Therefore, they should definitely be observed.

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Author Contributions

Henning Niebuhr: literature search, selection of relevant papers, writing of original draft, writing review and editing. Ferdinand Köckerling: literature search, selection of relevant papers, writing of original draft, writing review and editing.

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Supplemental Material: The article (DOI: 10.1515/iss-2017-0013) offers reviewer assessments as supplementary material.

Reviewer Assessment

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Henning Niebuhr and Ferdinand Köckerling*

Surgical risk factors for recurrence in inguinal hernia repair – a review of the literature

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Reviewers' Comments to Original Submission

Reviewer 1: anonymous

Feb 24, 2017

Reviewer Recommendation Term:	Accept
Overall Reviewer Manuscript Rating:	70
Custom Review Questions	Response
Is the subject area appropriate for you?	5 - High/Yes
Does the title clearly reflect the paper's content?	5 - High/Yes
Does the abstract clearly reflect the paper's content?	4
Do the keywords clearly reflect the paper's content?	4
Does the introduction present the problem clearly?	4
Are the results/conclusions justified?	4
How comprehensive and up-to-date is the subject matter presented?	4
How adequate is the data presentation?	3
Are units and terminology used correctly?	N/A
Is the number of cases adequate?	5 - High/Yes
Are the experimental methods/clinical studies adequate?	3
Is the length appropriate in relation to the content?	4
Does the reader get new insights from the article?	4
Please rate the practical significance.	5 - High/Yes
Please rate the accuracy of methods.	3
Please rate the statistical evaluation and quality control.	3
Please rate the appropriateness of the figures and tables.	N/A
Please rate the appropriateness of the references.	5 - High/Yes
Please evaluate the writing style and use of language.	4
Please judge the overall scientific quality of the manuscript.	4
Are you willing to review the revision of this manuscript?	Yes

Comments to Authors:

This is an excellent overview to get further insights into the risk factors for recurrences after inguinal hernia repair. The authors analyzed numerous meta-analyses and systemic Reviews as well as registries, so that the data are quite reliable. It remains, however, unclear how the authors selected the 80 relevant articles out of 1660 publications for this Review. Therefore, a bias cannot be excluded. Despite this fact, the data still appear to be reliable. Any surgeon interested in hernia surgery gets relevant information in particular with respect to possible risk factors for hernia recurrence after surgery.

Reviewer 2: anonymous

Mar 08, 2017

Reviewer Recommendation Term:	Accept
Overall Reviewer Manuscript Rating:	80

Custom Review Questions

	Response
Is the subject area appropriate for you?	5 - High/Yes
Does the title clearly reflect the paper's content?	5 - High/Yes
Does the abstract clearly reflect the paper's content?	5 - High/Yes
Do the keywords clearly reflect the paper's content?	4
Does the introduction present the problem clearly?	4
Are the results/conclusions justified?	4
How comprehensive and up-to-date is the subject matter presented?	4
How adequate is the data presentation?	4
Are units and terminology used correctly?	N/A
Is the number of cases adequate?	5 - High/Yes
Are the experimental methods/clinical studies adequate?	4
Is the length appropriate in relation to the content?	4
Does the reader get new insights from the article?	3
Please rate the practical significance.	5 - High/Yes
Please rate the accuracy of methods.	4
Please rate the statistical evaluation and quality control.	3
Please rate the appropriateness of the figures and tables.	N/A
Please rate the appropriateness of the references.	5 - High/Yes
Please evaluate the writing style and use of language.	4
Please judge the overall scientific quality of the manuscript.	4
Are you willing to review the revision of this manuscript?	Yes

Comments to Authors:

The author presents in this excellent manuscript important data regarding risk factors for inguinal hernia recurrence following surgical repair referring to relevant publications. The results based on meta-analyses and systematic reviews contain a high practical relevance for surgeons dealing with hernia repair to choose the optimal technique with respect to low complications rates and particularly recurrence.
