

# Results of Laparoscopic Versus Open Abdominal and Incisional Hernia Repair

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## ABSTRACT

**Background:** Incisional hernia is a frequent complication of abdominal surgery. The object of this study was to confirm the safety, efficacy, and feasibility of laparoscopic treatment of abdominal wall defects.

**Methods:** Fifty consecutive laparoscopic abdominal and incisional hernia repairs from September 2001 to May 2003 were compared with 50 open anterior repairs.

**Results:** The 2 groups were not different for age, body mass index, or American Society of Anaesthesiologists scores. Mean operative time was 59 minutes for the laparoscopic group, 164.5 minutes for the open group. Mean hernia diameter was 10.6 cm for the laparoscopic group, 10.5 cm for the open group. Mean length of stay was 2.1 days for the laparoscopic group, 8.1 days for the open group. Complications occurred in 16% of the laparoscopic and 50% of open group. Median follow-up was 9.0 months for the laparoscopic group, 24.5 months for the open group. Recurrence rates were 2% for laparoscopic group and 0% for the open group.

**Conclusion:** Results for laparoscopic abdominal and incisional hernia repair seem to be superior to results for open repair in terms of operative time, length of stay, wound infection, major complications, and overall hospital reimbursement.

**Key Words:** Laparoscopy, Incisional hernia, Umbilical hernia, Composite mesh.

## INTRODUCTION

Incisional hernia repair<sup>1</sup> represents a frequent problem for the general surgeon and is often a source of complications and prolonged hospital stay. It develops in 11% of patients after surgery and in 23% of patients who develop a post-operative wound infection.<sup>2,3</sup>

Treatment of incisional hernias can be done by an anterior approach with direct suture or mesh or by a laparoscopic transperitoneal approach using mesh. Which is the best treatment is still being debated, and recent reviews<sup>4,5</sup> confirm the controversies that exist. Still lacking are randomized, controlled trials with long-term follow-up that confirm that laparoscopic repair of incisional hernias has a lower complication rate, a decreased hospital stay, and a recurrence rate similar to that of open repairs.<sup>6-8</sup>

This study analyzed results of a single center experience in laparoscopic and open incisional hernia repairs. The aim of the present study was the prospective evaluation of a case series of laparoscopic incisional hernia repairs, performed at the same institution with broad experience in laparoscopy, compared with a historical control group of open anterior incisional hernia repairs.

## METHODS

Fifty patients underwent laparoscopic incisional and abdominal hernia repair between September 2001 and May 2003. These patients represent the entire number of incisional and abdominal hernias that came to our attention at a primary referral center. No selection of patient characteristics or hernia types was done. In 7 patients, a primary abdominal hernia, principally umbilical, was diagnosed. Patient data were recorded prospectively and noted age, sex, American Society of Anaesthesiologists (ASA) score, body mass index (BMI), previous incisional hernia repairs, operative time, hernia diameter, use of drainage, length of stay, complication rate, follow-up, and recurrence.

Follow-up consisted of an outpatient visit 1 month after the operation and a phone call as the last contact. Patients expected to have a recurrence were seen in an outpatient setting.

The historical control group consisted of 50 patients op-

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erated on between February 1998 and December 2001. They underwent an anterior incisional hernia mesh repair and represent the last patients operated on with this technique in our department. No selection was used in choosing the group. The same data were retrospectively collected as were collected for the laparoscopic group. Follow-up consisted of telephone contact and a clinical evaluation when needed.

Patient preparation for the laparoscopic technique was accomplished with bowel washout (Selg Esse, Promefarm srl Milan, Italy) and bowel gas reduction (Mylicon, Warner Lambert Consumer Healthcare, Milan, Italy). A first-generation cephalosporin was given as prophylaxis.

