

**VILNIUS UNIVERSITY
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The Final thesis

The Results of Incisional Hernia Repair

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Table of Contents

<i>Summary</i>	2
<i>Introduction</i>	3
<i>Methods</i>	6
<i>Results</i>	7
<i>Discussion</i>	15
<i>Conclusion</i>	16
<i>References</i>	17

Summary

Objective: Review articles to compare the results of open versus laparoscopic incisional hernia repair.

Methods: A systematic search of the literature published from 01/01/2018 to 31/03/2023 was performed using the resource databases Aertzteblart, Pubmed, and the Chochrane Library. The search was performed by using the keywords “incisional hernia repair”, “open” and “laparoscopic”.

Results: For the present literature, six publications were identified and their quality assessed for contributing to the stated topic. The outcome parameters used for each piece of literature, the main results, and the conclusions were collected for proper comparison and their strengths and weaknesses highlighted.

Conclusion: According to the results and conclusions of the reviewed articles, it can be stated that both open and laparoscopic approaches for incisional hernia repair are feasible and safe. The laparoscopic approach was associated with fewer postoperative complications, a shorter hospital stay, and a shorter duration of surgery. Both approaches showed a comparable recurrence rate.

Keywords: incisional hernia repair, open, laparoscopic

Introduction

An incisional hernia is defined as a fascial defect of the abdominal wall due to previous surgical incisions (1). It is a common complication that develops due to the failure of the abdominal wall to close properly (2,3). This can be due to multiple reasons, which can be summarized in patient-related factors, disease-related factors, and technical factors (2).

Patient-related factors include factors that impair wound healing and affect the strength of new tissue that supports the abdominal wall (2). This includes systemic chronic diseases like Diabetes Mellitus, renal failure, obesity, nicotine use, and malnutrition, as well as systemic long-term medications including steroids and immunosuppressants (1,2,4,5). Disease-related factors include the incision site, the timing and urgency of the procedure, its complications, and underlying diseases (1,2). Emergency surgeries, midline incisions, and infections result in a higher incidence of incisional hernia development (1,2). Technical factors include the surgical techniques and surgical material used for closure, but laparoscopic techniques are associated with a general lower incidence rate for incisional hernias (2,6).

The occurrence rate following laparotomy is as high as 20% and can occur in individuals of all ages, genders, and ethnicities (1,2,4). It is a type of ventral hernia and most commonly occurs on the abdominal midline (2). Incisional hernias can contain all the hernia components inside the defect, or they can be a weakness of the wall with just a shallow sac and the occasional bulge of hernia content (2). It is commonly seen as a complication of abdominal surgery (2).

Patients usually report unspecific symptoms like pain and gastrointestinal manifestations such as postprandial feeling and fullness, and some patients are even asymptomatic, which are often only diagnosed during cancer follow-up examinations (1,6). Larger hernias may be associated with significant morbidity and a great impact on quality of life, manifesting as lesions of the skin overlying the hernia, which are presented as a bulge with a positive cough impulse at the site of the previous incision (2,3,6). Other symptoms can include discomfort, pain, and even incarceration, affecting about 6-15% of cases. Obstruction or strangulation of abdominal tissue and organs is possible (1,2,6,7). They usually manifest in the first six months in about 50% of cases and at 97% in the first five years after abdominal surgery (1).

The exact pathophysiology of incisional hernia development is not clearly known but is believed to be multifactorial with many causative factors (1,2). Fascial edge-to-edge healing is essential in order to provide the strength to the fascia (2). Gaps in-between the healing fascial

edges and poor healing sites can potentially result in an incisional hernia (2). A chronically high intraabdominal pressure may also affect the healing and strength of the fascia (2).

The management of incisional hernias can be complex and typically involves surgical repair, but it can also be done by conservative nonoperative treatment (2,3). Small and asymptomatic hernias can usually be observed safely with a low risk of complications (2). Large or symptomatic hernias should in general be surgically repaired to avoid complications, relieve symptoms, and improve the quality of life of the patient (2,6).

