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ORIGINAL ARTICLE

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Prognosis factors in incisional hernia surgery: 25 years of experience

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Abstract *Background*: Incisional hernia underwent a change from conventional techniques to mesh implantation. The relevance of different factors, like operative technique, mesh material, and patient-related parameters concerning the outcome following mesh repair, are still under debate. *Methods*: In a comparative retrospective study of 421 incisional hernia operations on 348 patients, we investigated 241 Mayo procedures and 180 mesh repairs over a 25-year period. In addition to the quality of life following mesh implantation, the prognostic relevance of demographic, preoperative and intraoperative parameters, surgical technique, mesh material, and the surgeon's experience were analysed, both in a univariate and multivariate manner. *Results*: With a mean follow-up of 9.7 ± 8.8 years, the total recurrence rate following Mayo overlap was 37%, in contrast to 15% after mesh implantation ($P = 0.001$). Mesh size was the only significant prognostic factor concerning quality of life following mesh implantation, and 86% of the patients with mesh repair were satisfied. The complication rate was determined significantly by patients' risk factors, size of hernia, operative technique, and the surgeon's experience, whereas the rate of recurrences was significantly influenced by the parameters obesity (BMI > 25), size of hernia, and surgical experience. The recurrence rate decreased significantly with surgeon's experience—a minimum of 16 mesh repairs led to a recurrence rate of less than 10%. *Conclusions*: Only the mesh repair revealed acceptable recurrence rates with high patient comfort. From a surgical point of view, the most important prognostic factor following mesh repair is the surgeon's experience.

Keywords Incisional hernia · Mayo · Mesh repair · Prognostic factor · Surgeon's experience

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Introduction

Incisional hernia surgery underwent a change during the 1990s from conventional techniques, like the Mayo procedure, to a widespread usage of meshes. According to a national survey carried out in 1995, 85% of all German hospitals favoured the Mayo technique in primary incisional hernia surgery, and 63% favoured it even in recurrent incisional hernias. However, a repeat survey carried out in 2001 showed that only 18% and 21% of hospitals, respectively, still used the Mayo technique. As a result, approximately 80% of all incisional hernia repairs in Germany are now carried out using mesh implantation [1].

Due to fundamental changes in surgical techniques, the recurrence rate following conventional incisional hernia surgery undisputably decreased from 50% [2, 3, 4] to < 10% [3, 5, 6, 7, 8] following mesh repair. However, the literature indicates that even after mesh implantation, the results considerably vary concerning the recurrence rate with > 30% [9, 10] and the complication rate of > 50% [2, 3]. There are several reasons for these findings, thus creating a need to search for other possible solutions, amongst others, in inhomogeneous patient collectives with low case numbers, different mesh materials with variable implantation techniques within

an evaluation, and, last but not least, an insufficient time span of less than 2 years for follow-ups [6, 11].

Due to these confusing data, surgeons still disagree on the most appropriate procedure, namely what mesh ought to be used in which technique.

Patients' quality of life following incisional hernia surgery has not been tested sufficiently yet. While some authors found, in part, high rates of limited movement in the abdominal wall and several disorders in the patients' condition [6, 7, 12, 13, 14, 15], other research groups had mainly positive results [6], in particular following a standardised operative technique.

Consequently, the aim of this retrospective study was to compare conventional procedures to mesh implantation over a period of 25 years using a large number of patients and, furthermore, to define possible prognosis factors that affect the results. Taking the prognosis factors into consideration or modifying them could improve the quality of the results.

Patients, material, and methods

The study included the analysis of 674 files of patients who were operated on due to incisional hernia. Two hundred twenty-five operations had been carried out in other hospitals, and 17 with incomplete data were excluded from the study. Four hundred twenty-one operations carried out between 1976 and 2001 at the department of general surgery at the University of Göttingen were included for further evaluation. The procedures were performed in 348 patients (42% women, 58% men) with a mean age of 57.4 ± 13.3 years. The 421 operations included 241 Mayo procedures and 180 mesh repairs. In most cases (86%), the sublay technique was used and particularly in combination with Marlex mesh (76%) (Fig. 1). Due to the different case numbers, a statistical evaluation was only performed for the Mayo procedure compared to the mesh technique. Differences concerning different mesh materials or implantation techniques were only described in the text.

