

The Impact of Type of Mesh Repair on 2nd Recurrence After Recurrent Groin Hernia Surgery

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Abstract

Background According to the Swedish Hernia Register (SHR), the reoperation rate is more than doubled after recurrent groin hernia repair compared with primary repair. The aim was to study the impact of type of mesh repair used in recurrent groin hernia surgery on a 2nd recurrence in a population-based cohort derived from the SHR.

Material and method All 1st recurrent hernia repairs in the south-west region of Sweden, registered in SHR between 1998 up to 2007 were included. A questionnaire was sent in 2009. Patients stating a new lump or persisting problems were examined. A 2nd recurrence was identified as a 2nd reoperation or at physical examination. The incidence was analysed comparing anterior mesh repair (AMR) and posterior mesh repairs (PMR) (endoscopic and open).

Results Eight hundred and fifteen recurrent operations in 767 patents were analysed, 401 AMRs and 414 PMRs. PMR had a lower 2nd recurrence rate compared with AMR (5.6 vs. 11.0 %) ($p = 0.025$). An increased risk [3.21 (CI 1.33–7.44) ($p = 0.009$)] of a subsequent 2nd recurrence was seen after anterior index repair followed by AMR and a decreased risk [0.08 (CI 0.01–0.94) ($p = 0.045$)] after posterior index repair followed by AMR.

Conclusion PMR in recurrent groin hernia surgery was associated with a lower 2nd recurrence rate compared to anterior. A posterior approach for 1st recurrent operation is recommended after an anterior index repair and an anterior approach after a posterior index operation.

Introduction

The recurrence rate after groin hernia surgery has decreased considerably during the last 20 years mainly due

to the introduction of standardised techniques and mesh for reinforcement. The proportion of groin hernia repairs performed on recurrent hernias annually registered in the Swedish Hernia Register (SHR) has dropped from 16.4 % in 1992 to 9.2 % in 2013 [1].

Although there are several plausible outcome measures, studies from national hernia registers often focus on reoperation rates. Other endpoints, such as persisting pain and postoperative complications, may be of equal importance, but are more difficult to evaluate. In 2013, the overall reoperation rate 5 years after primary groin hernia surgery was 2.7 %, whereas the reoperation rate after recurrent groin surgery was 5.8 % according to SHR. The cause of this large discrepancy is not fully explored. Factors that affect the outcome could be patient-related (gender, age, type of hernia, risk factors), surgeon-related

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Table 1 Method of 1st recurrent repair

Mean age, years (SD)	AMR <i>n</i> = 401 64 (13)	PMR <i>n</i> = 414 63 (14)	E-PMR (<i>n</i> = 208) 63 (14)	O-PMR (<i>n</i> = 206) 64 (13)	Total (<i>n</i> = 815) 64 (14)
Sex					
M	396 (98.8)	390 (94.2)	199 (95.7)	191 (92.7)	786 (96.4)
F	5 (1.2)	24 (5.8)	9 (4.3)	15 (7.3)	29 (3.6)
Type of hernia					
Lateral	146 (36.4)	112 (27.1)	52 (25.0)	60 (29.2)	258 (31.7)
Medial	217 (54.1)	237 (57.2)	129 (62.0)	108 (52.4)	454 (55.7)
Femoral	0 (0)	16 (3.9)	4 (1.9)	12 (5.8)	16 (2.0)
Combined	35 (8.7)	45 (10.9)	23 (11.1)	22 (10.7)	80 (9.7)
Other	3 (0.8)	4 (1.0)	0 (0)	4 (1.9)	7 (0.9)
Size of hernia (cm)					
<1.5	65 (16.2)	78 (18.8)	42 (20.2)	36 (17.5)	143 (17.6)
1.5–3	149 (37.2)	214 (51.7)	114 (54.8)	100 (48.5)	363 (44.5)
>3	135 (33.7)	114 (27.5)	47 (22.6)	67 (32.5)	249 (30.5)
Data missing	52 (12.9)	8 (1.9)	5 (2.4)	3 (1.5)	60 (7.4)

Baseline characteristics on 815 1st recurrent groin hernia repairs in 767 patients, distributed in two main groups of repairs, *AMR* anterior mesh repairs and *PMR* posterior mesh repairs. The *PMR* group is subdivided in *E-PMR* endoscopic posterior mesh repairs and *O-PMR* open posterior mesh repairs