There are many surgical techniques available, including open, laparoscopic, and robotic techniques, which should be adequately timed based on the patients complaints, the morphology and size of the abdominal wall defect, and risk factors for surgery, which include age, obesity, and tobacco use (2,3,6). The choice of technique is tailored for each individual patient and their specific hernia characteristics (2). There are conventional suturing techniques without the use of a mesh and surgical techniques using a mesh (1). In general, a mesh is used for most repairs to strengthen the defect in the abdominal wall (2). Different options for mesh placement are available, including “Onlay”, “Inlay” and “Sublay” referring to their anatomical placement inside of the abdominal wall (2,6), which can be seen in Figure 1. Sublay mesh placement is usually most suitable for midline incisional hernia repair, during which the posterior sheath of the rectus abdominis muscle is released, creating a newly created prefascial retromuscular space in which the mesh is placed (6,8). The other mesh placements are usually not used due to the significantly poorer outcomes regarding recurrence rate and wound complications compared to sublay mesh repair, which has the advantage of the extraperitoneal location reducing adhesions affecting bowel function, the formation of enteroprosthetic fistula, and the deterioration of mesh inflammation (6). Laparoscopic mesh repair is a minimally invasive surgery in which the mesh is placed intraperitoneally (6). During this procedure, the hernial orifice is necessarily closed because the mesh extends the abdominal wall at the site, strengthening it (6). Different types of meshes can be used and are characterized by whether they are permanent or absorbable and whether they are synthetic or biologic (2,9). Permanent synthetic meshes are used most commonly (2,6).

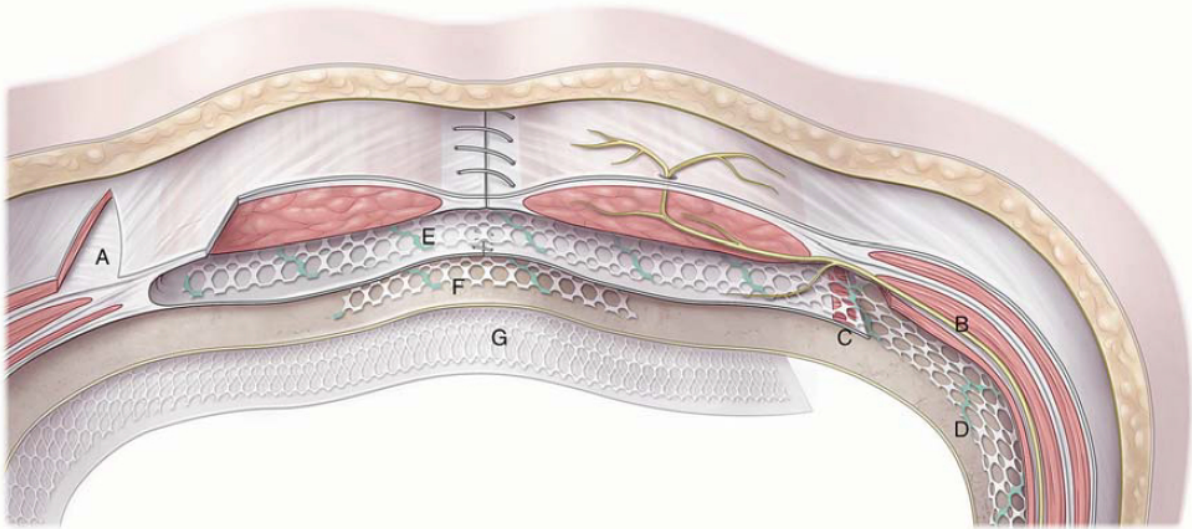


Figure 1: Transverse section of the supra umbilical abdominal wall, showing relevant anatomical structures and mesh locations for incisional hernia repair (6).

- A) Releasing incision of the abdominal external oblique aponeurosis as part of the component separation technique described by Ramirez.
- B) Typical course of an intercostal nerve between the transversus abdominis muscle and the abdominal internal oblique muscle; the nerve enters at the lateral margin of the rectus sheath into the rectus abdominis muscle and gives off a cutaneous branch at its end.
- C) During transversus abdominis release (TAR) for positioning a mesh lateral to the rectus sheath, the course of this nerve has to be spared to prevent subsequent abdominal wall paralysis.
- D) With TAR, the mesh is placed between peritoneum and transversus abdominis muscle.
- E) Typical sublay mesh position (retromuscular).
- F) Underlay mesh position (preperitoneal).
- G) Intraperitoneal mesh position (IPOM = intraperitoneal onlay mesh).