### Laparoscopic Technique

The laparoscopic technique was performed with the patient under general anaesthesia. Patients were placed in the supine position, and the surgical equipment was positioned according to the site of the hernia. Pneumoperitoneum was established with a Veress needle usually placed most distally to the previous surgical incision. A 3-trocar (Ethicon EndoSurgery, New Brunswick, NJ, USA) technique was used. A security test with a water-filled syringe was performed before insertion of the first 5-mm to 12-mm trocar, as laterally as possible to the hernia. A 30-degree scope was used because it provides a good view of the inner face of the anterior abdominal wall. Two additional trocars (5 mm to 12 mm and 5 mm, respectively) were placed on the same side in a triangular fashion (**Figure 1**). Adhesiolysis was performed with a 5-mm ultrasonic scalpel (Ultracision, Ethicon EndoSurgery, New

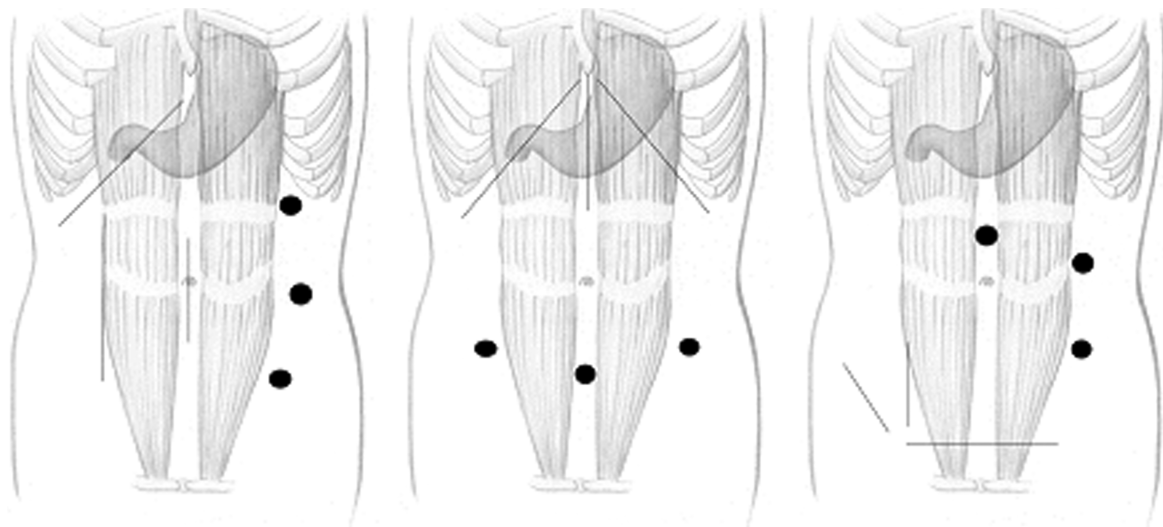
Brunswick, NJ, USA) and scissors. In case of severe adhesions, we use the sole active blade of the dissector or cold scissors for complete exposure of the hernial ring.

All bowel was detached from the abdominal wall to expose the hernia ring. No attempt was made to reduce or resect the peritoneal sac. The mesh (Parietex Composite mesh, Sofradim, France), composed of polyester fibers with a collagen coating (**Figure 2**), was rolled and introduced via the 5-mm to 12-mm trocar. The collage coating was positioned inside the roll to avoid damaging the collagen during cannula transit. The roll was opened inside the abdominal cavity. Four transparietal stitches were used to maintain the mesh in position. The mesh must overlap the defect at least 4 cm to 5 cm. A first ring of 5-mm spiral tacks (Pro-Tack; Auto Suture, US Surgical Corp, Norwalk, CT, USA) was positioned, at least 1 cm from the mesh border. An inner one was positioned 1 cm to 2 cm from the hernial ring (**Figure 3**). Then the stitches were removed. No drainage was used. Before abdominal decompression, bowel, omentum, and trocar site were checked for bleeding.

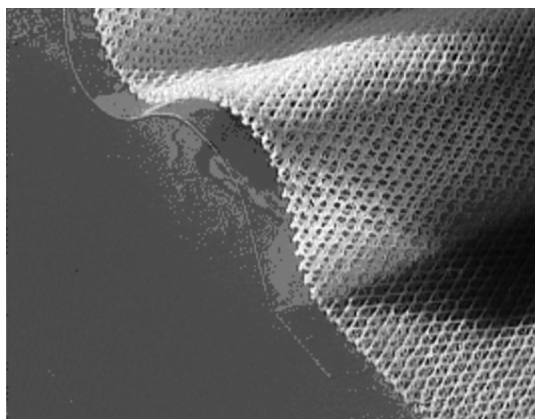
Patients were allowed to eat a soft diet on the first post-operative day and usually discharged between the second and fourth postoperative days.