Values in parentheses are percentages

(skills) and technique-related (according to type of hernia repair). A meta-analysis on recurrent groin hernia surgery from 2010 [2] revealed no differences between anterior and preperitoneal mesh techniques regarding a 2nd recurrence or chronic pain, while other studies suggest a more favourable outcome after preperitoneal mesh techniques [3–6]. Women seem to benefit more than men from a preperitoneal mesh repair, due to the higher prevalence of femoral hernias [4]. A femoral hernia could be overlooked when performing an anterior repair. It will be defined as a recurrence at the next operation even though it has been there all the time. The previous method of repair also has to be taken into account when choosing technique for the recurrent operation. The recommendation from the European Hernia Society guidelines [7, 8] is to adjust the technique depending on the previous repair and if possible, implant the mesh in a plane where no previous surgery has been performed.

To describe the “true” recurrence rate after groin hernia surgery a follow-up is needed including clinical examination or even interventional diagnostic methods. The “true” recurrence rate 3 years after hernia surgery is estimated to exceed the reoperation rate by a factor of two, due to the fact that many patients with a recurrence will never be re-operated or even diagnosed [9]. The referred study was based on 86 % primary hernia repairs using a postal questionnaire and selective physical examination for diagnose of a recurrence. This method has though not been applied on patients operated for a recurrent groin hernia.

The aim was to study the risks of developing a 2nd recurrence after a recurrent groin hernia repair taking into account the type of mesh repair. The patient cohort was derived from the SHR.

Materials and methods

The SHR started in 1992 and is since more than 10 years covering more than 98 % of all hernia operations in Sweden. The registrations are performed prospectively according to a standardised protocol. The accuracy and completeness of the recorded data are validated annually. Since each Swedish resident has a unique personal identification number, any hernia repair in a given patient can be linked to the previous registered repair in the SHR, wherever performed in the country.

Five hospitals in south west of Sweden participated in the study, two university hospitals, one county hospital and two small hospitals only performing planned surgery. One of the small hospitals is associated with the two university hospitals and the other with the county hospital, resulting in three separate units for registration in the SHR (referred to as A, B and C). All 1st recurrent groin hernia repairs performed at these units were included. The units joined the SHR in different years; A joined in 1998, B in 2003 and C in 2000. Operations registered from joining SHR until the 31st of December 2007, were eligible for inclusion. Exclusion criteria were death before follow-up and

non-mesh repairs. The first operation for a recurrent hernia at respective groin side for each patient registered in SHR was considered the 1st recurrent groin hernia repair and fulfilled the criteria for inclusion. A patient could be included twice, if fulfilling inclusion criteria for both groins. The 1st recurrent hernia repair was classified in two groups: anterior mesh repair (AMR) and posterior (preperitoneal) mesh repair (PMR). All repairs performed on a groin after previous groin hernia repair (inguinal or femoral) were considered recurrent repairs, regardless of hernia anatomy at the preceding repair and reoperation. Included patients were registered for baseline data at 1st recurrent repair for age, sex, type of hernia and size of hernia defect (Table 1). The SHR and medical records were scrutinized for information on the index (operation prior to the first recurrent repair) operation method. The index operations were classified as anterior or posterior repairs. The second reoperation, named 2nd recurrent operation, was identified by searching the SHR for a new registration of a hernia repair on the specific groin.

Questionnaire

A questionnaire was sent to all patients alive in September 2008. Two reminders were sent. The questionnaire consisted of two questions: to be answered *Yes* or *No*.

Have you noticed a new lump in the groin after surgery?

Have you had any problems or discomfort after surgery?

The patient was invited for a physical examination if any of these questions was answered with a *Yes*. Two reminders were sent. Clinical examinations were conducted in 2009 by an independent surgeon, according to a standardised protocol. Both groins were examined in patients who were operated bilaterally. Recurrence was defined as the presence of a lump or an expansile cough impulse in the operated groin. The questionnaire and the procedure for selective clinical examination have previously been evaluated [9].

Mesh methods for the 1st recurrent operation

The analysis was based on the two groups of mesh repairs, AMR and PMR. The PMR group was further sub-grouped into endoscopic posterior mesh repair (E-PMR) and open posterior mesh repair (O-PMR). The AMR group included patients operated with a modified Lichtenstein technique. The E-PMR group included patients operated with total extraperitoneal (TEP) or transabdominal preperitoneal (TAPP) techniques. The O-PMR group included patients operated with open approach for a preperitoneal position of the mesh. The O-PMR was either performed through a transverse incision above the inguinal canal (Nyhus/Wantz) [10, 11], through a midline abdominal incision

(Stoppa) [12], or through the inguinal canal (TIPP—transinguinal preperitoneal) [13].