Methods

A systematic literature review was conducted about the results of incisional hernia repair with a special focus on the comparison of open versus laparoscopic techniques using the resource databases Aertzteblatt, Pubmed, and the Chochrane Library. The included keywords for this literature search were “incisional hernia repair”, “open” and “laparoscopic”. The found literature was evaluated according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), with the inclusion of the topics of reoperations, complications, duration of hospital stay and recurrences. (10)

A total of 548 publications were found. 365 articles were excluded due to them being published before 2018, leaving 185 publications. These were screened for relevant data to compare the outcome of the incisional hernia repair. 159 publications were excluded after rigorous analysis. Further, 20 publications were excluded after detailed analysis, they were deemed to not fit the comparison of the two surgical techniques regarding their results or them being systemic reviews. Thus, leaving six publications fulfilling the criteria for the systematic analyses. (10) The articles were analyzed in terms of number of subjects, demographics (age, sex), body mass index, comorbidities, fascial defect size, and multiple surgical outcome parameters, including recurrence rate, complications, morbidity rate, duration of hospital stay, duration of surgery, and quality of life.

Results

Figure 2 shows the flow chart following the PRISMA principle for selecting literature for a systematic review. The literature that was selected for this systematic review is presented in Table 1, together with the main comparative data, including the type of study, the number of subjects involved for each literature, the time period in which the data was selected from, the parameters from which the outcome is measured, and the main results for each literature.

Alizai P. and co-authors describe a four-year study (May 2012 to August 2016). The 102 patients included in this study underwent incisional hernia repair of medium- or large-sized defects according to the EHS classification. Out of the total number of patients, 31 underwent laparoscopic IPOM and 71 open SUBLAY repair. 46 patients were female, accounting for 45%. The mean age was 63 years, while the mean BMI was significantly higher in the IPOM group (32 versus 28 kg/m²). Most hernias were located in the midline (86%), and in 20 patients, they were classified as recurrent hernias.

The outcome of the incisional hernia repair was measured primarily by postoperative complications assessed by Clavien-Dindo classification and morbidity rate and secondarily by length of hospital stay, the duration of surgery, and recurrence rate.

A lower morbidity rate was found in the IPOM group compared to the SUBLAY group (19 versus 41%), as were the postoperative complications according to the Clavien-Dindo classification. Surgical revision was higher for the SUBLAY group compared to the IPOM group (13% versus 3%). Comparable results were seen between the two groups regarding the occurrence rate of seroma and surgical site infections. The median duration of surgery was shorter for the IPOM group compared to the SUBLAY group (81 versus 107 minutes), as was the median length of hospital stay (four days versus seven days). After a follow-up period of 28 months, 6 patients had recurrent hernias (9%) without significant differences between both groups.

This study might contain some selection bias as it is neither randomized nor case-controlled, and the surgical procedure type was left to the surgeon. The cohort for this literature is rather small, with a greater SUBLAY group compared to the IPOM group.

The authors conclude that laparoscopic repair of medium- and large-sized defects is a feasible and safe approach, showing significant lower morbidity and a reduction in length of hospital stay. (11)