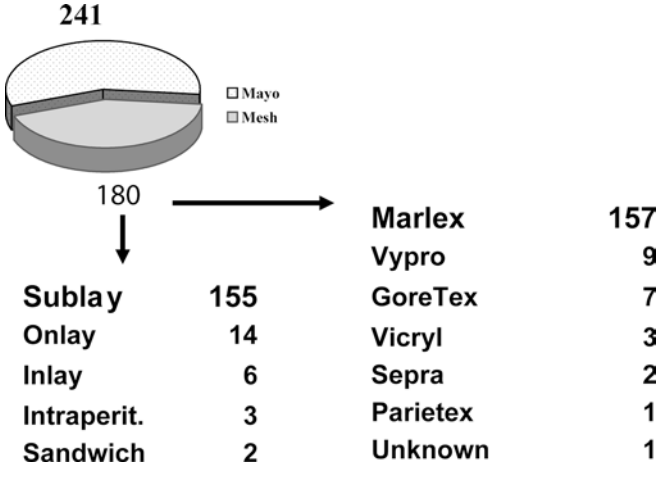

Fig. 1 Operation techniques and kinds of meshes in 421 incisional hernia repairs

Data collection

All data was collected by one person. Information on preoperative, intraoperative, and postoperative development was obtained from patient files. All primary and recurring incisional hernia repairs that were carried out during the time period mentioned above at the department of general surgery at the University of Göttingen were included in the data. All patients who were not part of a follow-up program were formally asked in writing to come for a checkup or otherwise to fill out and return a questionnaire. In cases where patients did not respond to the letters, telephone interviews were conducted with the patients and their doctors.

Additionally, patients with a mesh repair were asked about their satisfaction with the operation outcome, their pain in the operation area, limited movement in the abdominal wall, and the sensation of a foreign body in the operation area.

In only 4.1% of all operations, the data were collected merely from patient hospital files. Thirty-three percent of the patients could be examined by the investigators, while the remaining patients did not wish a control examination. Of respondents, 33.9% answered a questionnaire, 25% were interviewed by telephone, and 4% of the patients' general practitioners answered for them, which corresponds to an overall follow-up rate of 95.9%.

Operation procedure

The largest group of mesh repair, the sublay technique, followed the standardised description from the literature [3, 6], such as the Mayo procedure [16]. The sublay technique was favored because a mesh in the sublay position is fixed by intra-abdominal pressure. We always tried to perform the repair of the whole scar, particularly if multiple hernias were present. The meshes were placed in the preperitoneal space underneath the rectus muscle. Above the linea arcuata the meshes were fixed with single sutures on the posterior rectus sheath, below on the preperitoneal tissue with an overlap of at least 5 cm completely around the defect. If possible, the posterior as well as the anterior rectus sheath were closed by running sutures. A minimum of two drains were placed on the meshes and a single shot antibiosis was always given. However, the remaining procedures (inlay, onlay, sandwich, intraperitoneal) in combination with single application of special meshes (Vicryl, GoreTex, Sepramesh, ParieTexComb) cannot be assigned to a standard technique and must be considered as the individual procedure of the respective surgeon.

Statistics

Data documentation was performed with Microsoft Access Database Systems and Statistical Analysis with SAS 8.01. Null hypotheses were tested two-sided, and the significance level was set at 5%, which confirms with good statistical praxis. The pairwise comparisons were done as follows: For dichotomous data, we used Fisher exact test and chi-square test. If the data were ordinal or metric, we proposed the Cochrane Armitage test or Wilcoxon test. For taking more than one factor into consideration, logistic regression was used.