Index operation

The index operation was defined as the original operation for the primary hernia. The information on the type of operative method was retrieved from a former registration in SHR. If this was missing a manual search was performed in the patients' medical records. The repairs were classified as the "anterior index group" that consisted of both sutured and mesh repairs and the "posterior index group" that consists of both E-PMR- and O-PMR-operated patients.

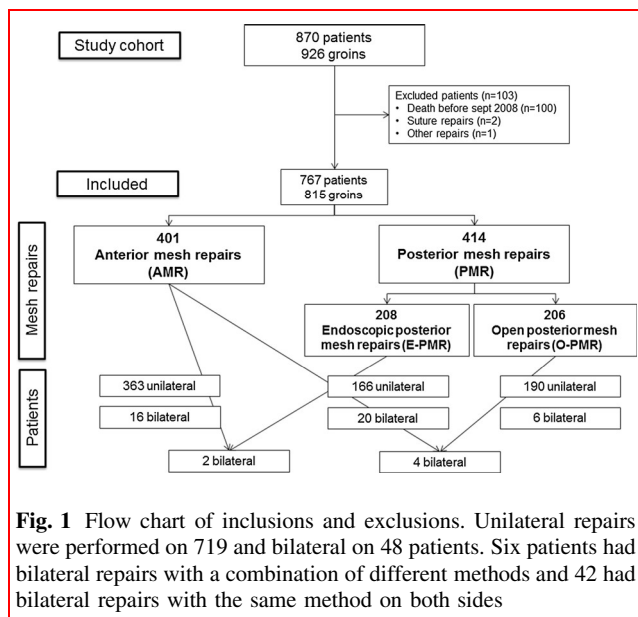
2nd recurrence

A 2nd recurrence was considered the endpoint. This was confirmed either by a registration of a 2nd recurrent repair in the SHR or at physical examination. The SHR was checked for any 2nd recurrent repairs from the time of the 1st recurrent repair until December 31st 2013. The median follow-up was calculated from the date of the 1st recurrent repair until the 2nd recurrent hernia was diagnosed (operation or clinical examination) or else until death by cross-matching with the Swedish Cause of Death Register. If none of these occurred, the patients were followed until December 31st 2013.

Statistical analysis

Primary endpoint was a 2nd recurrence, comparing AMR with PMR consisting of the merged group of preperitoneal mesh repairs (E-PMR and O-PMR). A subgroup analysis was performed on the E-PMR and the O-PMR groups. Age was described as mean, with standard deviation (SD). The follow-up and time between index operation and 1st recurrent repair were described as years in median, with interquartile range (IQR). Pearson χ^2 two-sided test was used to analyse differences in the ratio of repairs in women and emergency repairs. The tests were two-sided and $p < 0.05$ was considered significant. Mann–Whitney U test was used to compare time between different methods of index repair and 1st recurrent repair.

Plots showing cumulative rate of 2nd recurrence were generated by the Kaplan–Meier method and differences in 2nd recurrence rates were compared using the Log Rank test. Cox proportional hazard analyses were performed to estimate the risk of a 2nd recurrence for different mesh methods, stratifying for the index hernia repair. Statistical analysis was performed using SPSS[®] version 22.0 (IBM, Armonk, NY, USA). Ethical approval was granted by the



research ethics committee in Lund, Sweden. (Dnr 580/2007).

Results

During the study period, 926 recurrent groin hernia repairs were performed in 870 patients. A total of 103 patients were excluded according to Fig. 1. Altogether, 815 recurrent groin repairs in 767 patients were included in the analyses. Baseline characteristics are presented in Table 1. Unilateral operations were undertaken in 719 patients and 48 were operated bilaterally within the study protocol. Out of these operations, 401 were AMRs and 414 PMRs, of which 208 were E-PMRs (182 TEP and 26 TAPP) and 206 were O-PMRs. The distribution of methods of mesh repairs performed at the three SHR units is shown in Table 2. The units had different strategies for recurrent groin hernia operations and unit A performed 62 % of all AMRs, unit B performed 76 % of all E-PMRs and unit C performed 59 % of all O-PMRs. The median follow-up from the 1st recurrent operation was median 9.1 years (IQR 3.6) and subdivided for the groups: AMR 10.0 years (IQR 4.8), PMR 8.7 years (IQR 3.0), and PMR in subgroups; E-PMR 8.3 years (IQR 2.6) and O-PMR 9.2 years (IQR 3.4).