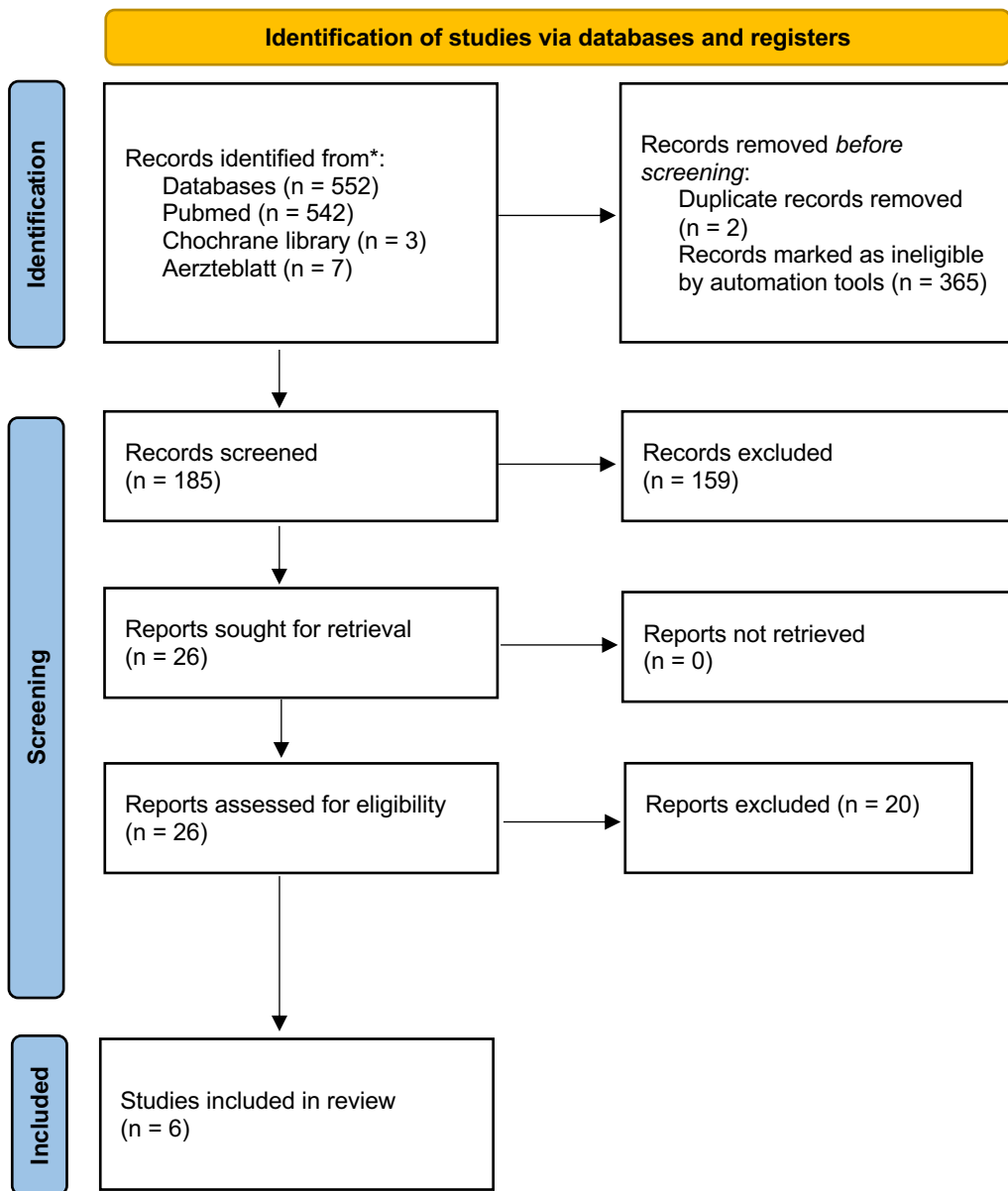


Figure 2: PRISMA Flowchart

Table 1: Comparison of studies reported in the present literature

Study (author, year)	Study type	Number of subjects	Data from	Incisional hernia repair outcome parameter	Main results, conclusions
Alizai P., 2019	Retrospective cohort study	102	May 2012 to August 2016	Recurrence rate, complications, morbidity rate	Laparoscopic repair is a feasible and safe approach with lower morbidity, a shorter hospital stay, and a comparable recurrence rate.
Köckerling F., 2019	Retrospective cohort study	9907	September 2009 to June 2016	Complications, recurrence rate, reoperation rate, recurrence rate	Laparoscopic repair was found to have advantages compared to the open technique regarding postoperative complications and reoperation rates, but disadvantages in terms of intraoperative complications.
Lavanchy J., 2019	Retrospective cohort study	184	September 2004 to September 2015	Recurrence rate, operation time, length of hospital stay, frequency of SSI, complications,	The laparoscopic approach was proven to have a shorter operation time, hospital stay, reduced complications, and