### Prosthesis

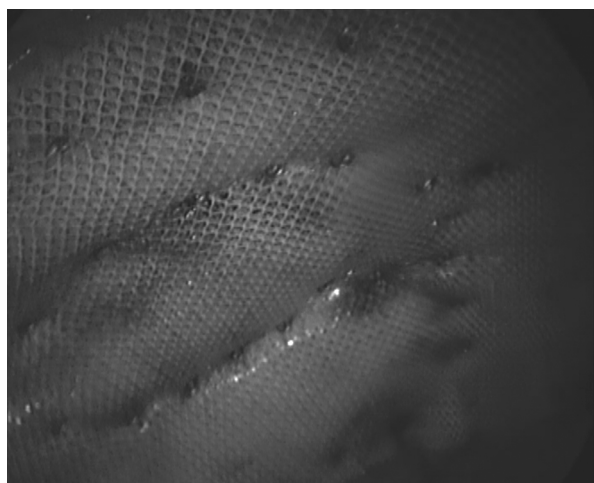
Quick, complete tissue growth is essential for an ideal mesh. To have both good tissue growth on 1 side and no adhesions on the other, a new generation of polyester



**Figure 1.** Trocar positions in relation to incisional hernia site.



**Figure 2.** Mesh (Parietex Composite mesh, Sofradim, France).



**Figure 3.** Laparoscopic view of mesh with double ring of tacks.

mesh in which a hydrophilic absorbable film protects the bowel side has been designed (Parietex Composite mesh, Sofradim, France).<sup>9</sup>

This mesh is made of a soft, adaptable 3-dimensional multifilament polyester fiber, the structure of which hastens cellular integration and vascularization of the mesh, avoiding formation of a tissue capsule and fluid loculation, thus reducing the risk of seroma.

The particular texture of this mesh confers unique elasticity in all directions, allowing adaptability to all anatomical situations and reducing the typical aggressiveness of conventional polypropylene meshes. One side of the mesh is coated with a smooth, absorbable hydrophilic film made of collagen, glycerol, and glycolic polyethylene to reduce the risk of adhesions.

### Open Technique

Patient preparation for the open technique consists of issuing a first-generation cephalosporin. The open technique consists of a wide dissection of the subcutaneous fat, isolation of the ring, and creation, whenever possible, of a space beneath the rectal muscles. The sac is not usually opened or resected. When needed, an absorbable mesh (Vicryl knitted mesh, Ethicon EndoSurgery, New Brunswick, NJ, USA) is used to separate the bowel from the mesh. The mesh (Polypropylene, Surgimesh, Nürnberg, Germany) is usually positioned inlay, ie, under the rectal muscles. Otherwise, it is placed under the anterior fascia or onlay (subcutaneously). The mesh is fixed with nonabsorbable separate stitches. A number of stitches varying from 6 to 12 is usually used to fix the mesh to the fascial and muscular layer of the lateral abdominal wall, according to the diameter of the defect and the integrity of the edges, in a tension-free manner. Drains are usually used, unless not indicated (ie, small hernias). Patients are allowed a clear diet on the first postoperative day and a soft diet on the second one. They are usually discharged after the fourth postoperative day.

### RESULTS

Between September 2001 and May 2003, 50 laparoscopic incisional and abdominal hernia repairs were carried out in 30 patients in our department. The control group consisted of the last 50 anterior incisional hernia repairs done in our department. Patient characteristics are summarized in **Table 1**. Median age was 64.5 in LG and 68 in OG. ASA scores are listed in **Table 2**. No statistical difference was noted between the 2 groups. Median BMI was 29 in LG and 28 in OG.

Ninety-eight percent of patients in the LG underwent their first attempt at hernia repair (1 patient was undergoing her third mesh repair), while 90% of patients in the OG underwent their first repair. One patient in the OG had her

**Table 1.**  
Patient Characteristics

	Laparoscopic Group	Open Group
Number of patients	50	50
Sex (M/F)	26/24	21/29
Median age (years)	64.5	68
Median body mass index	29	28.5
First repair (%)	97	90

**Table 2.**

American Society of Anaesthesiologists (ASA) Scores

ASA Score	Laparoscopic Group	Open Group
1	14	13
2	29	27
3	6	8
4	1	2
5	0	0
Total	50	50

fourth repair (none with mesh), one patient a second repair (after a suture repair), and the last underwent a second repair after an initial attempt with mesh repair. The LG comprised 7 patients (14%) who had a primary abdominal hernia (6 umbilical, 1 epigastric). They represent the first cases operated on in our experience.