Emergency surgery was performed in 48 of the 815 groin operations (5.9 %). The rate of emergency repairs was 19/339 (5.6 %) for unit A, 15/219 (6.8 %) for unit B and 14/257 (5.4 %) for unit C with no difference between the units ($p = 0.58$). The AMR was used more frequent compared with PMR in the emergency setting, 33 and 15 repairs, respectively ($p = 0.005$). Emergency recurrent

repairs were not associated with a higher rate of a 2nd recurrence compared to elective recurrent repairs, 4/48 (8.3 %) and 63/767 (8.2 %), respectively ($p = 0.98$).

Questionnaire

The questionnaire was sent to 767 patients, of whom 48 patients underwent surgery in both groins for a 1st recurrent groin hernia, yielding a total number of 815 groins operated. The questionnaire was answered by 509 patients (66 %), representing patients who had been operated in a total number of 523 groins. A total of 141 patients (28 %) indicated a new lump or other discomfort in the groin. Physical examination was undertaken in 97 of 141 patients (69 %). The remaining patients chose not to be examined.

Index operation

Data on the index operation were available for 674 of the procedures (83 %) out of which 139 (17 %) repairs were registered in SHR and 535 (66 %) were retrieved from previous patients medical records. Out of these, 560 repairs were performed prior to December 2001 (83 %). The anterior group consisted of 534 sutured repairs and 87 AMRs and the posterior group consisted of 29 E-PMRs and 12 O-PMRs. Twelve repairs were not possible to classify as anterior or posterior repairs (Table 3). The median time from the index operation to the 1st recurrent operation was 10.0 years (IQR = 17.0) for all index repairs. The corresponding time for suture repair was 13.0 years compared with mesh repair 2.0 years (AMR 2.0 years and PMR 3.0 years) ($p < 0.001$).

Gender differences

Twenty-nine repairs (3.6 %) were performed on women. The women were operated with a PMR, (E-PMR or O-PMR), in 24 of the 29 repairs (83 %) with a statistical difference compared to AMR ($p = 0.001$). Of these 29 repairs, a femoral hernia was found in 12 repairs (41.4 %). The index repair was identified in 27 out of the 29 repairs in women (93 %). An anterior index repair was reported in 21 repairs. At the 1st recurrent repair, a femoral hernia was found in 10 of these 21 index repairs (47.6 %).

Men were operated with a PMR in 390 of 786 1st recurrent repairs (49.6 %) and a femoral hernia was found in 24 of the 786 repairs (3.1 %). A total of 20 femoral hernias were found at the 1st recurrent repair in men, after 600 anterior index repairs (3.3 %).

There was no difference in 2nd recurrence rate between women and men, 1 out of 29 repairs (3.4 %) and 66 of 786 repairs (8.4 %), respectively (log rank test $p = 0.461$).

Table 2 Distribution of methods of 1st recurrent repairs between the three SHR units

SBR unit	AMR <i>n</i> = 401	E-PMR <i>n</i> = 208	O-PMR <i>n</i> = 206	Total <i>n</i> = 815
A	248 (62)	9 (5)	82 (40)	339 (42)
B	57 (14)	159 (76)	3 (1)	219 (27)
C	96 (24)	40 (19)	121 (59)	257 (31)

Values in parentheses are percentages

AMR anterior mesh repair, E-PMR endoscopic posterior mesh repair, O-PMR open posterior mesh repair

2nd recurrence in relation to method of mesh repair

A 2nd recurrence was found in 67 out of 815 1st recurrent groin hernia repairs (8.2 %). Fifty-two out of these (78 %) were registered in the SHR for a 2nd recurrent repair and 15 (22 %) were found at clinical examination.

A 2nd recurrence was found in 44 of 401 (11.0 %) in the AMR group and in 23 of 414 in the PMR (5.6 %). The AMR group was compared to the PMR group in a Kaplan–Meier analysis with a log rank test showing a lower rate of a 2nd recurrence for the PMR group ($p = 0.025$) (Fig. 2a). A 2nd recurrence was discovered in 14 out of the 206 (6.8 %) in the O-PMR group and in 9 of 208 (4.3 %) in the E-PMR group ($p = 0.276$) (Fig. 2b). A subgroup analysis was performed on the O-PMR group for the different incisions through which the repairs were performed (Fig. 3). The proportion of TIPP in the O-PMR group was 32 out of 206 repairs (15.5 %). Nine of 32 TIPPs had a 2nd recurrence (28 %). The corresponding figures for the repairs performed through a transverse incision (Nyhus), was 4 out of 161 (2.5 %). The difference between TIPP and Nyhus was tested in a log rank test. ($p = 0.001$). There was no difference in rate of 2nd recurrence for patients who had bilateral 1st recurrent repairs compared to patients with unilateral repairs ($p = 0.917$).