				reoperations, chronic pain, localization of hernia relapse	lower rate of SSI. No difference in recurrence rate between the different approaches was found.
Henriksen N. A., 2021	Retrospective cohort study	5378	January 2007 to December 2018	Readmission rate, reoperation rate, recurrence	The laparoscopic approach has shown a decreased rate of early complications and recurrence rate.
Asencio F., 2021	Prospective cohort study	85	February 2003 to February 2006	Recurrence rate, reoperation rate, death, HRQoL, complications	Both techniques seem to have similar results for recurrence, reoperation rates, and global HRQoL. The laparoscopic approach seemed to have better cosmetic results.
Goh SSN, 2023	Retrospective cohort study	174	2010 to 2015	Recurrence rate, pain, infection, hematomas, seroma formation, reoperation rates	Comparable outcomes between the two techniques were seen. The laparoscopic approach seems to have the advantage of lower infection rates and blood loss.

Köckerling F. and co-authors conducted a multicenter study comparing laparoscopic versus open elective incisional hernia repair. A total of 9907 patients were selected between September 2009 and June 2016 from the Herniated Hernia Registry. 4110 patients underwent laparoscopic surgery, and 5797 patients underwent open incisional hernia repair. The comparison of the results of surgery was based on variables including perioperative complications and reoperations, recurrence rates, pain at rest and exertion, and pain requiring treatment after one year of follow-up. This literature used propensity score matching for the evaluation and comparison of each surgical technique. The cohort for laparoscopic surgery had a statistically significant difference in age, BMI, defect size, and risk factors compared to the cohort for open surgery. Patients in the open surgery cohort were on average older but had a lower BMI, smaller defects, a higher proportion of medial incisional hernias, but a lower proportion of combined defect localizations according to the EHS classification, and a higher proportion of patients with risk factors.

No significant deviation for recurrence was seen by the data collected, as were pain at rest, pain on exertion, and pain requiring treatment after a one-year follow-up. A significant deviation was observed regarding postoperative complications, mainly due to surgical site infection, seroma and bleeding, and general postoperative complications. These were less common for laparoscopic surgical repair compared to open surgical repair. A significant deviation was found to the disadvantage of the laparoscopic technique regarding intraoperative complications. No significant difference in recurrence was found.

The limitation of this literature is the short follow-up period of one year to make an evaluation of the outcome of each surgery. Also, the literature may potentially include some bias due to being retrospective and the lack of randomization of the patient data.

The authors conclude that there is a clear advantage to the laparoscopic approach regarding postoperative complications and complication-related reoperations, but they also conclude that there are disadvantages to that technique regarding intraoperative complications. (12)

Lavanchy J. and co-authors investigated the long-term results of laparoscopic versus open incisional hernia repair in a propensity score-matched analysis. The study included 184 patients who underwent incisional hernia repair between September 2004 and September 2015. The outcome of the hernia repair was measured by hernia recurrence, operation time, length of hospital stay, surgical site infections, complications, reoperation, chronic pain, and localization of recurrence. Among the patients, 65% underwent laparoscopic hernia repair and, 35% underwent open hernia repair. After propensity score matching, 96 patients remained in the laparoscopic IPOM group and 48 in the open IPOM group.

The recurrence rate for the laparoscopic group was 20% compared to 19% in the open group and showed no significant difference. However, this literature suggests that with both methods, the steady state is at 4.7 years postoperatively regarding the recurrence rate. The median operation time was shorter for the laparoscopic group compared to the open group (120 versus 180 minutes) and there was a shorter hospital stay (6 versus 8 days). Complications like surgical site infections occurred less frequently in the laparoscopic group (10% versus 21%). No significant differences were seen in the frequency of reoperation, chronic pain, or overall complications between the two groups.

Similar to the previous literature, bias is a weakness of this literature regarding its nature of being retrospective and the lack of randomization.