Results

The overall change in incisional hernia surgery is reflected in the distribution of operation methods in our own clinic (Fig. 2). Although Mayo operations were carried out almost exclusively until the early 1990s, the mesh repair and Mayo procedure curves crossed over in the mid-1990s with a steady decrease of the Mayo curve to 0% and a rise in the mesh curve to 100% in 2001. GoreTex repairs were only used briefly and in small numbers. The use of heavyweight Marlex meshes has declined since the mid 1990s, while the use of low-weight Vypro meshes with large pores has risen consecutively.

Complications

The outcome for mesh repairs, with an overall complication rate of 32%, was worse than for Mayo procedures with 17% ($P = 0.001$), and as well concerning the major complication rate with the need of surgical intervention ($P = 0.009$). Wound infections, seromas, and haematomas were most common with 50%, which in the majority of cases (65%) were successfully treated with a limited wound revision and repeated drainage. More serious complications, such as postoperative bleeding, ileus, and bowel perforation, occurred less frequently with 15% in each group. Relaparotomies with adhesiotomy, bowel suture or bowel resection were necessary in these patients. A mesh explantation was necessary only once due to an infected GoreTex mesh. Most of the major complications occurred in the GoreTex group, followed by Vypro and Marlex. Comparison of the different implantation techniques with regard to the total complication rate showed an advantage for the sublay technique.

Recurrences

Recurrences occurred primarily during the first two postoperative years following the Mayo procedure as well as mesh repairs. The total recurrence rate following the Mayo procedure was 37%, compared to 15% after mesh implantation ($P = 0.001$). The highest recurrence rate was recorded for the inlay technique, compared to onlay and sublay. With regard to the mesh material, the GoreTex group had the poorest results. No recurrences were recorded in the Vypro group; however, at the time it still had the shortest follow-up of 13.4 ± 7.2 months. If the recurrence rate after mesh repair is calculated exclusively for Marlex meshes and the sublay technique, which is the most frequent combination with over 80%, the total recurrence rate was 12%.

Leading causes of recurrences after mesh repair were recurrences at the upper or lower edges of the meshes in the extension of the laparotomy (44%). Furthermore, two overweight patients each developed one central recurrence caused by Marlex meshes in the sublay position. As in the two previously mentioned recurrences, the most common therapy consisted of implanting additional meshes with an sufficient overlap over the new hernia and suturing the second mesh to the first one. One GoreTex mesh had to be explanted due to infection; the cause of the recurrences could not be found in 12 cases. The majority of the patients with recurrences have not yet undergone surgery again; the procedure risk in two patients seemed too high due to

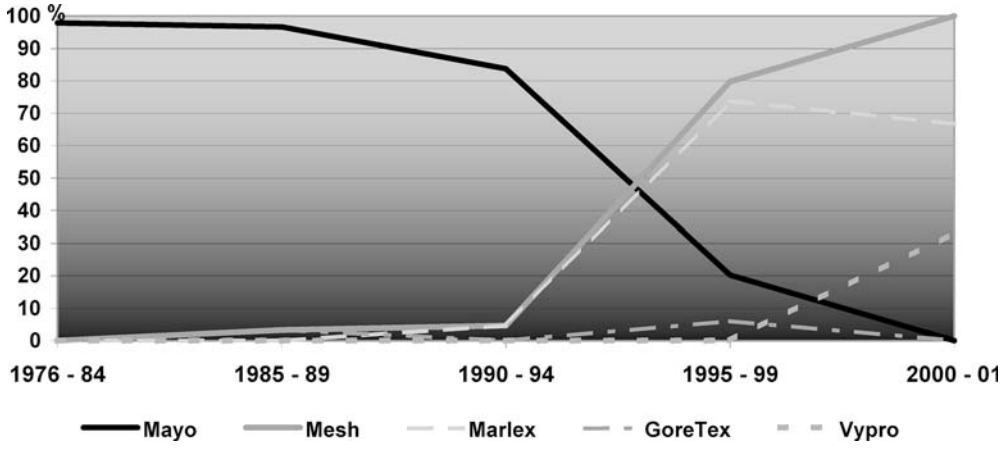

Fig. 2 Incisional hernia repairs from 1976 to 2001

comorbidity, two patients would like to undergo surgery in the near future, and eight patients have decided against a further procedure.