2nd recurrence in relation to index method of repair

The impact of the index operation on the rate of 2nd recurrences was studied using a univariable Cox proportional hazard analyse (Table 3). The anterior index group was merged from 534 sutured repairs and 87 AMRs and the Posterior index group from 29 endoscopic and 12 open PMRs. Of the known 674 previous repairs, 12 repairs were omitted, since they could not be classified as either anterior or posterior repairs. An increased risk [3.21 (CI 1.33–7.44) ($p = 0.009$)] of a subsequent 2nd recurrence was seen after an anterior index repair followed by an AMR compared to an E-PMR (reference). A decreased risk [0.08 (CI 0.01–0.94) ($p = 0.045$)] of a subsequent 2nd recurrence was seen after a posterior index repair followed by an AMR compared to an E-PMR.

Discussion

The present study indicates that 1st recurrent groin hernia should preferably be operated with a mesh repair in the previously non-operated space in the groin to minimize the risk of a 2nd recurrence. This is in accordance with the European guidelines [7]. Endoscopic methods of repair were associated with the lowest rate of a 2nd recurrence and AMRs the highest. These results are in accordance with the randomised study by Kouhia [14], but in contrast to the latest review articles [2, 15], which does not show any differences in 2nd recurrence between endoscopic and Lichtenstein repairs. Most studies on recurrent hernia compare endoscopic and tension-free anterior repairs and do not include open PMRs. National data from the SHR 2012, show that 18 % of the recurrent repairs were O-PMRs [1]. The proportion of O-PMR in the current study was 25 %. The study shows that the O-PMRs as a group is equally favourable to the endoscopic repairs. In subgroup analyses, however, the TIPP technique does not seem to be as favourable.

A PMR is applicable if the index operation, prior to the 1st recurrent repair, is an anterior repair. These findings are consistent with previous register studies [4, 5]. In this study, most index repairs were anterior suture repairs that are now considered outdated. For the relatively small group of patients who had a 1st recurrent repair after a previous posterior repair, this study shows a lower risk of a 2nd recurrence if an AMR was used. Although not been proven in previous studies, this is in line with the recommendations from the European Hernia Society guidelines, which advocate implanting the mesh in a plane where no previous surgery has been performed [7]. To use the untouched space in the groin appears favourable after having a recurrence in order to diminish the risk of having a 2nd recurrence. This seems logic since the untouched space is more easily accessed, resembling a primary repair.

In this study, 42 % of the recurrent operations were performed through a previously used space. Most recurrences emanates from an anterior approach performed when the Shouldice procedure was popular. To repair a recurrence in the same space after a sutured repair seems

Table 3 Cox proportional hazard ratio of 2nd recurrence after the three different methods of 1st recurrent repairs, depending on the index method of repair

Method of 1st recurrent repair	Index method of repair					
	Anterior (<i>n</i> = 621)			Posterior (<i>n</i> = 41)		
	<i>n</i>	Hazard ratio (CI)	<i>p</i>	<i>n</i>	Hazard ratio (CI)	<i>p</i>
E-PMR	179	Ref 1.0	–	5	Ref 1.0	–
AMR	263	3.21 (1.33–7.44)	0.009	29	0.08 (0.01–0.94)	0.045
O-PMR	179	1.75 (0.65–4.73)	0.271	7	0.45 (0.04–5.17)	0.525

With E-PMR as reference, HR 1.0

p < 0.050 versus reference category (Cox proportional hazard analysis). Values within brackets shows 95 % confidence interval

E-PMR endoscopic posterior mesh repair, AMR anterior mesh repair, O-PMR open posterior mesh repair

more accessible than after a former mesh repair. We have, however, not made this group distinction since the numbers of index mesh repairs were few. The results are overwhelming with a more than three times higher risk of having a new recurrence when the same anterior space was used. This is in accordance with previous studies from the Swedish and Danish hernia registers [4, 5]. The number of patients with a former suture repair will diminish over time, but still these patients will be common. The median time to develop a 1st recurrence was 10 years in this study. Our results indicate that recurrences appear earlier if the index operation was a mesh repair compared to a suture repair. This is in contrast to a study by Magnusson et al., who reported early recurrence after suture and endoscopic repair compared with AMR [16]. Early recurrence is, however, often considered the result of a technical failure.