The authors conclude that there are benefits to using laparoscopic IPOM regarding operation time, hospital stay, and reduced complications, but there seems to be no benefit regarding recurrence rate for either surgical technique. (13)

Henriksen N. and co-authors conducted a study between 2007 and 2018 with the aim of examining outcomes after open and laparoscopic elective incisional hernia mesh repair in relation to the size of the incisional hernia defect. The data was gathered from the Danish Hernia Database and the National Patient Registry. A total of 5378 patients were included in this literature and compared with respect to rates of readmission, reoperation, length of hospital stay, and late operation for recurrence. Out of these, 2288 patients had open surgery and 3090 had laparoscopic surgery. The median hospital stay was significantly shorter for laparoscopic repair (1 day) compared to open repair (2 days). The recurrence rate showed no significant difference for either surgical technique. Readmission after 90 days (16.2% for laparoscopic versus 19.3% for open) and reoperation (7.0% for laparoscopic versus 12.5% for open) showed lower results for laparoscopic repairs compared to open repairs. Readmission due to surgical site infections was more frequent in open repair, while readmission due to pain was significantly more common for patients operated on laparoscopically. Bowel obstruction, or bowel resection, was twice as common after laparoscopic repair compared with open repair. The hernia recurrence rate was 8.4 percent after open and 7.4 percent after laparoscopic repairs. Readmission, reoperation, and operation for hernia recurrence were significantly lower in laparoscopic incisional hernia repair for patients with medium-sized incisional hernias. Large or giant incisional hernias had a significantly decreased rate of reoperation after laparoscopic repair compared with those having open repair, but without alteration in the risk of repair of recurrent hernias. Lower rates of early complications were found for laparoscopic repairs.

The strength of the study is nationwide data collection, which allows a large number of patient data points to be analyzed. Also, the median follow-up of four years allowed for the collection of complications that occur later and not exclusively immediately postoperatively. Like previously, biases are not preventable due to the lack of randomization and the fact that patients were selected based on certain unknown criteria by surgeons for either of the surgical techniques. The literature does not provide data on BMI and smoking. Furthermore, data regarding long-term complications was not collected due to the median follow-up of four years. The authors conclude that laparoscopic intraperitoneal mesh repair for incisional hernias should be considered for defects between 2 and 6 cm due to the decreased rates of early complications. (14)

Asencio F. and co-authors describe a 10-year long-term follow-up study of laparoscopic versus open incisional hernia repair results. This study is an extension of a previous randomized controlled clinical trial. The extended follow-up included 85 patients who were scheduled for elective incisional hernia repair between February 2003 and February 2006. The surgical technique used was randomly assigned and prospectively followed up for 10 to 15 years. 39 patients underwent open surgery, while 46 underwent laparoscopic surgery. 25 patients died at the initiation of the extension of the study and were evaluated by review and available abdominal CT scans. The remaining two from each group have not responded for follow-up, leaving a remaining 58 patients, out of whom 11 were excluded for HRQoL assessment due to additional operations during follow-up. Recurrence, reoperation, HRQoL, and mesh complications were compared for the open and laparoscopic surgical methods. Both surgical techniques showed a similar recurrence rate. Intraperitoneal mesh complications for the laparoscopic group were evident in three patients (6.15%), one with partial mesh extrusion presenting as chronic sinus, and the other two were reoperated for intestinal obstruction. No mesh-related complications were seen in the open surgery group. 13 patients in the open group and 12 patients in the laparoscopic group have died during follow-up, showing no significant differences between the groups. In the EuraHS-QoL questionnaire, no overall statistically significant difference was observed between these two groups. Only one of the EuraHS-QoL dimensions showed a statistically significant advantage for laparoscopic hernia repair, which is the dimension of “Activities of daily living”. Additionally, cosmetic discomfort seems to be less after laparoscopic repair in comparison to open repair, but no overall significant difference was found in HRQoL scores.

The strength of this literature is the randomization of the surgical techniques that was done for the study, which excludes some of the bias that can be seen in other literature. Also, this

literature does not measure the outcomes of incisional hernia repair based on mostly the recurrence rate and complications but also on patient HRQoL, which highlights other aspects that were not considered in other literature, such as patients daily lives after the hernia repair or cosmetic outcomes. However, the limitations of this study are the exclusion of abdominal fascial defects smaller than 5cm and larger than 15cm, as well as the reduced sample size compared to the original study and the retrospective evaluation of deceased patients.