Quality of life

Checks on patients' quality of life following mesh repair have shown that 86% of the patients are satisfied or very satisfied. In contrast to high patient satisfaction, 38% of mesh patients experienced occasional pain in the operation area, 43% reported moderate immobility of the abdominal wall, and 31% reported an unspecified foreign-body sensation. Extreme cases with a completely stiff abdominal wall or pain requiring regular medication have not occurred so far.

Prognosis factors

With the analysis of potential influence factors, it was possible to prove a significant effect on complication rate for risk factors in patients ($P = 0.008$), the hernia size ($P = 0.007$), the mesh-implantation technique ($P = 0.012$), and the surgeon's experience ($P = 0.011$). Without significant relevance in the univariate analysis were: age, body mass index (BMI), kind of laparotomy, seriousness of the underlying operation (OSS), the distinction between primary and recurrent incisional hernia, the mesh material, and the mesh size.

In view of the recurrence rate, significant influencing factors were overweight with a BMI > 25 ($P = 0.002$), size of the hernia ($P = 0.025$), and surgeon's experience ($P = 0.004$); whereas the following factors did not reach a significant level: age, risk factors, kind of laparotomy, seriousness of the underlying operation (OSS), the distinction between primary and recurrent incisional hernia, the mesh material, the mesh size, and the implantation technique.

In the statistical analysis of potential influencing factors on the patients' quality of life following mesh repair, only the parameter of mesh size regarding the postoperative mobility of the abdominal wall reached a significant level ($P = 0.018$), whereas BMI, the distinction between primary and recurrent incisional hernia, mesh material, implantation technique, and the surgeon's experience had no relevance.

Precise analysis of the surgeon's experience factor in incisional hernia surgery, with reference to the total patient collective, showed a significant linear fall in the recurrence rate, from 33% in the group with less than ten incisional hernia repairs to 8% in the group with 20 or more operations ($P = 0.001$). Such an effect could not be proven with regard to the rate of major complications. Focussing exclusively on mesh repairs, the rate of recurrences decreased from 18% to 8% with increasing experience of the surgeon, and, at the same time, there was improvement of patients' postoperative quality of life with a decrease in foreign-body sensations, from 19% to 5%, and a drop in pain and immobility, from 31% to 23% or from 37% to 20%, in each of the groups with the most experienced surgeons (Fig. 3). None of the parameters reached a significant level.

The necessary experience of the surgeon, in order to obtain a recurrence rate of less than 10%, was calculated as a limit of at least 16 mesh repairs. From a total of 22 surgeons of these collectives that carried out mesh repairs, only three surgeons reached this limit (14%).

Discussion

The results after Mayo procedure of incisional hernia are unacceptably poor with a recurrence rate of 37% and confirm the figures of the literature [4, 17]. The introduction of mesh repairs reduced the rate to 15%; taking only the most often used combination—Marlex in sublay technique—into consideration, the rate was reduced to 12%, which corresponds to current publication data [3, 6, 7, 18].

The main cause of recurrence after mesh implantation in the given collective was not an insufficient overlap of the hernia, but the failure to remove all of the former incision. This is a well known phenomenon [19]; therefore, the recommendation is to treat not only the current hernia area with a mesh overlap of 5 cm but always to remove the entire scar and place a larger mesh for a sufficient reinforcement of the abdominal wall.

The drawback of mesh repairs is a higher rate of complications, in particular seromas and haematomas that require revision. For this reason, 8% complications requiring revision remained, as was the case for other authors [7, 11]. Beside those factors that the surgeon essentially can't influence, like hernia size and patient's risk factors, two other parameters were of primary