Groin hernia repairs in women constitute 9 % of all hernia repairs registered in the SHR 2013. In this cohort of recurrent repairs, the corresponding figure was 3.6 %. The proportion of women operated with a PMR was 83 %, which must be considered high from a nationwide perspective. The corresponding figure for men was 49.6 %. There was no significant difference in 2nd recurrence rates between men and women.

The first annual report from the SHR that reported methods of repair in men and women separately was in 2008. Of the 1,340 repairs in women that year, 761 (56.8 %) were performed with an AMR (Lichtenstein and Plug repairs). This clearly indicated the need for a change in the operative management of hernia in women. This was supported by other studies that showed the advantage of the TEP procedure in detecting femoral hernia in women [17] and large register studies have confirmed that PMR in women is associated with a lower risk for reoperation than AMR [18, 19].

In the current study, a femoral hernia was found in 41.4 % of repairs in women and in 3.1 % in men at the 1st recurrent hernia repair. These figures indicate a higher prevalence of femoral hernia at recurrent repairs compared

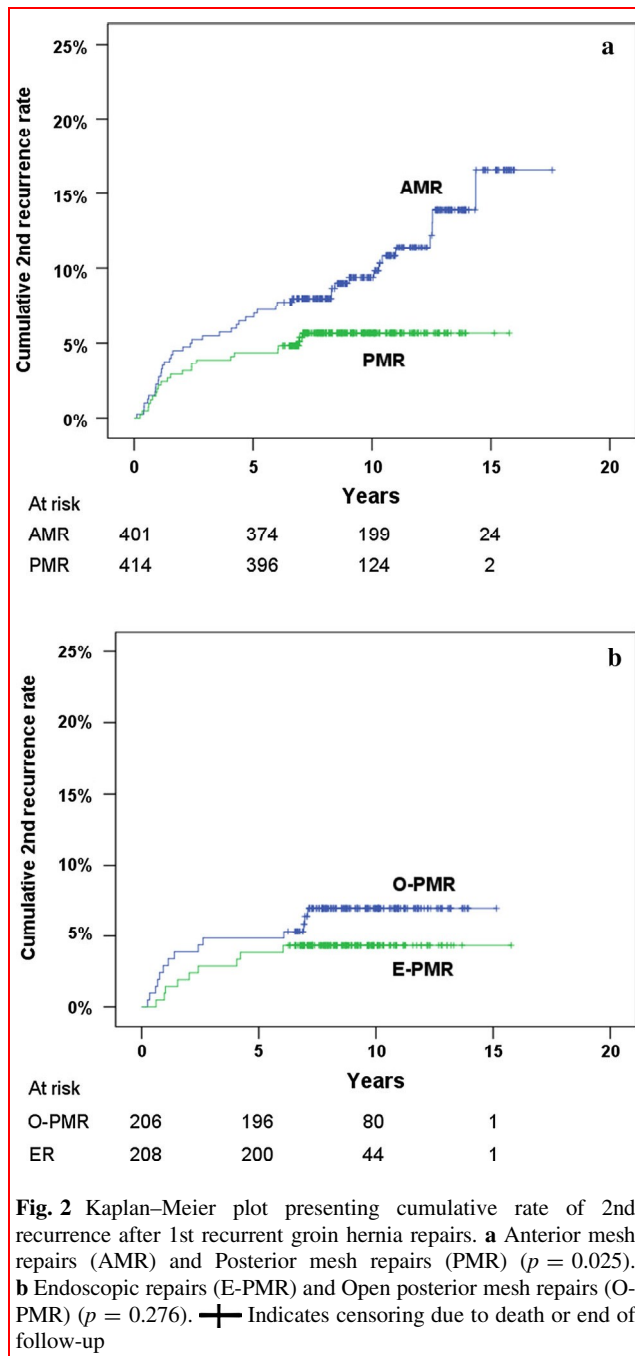
to primary repairs. This is confirmed by non-published national data from the SHR 2004–2013, showing that men were found to have a femoral hernia in 0.9 % (1,187/133,627) of primary repairs and in 3.9 % (546/13,980) of recurrent repairs. The corresponding data for women were 23.5 % (2,953/12,580) of primary repairs and 42.1 % (343/814) of recurrent repairs.