The authors conclude that laparoscopic incisional hernia repair seems to be comparable to open surgery regarding safety and efficacy in terms of recurrence, reoperation rates, or global HRQoL. (15)

Goh SSN and co-authors conducted a retrospective study on the comparison of elective incisional hernia repair with the focus on postoperative wound infection in laparoscopic versus open repair. 174 patients were analyzed who had open repair (86) or laparoscopic repair (88) between 2010 and 2015. The mean age was comparable for the two groups (the open group was 62.5 and the laparoscopic groups was 61.5), similar to the gender (70.9% for the open and 75% for the laparoscopic group). The average body mass index in the laparoscopic and open groups was 27.1 and 28.1 kg/m², respectively. There were no significant differences in comorbidities or ASA status between the two groups. The mean operation duration for open repair was 116 minutes and 139 minutes for laparoscopic repair. Blood loss was significantly lower in the laparoscopic group of 10 mL compared to the 50 mL in the open group. Within one year, 13 patients who had postoperative infections in the open group and one patient in the laparoscopic group. Out of the 13 patients who underwent open repair and developed postoperative infections, 10 had superficial wound infections and three had acquired deep infections. The one patient in the laparoscopic group with postoperative infections had a superficial wound infection. No statistically significant difference was found regarding postoperative pain between the two groups, as well as the recurrence rate and regarding postoperative hematoma and seroma formation. The limitation of this literature is the relatively short follow-up duration of just one year for the postoperative outcomes and the small sample size originating from a single institute. Also, a possible selection bias can be assumed in this literature due to the retrospective nature of this literature and the lack of standardization of surgical techniques.

The authors conclude that the laparoscopic approach seems to have comparable outcomes but offers added advantages regarding the reduction of postoperative infection rates and blood loss. (16)

Discussion

The consensus of the literature selected for this systematic literature review is the safety of the laparoscopic approach for incisional hernia repair as well as the advantage regarding the outcome of the surgery. The identified advantages were mostly notable in postoperative complications, hospital stay, and operation time, which were highlighted by the literature. Other outcome parameters were not found to be advantageous for laparoscopic incisional hernia repair. These were mostly regarding the recurrence rate, but also other parameters like global quality of life. Köckerling F. observed a disadvantage regarding intraoperative complications. (11–16)

The present paper is based on literature with a notable number of participants, which solidifies their findings and makes them a great asset for comparing surgical techniques. The large databases that they are based on show great weight for drawing conclusions on the results of these surgical techniques.

The literature compared in the present paper shows varieties in their research population and research parameters. This highlights different aspects regarding the outcomes for the different surgical techniques, which allows for conclusions on various parameters that have not been previously highlighted by previous literature. Creating a bigger picture regarding various aspects like quality of life, which was considered in Asencio F., helps to identify advantages and disadvantages that were previously not considered to a large degree.

A weakness of the present literature is the great use of retrospective cohort studies due to the nature of collecting the required data. This might introduce bias that cannot be avoided in these forms of literature. The surgeons might have a preferred surgical technique, which is not considered in the analysis, as well as the lack of standardization due to the absence of case control and randomization of the participants and their appointed surgical techniques. Asencio F. excludes some of these biases due to being a prospective cohort study, which gives validity to the claims regarding the presented outcomes for the surgical techniques. The differences in size of the datasets used by the different literatures were great in some cases. While Köckerling F. had a dataset of 9907 participants and Henriksen N. A. had a dataset of 5378 participants, other datasets included in the present literature were not as sizable in comparison.

The present literature compares two surgical techniques for incisional hernia repair, which is the open technique and the laparoscopic approach. However, there are various other techniques, some more novel than others. Their safety and outcomes have not yet been explored like those of the techniques that were compared in the present literature. More literature is

needed to fully explore the potential of these approaches and highlight their potential advantages and disadvantages. One very notable new technique is the robotic approach. The need for further investigation of these techniques is especially important due to the decline in usage of laparoscopic approaches for incisional hernia repair (17).

Conclusion

Based on the results and conclusions of the published articles, it can be concluded that laparoscopic incisional hernia repair is a feasible approach with some advantages over open incisional hernia repair regarding hospital stay, duration of surgery, and postoperative complications, but no significant difference was found regarding recurrence rate.

In order to better analyze and conclude the advantages and disadvantages of these two surgical techniques, randomized prospective trials with a sufficiently large and representative sample and long-term follow-up are needed.

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