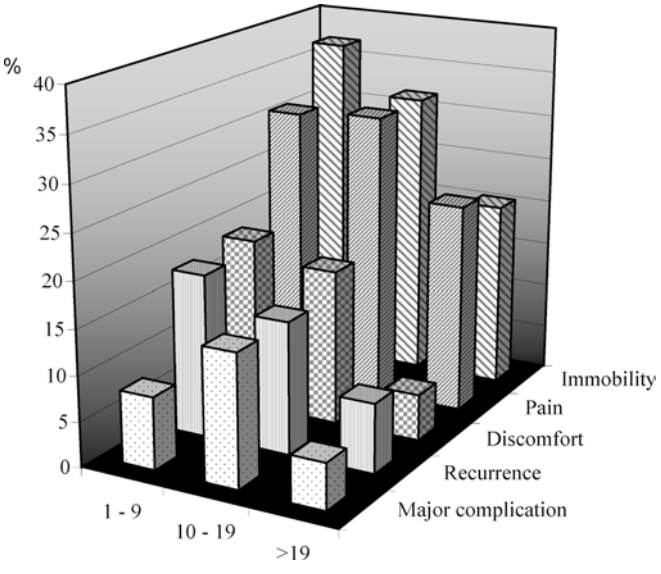

Fig. 3 Influence of surgeon's experience (< 10, 10–19, > 19 mesh repairs per surgeon) concerning the outcome following mesh repair

importance in the univariate analysis of prognostic factors: the operative technique as well as the surgeon's experience in incisional hernia surgery. As previously described by other groups, the onlay technique has a higher rate of seromas compared to the sublay technique; this is thought to be due to the direct contact of the mesh material to the subcutis. Moreover, the onlay technique requires larger wound areas to place and fix the meshes, which inevitably causes seromas and/or hematomas. Furthermore, complications after mesh repair are, at least in part, caused by the mesh material and are the price for this new principle in incisional hernia surgery. The proportion of complications requiring revision, therefore, cannot be reduced from a total of 9% below 5%, even by the most experienced incisional hernia surgeons of our collective. In this context, one can hope that the development and use of light meshes with large pores will lead not only to a reduction in the complication rate but as well to postoperative immobility of the abdominal wall, pain, or a feeling of discomfort [7, 12, 13]. Due to the small number of such meshes (Vypro) in our collective, a comparison with conventional heavyweight meshes (Marlex) is not possible.

In recent years, a further aspect that has increasingly been brought up in discussions regarding the causes of incisional hernias and their recurrences after mesh repairs is the individual predisposition due to collagen I/III-ratios and characteristic expression profiles of different matrixmetalloproteinases in patients with incisional hernias [20, 21, 22].

The importance of the surgeon's experience, in addition to the technique of implantation and mesh material, is highlighted by the fact that in the given collective, the postoperative pain rate, immobility of the abdominal wall, and discomfort were considerably reduced by increased surgeon experience in incisional hernia.

In view of the limited significance of retrospective analysis, especially with a wide range of case numbers, at least some operative aspects may explain the better results in the group of the most experienced surgeons. For example, the preservation of the vessels and nerves at the linea semilunaris seems, therefore, to be of particular importance. Further aspects include the closure of the ventral rectus fascia without tension, if necessary, by lateral incisions of the fascia and the avoidance of excessive dissection of tissue in the operation field. The mesh should be implanted and fixed without tension but as well without wrinkling. Obviously, all these effects together may lead to a relevant improvement of the patient's outcome following mesh repair in incisional hernia surgery [23].

This effect becomes particularly apparent in the analysis of the recurrence rate. Taking into account only the "experience" factor of the most experienced incisional hernia surgeon group, a reduction of 25% was noted in the overall recurrence rate of all operations; the recurrence rate after mesh repair was reduced by 10% and is currently 8%.

Although in the logistical regression analysis, overweight represents the only significant prognosis factor for a higher recurrence rate (BMI≥25, $P = 0.0014$), "experience" is a crucial factor in the evaluation of the different prognosis factors, as this is the only factor that can be influenced by the surgeon. Until now, only little attention has been paid to this quality factor, which is highlighted by the fact that only three out of the 22 surgeons who performed mesh implantations in our own clinic exceeded an experience of more than 16 mesh repairs, which was in our investigation a precondition for a recurrence rate of less than 10%.

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