When the index operation was an anterior repair, a femoral hernia was found at the 1st recurrent repair in 47.6 % of women and in 3.1 % of men. This indicates a high risk for a missed femoral hernia when performing anterior repair, if not taking specific actions to exclude the presence of a femoral hernia.

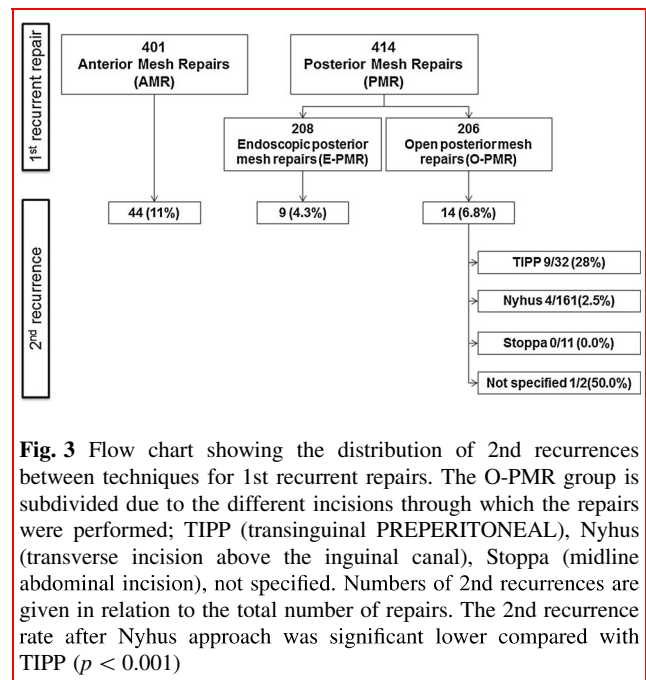
These data support the use of PMR methods in women for both primary and recurrent groin hernia repair and in men with recurrent hernia.

The study reveals large differences in 2nd recurrence rate after different open PMRs correlated to the surgical approach. If the mesh was placed in the preperitoneal position through a transverse incision above the inguinal canal (Nyhus/Wantz), the rate of a 2nd recurrence was lower than all other mesh methods (2.5 %). With a transinguinal approach (TIPP), the 2nd recurrence rate came close to 30 %. These results may reflect the fact that these operations often are performed through scar tissue after previous anterior repairs, which makes the dissection and placement of the preperitoneal mesh more difficult. It is suggested to avoid the TIPP procedure in recurrent groin hernia surgery. The Kugel herniorrhaphy was not used in the current study, though other studies have shown results comparable with endoscopic techniques [20].

A weakness of the study is that the clinical examination was performed in 2009 although 2nd recurrent repairs were included from the SHR until December 31st 2013. This means that clinical 2nd recurrences that were not re-operated in this interval have been overlooked. Another weakness is the incompleteness of answers to questionnaire and of clinical follow-up. The study detected 67 2nd recurrences from which all together 15 (22 %) were found



after having a 66 % response rate to the questionnaire and 69 % of patients having had a clinical examination after indicating a new lump or other discomfort. It is hard to draw any conclusions what this incompleteness means in numbers of missed 2nd recurrences. It could be assumed that the majority of patients with a symptomatic 2nd recurrence most likely would answer several reminders and offer to become clinically examined. Our data suggest that the 2nd recurrence rate could be estimated by multiplying the reoperation rate registered in the SHR with a factor of



at least 1.3 (67/52). In the Ekelund study, this factor was 2.7 [21]. One strength of the study was the high level of completeness, including previous and subsequent repairs, which made it possible to analyse the impact of the index repair. This study has also supplemented the data taken from the SHR with a postoperative follow-up procedure to detect non-re-operated 2nd recurrences. The study reflects the outcome after routine hernia surgery performed in the decade of 2000s. This is in contrast to the randomised controlled trials [14, 22, 23] that mainly were conducted in the 1990s and included small numbers of patients.

Eklund et al. [21] reported a cumulative increasing 2nd recurrence rate from 6 % after 1 year and 19 % after 5 years for the TAPP and 8 % after 1 year and 18 % for Lichtenstein after 5 years. These frequencies are high but at that time the meshes were smaller, which could have contributed to the high 2nd recurrence rate. A cumulative recurrence rate is also noted by us in the AMR group being 8 % after 5 years and 17 % after 15 years. This is in contrast to the PMR group that plateaued on 5 % after 7 years suggesting this technique to be a good choice for a good long-lasting repair.

In conclusion, the untouched side of the abdominal wall in the groin is recommended for a 1st recurrent hernia repair. Both an endoscopic and an open Nyhus mesh repair could be used for posterior repair in order to archive a low 2nd recurrence rate. Transinguinal approach to the preperitoneal space should be avoided in recurrent hernia surgery. Women who undergo surgery for recurrent groin hernia should be operated with a PMR, due to the very high prevalence of femoral hernia.

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Conflict of interest None.

References

- SHR (Swedish Hernia Register) web site, www.svensktbrackregister.se/index.php?lang=en. Accessed Nov 2014
- Karthikesalingam A, Markar SR, Holt PJ, Praseedom RK (2010) Meta-analysis of randomized controlled trials comparing laparoscopic with open mesh repair of recurrent inguinal hernia. *Br J Surg* 97:4–11
- Sevoniuss D, Gunnarsson U, Nordin P, Nilsson E, Sandblom G (2009) Repeated groin hernia recurrences. *Ann Surg* 249:516–518
- Sevoniuss D, Gunnarsson U, Nordin P, Nilsson E, Sandblom G (2011) Recurrent groin hernia surgery. *Br J Surg* 98:1489–1494
- 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
- Saber A, Ellabban GM, Gad MA, Elsayem K (2012) Open preperitoneal versus anterior approach for recurrent inguinal hernia: a randomized study. *BMC Surg* 12:22
- Simons MP et al (2009) European Hernia Society guidelines on the treatment of inguinal hernia in adult patients. *Hernia* 13:343–403
- Miserez M 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
- Haapaniemi S, Nilsson E (2002) Recurrence and pain three years after groin hernia repair. Validation of postal questionnaire and selective physical examination as a method of follow-up. *Eur J Surg* 168:22–28
- Nyhus LM (1989) The recurrent groin hernia: therapeutic solutions. *World J Surg* 13:541–544. doi:10.1007/BF01658868
- Wantz GE (1989) Giant prosthetic reinforcement of the visceral sac. *Surg Gynecol Obstet* 169:408–417
- Stoppa R, Petit J, Henry X (1975) Unsutured Dacron prosthesis in groin hernias. *Int Surg* 60:411–412
- Maillart JF, Vantournhout P, Piret-Gerard G, Farhadani H, Mael E (2011) Transinguinal preperitoneal groin hernia repair using a preperitoneal mesh preformed with a permanent memory ring: a good alternative to Lichtenstein's technique. *Hernia* 15:289–295
- Kouhia ST et al (2009) Lichtenstein hernioplasty versus totally extraperitoneal laparoscopic hernioplasty in treatment of recurrent inguinal hernia—a prospective randomized trial. *Ann Surg* 249:384–387
- Dedemadi G, et al. Recurrent Inguinal Hernia Repair: What is the Evidence of Case Series? A Meta-Analysis and Metaregression Analysis. *Surgical laparoscopy, endoscopy & percutaneous techniques* (2014)
- Magnusson N, Nordin P, Hedberg M, Gunnarsson U, Sandblom G (2010) The time profile of groin hernia recurrences. *Hernia* 14:341–344
- Schouten N et al (2012) Female 'groin' hernia: totally extraperitoneal (TEP) endoscopic repair seems the most appropriate treatment modality. *Hernia* 16:387–392
- Koch A, Edwards A, Haapaniemi S, Nordin P, Kald A (2005) Prospective evaluation of 6895 groin hernia repairs in women. *Br J Surg* 92:1553–1558
- Mikkelsen T, Bay-Nielsen M, Kehlet H (2002) Risk of femoral hernia after inguinal herniorrhaphy. *Br J Surg* 89:486–488
- Li J, Wang X, Feng X, Gu Y, Tang R (2013) Comparison of open and laparoscopic preperitoneal repair of groin hernia. *Surg Endosc* 27:4702–4710
- Eklund A et al (2007) Recurrent inguinal hernia: randomized multicenter trial comparing laparoscopic and Lichtenstein repair. *Surg Endosc* 21:634–640
- Beets GL et al (1999) Open or laparoscopic preperitoneal mesh repair for recurrent inguinal hernia? A randomized controlled trial. *Surg Endosc* 13:323–327
- Dedemadi G, Sgourakis G, Karaliotas C, Christofides T, Koutrakis G (2006) Comparison of laparoscopic and open tension-free repair of recurrent inguinal hernias: a prospective randomized study. *Surg Endosc* 20:1099–1104