Operative findings are shown in **Table 3**. No additional procedures were performed in any patients. Mean operative time in the LG was 59 minutes. Adhesiolysis was required in all incisional hernia repairs (43 patients). Operative time in the OG was 164.5 minutes. The difference was statistically significant. Mean hernia diameter was 10.6 cm (range, 4 to 23) in the LG and 10.5 cm (range, 7 to 21) in the OG. No drainage was used in the LG while in the OG it was used in 96% of cases. Mean length of stay was 2.1 days (range, 1 to 4) in the LG and 8.1 days (range, 6 to 14) in the OG.

In 5 (10%) LG patients, we had to repair serosal tears in

**Table 3.**  
Operative Findings

	Laparoscopic Group	Open Group
Mean operative time (min)	59 (35–120)	164.5 (100–187.3)
Mean hernia diameter (cm)	10.6 (4–23)	10.5 (7–21)
Incarcerated	4 (8%)	6 (12%)
Adhesiolysis (no. patients)	43/50 (86%)	0
Use of drainage	0	96%
Mean length of stay (days)	2.1 (1–4)	8.1 (6–14)
Complications	8 (16%)	24 (48%)
Median follow-up (months)	9.0 (2–20)	24.5 (14–43)
Recurrence	1 (2%)	0
Mortality	0	0

small bowel loops because injury had occurred during dissection (3 patients) and for loops caught in previous fascial sutures (2 patients). We did not have to convert any of the laparoscopic procedures.

Complications occurred in 8 patients (16%) in the LG. Of these, 6 were persistent seromas (more than 4 weeks). In 1 patient, infection of the seroma occurred after 1 month, requiring removal of the mesh via laparoscopy and direct suture of the abdominal wall. We did not consider this case a recurrence. Another patient had persistent neuralgia for 2 months. No gastrointestinal problems occurred related to the intraperitoneal mesh. We did not encounter major complications.

Complications occurred in 25 patients (50%) in the OG. Twenty-three were minor complications (7 wound infections with removal mesh in 1 patient; 5 persistent serous secretions; 8 patients with persistent neuralgia; 3 small bowel occlusions); and 2 were major complications (1 pulmonary embolism, requiring admittance to the intensive care unit and 1 postoperative hemorrhage, requiring reintervention). Median follow-up was 9.0 months in the LG (range, 2 to 20) and 24.5 months (range, 14 to 43) in the OG (**Table 4**).

Hernia recurred in 1 patient (2%) in the LG 1 month after surgery. This recurrence developed in a patient with a large hernia (20 cm) in which the mesh overlapped the defect by only 2 cm. A second laparoscopic repair was performed by placing a second mesh (10x15 cm) over the defect and obtaining a wide overlap of the hernia margins. No recurrence was observed in the OG. Mortality was 0 in both groups.

We calculated a direct cost of 1,900 Euros (mesh, ultrasonic dissector, disposable trocars, and tacks) for each laparoscopic repair and 300 Italian lira (polypropylene mesh, no absorbable sutures, drainages, skin stapler) for each open repair. In 3 OG patients, Vicryl Knitted Mesh, costing 200 Euros, was needed to close the peritoneum, and in 100% of cases a polypropylene mesh was used. A single day of hospitalization costs 400 Italian lira. We calculated indirect costs multiplying per day hospitalization costs for the mean length of stay for each group and added it to obtain the total cost for each group. For laparoscopic repair, with or without complications, we considered the corresponding DRG (Disease Related Group), which gives a different reimbursement than the National Health Service (NHS). The same was done for open repair. **Table 5** provides the results. Total costs are lower for laparoscopic repair if the shorter length of stay is considered.

**Table 4.**  
Complications

Complication	Laparoscopic Group	Open Group
Seroma	6	0
Wound infection	1 reoperation with removal of the mesh	7 (1 removal of mesh)
Persistent serous secretion	0	5
Pulmonary embolism	0	1
Hemorrhage	0	1 (reoperated)
Persistent pain	1	8
Occlusion	0	3
Total	8 (16%)	25 (50%)

**Table 5.**  
Analysis of Hospital Costs and Disease Related Group (DRG) Reimbursement

Cost	Laparoscopy Group	Open Group
Direct cost	1900	300
Cost of a hospital day	400	
Total cost*	2700	3540
DRG reimbursement		
Without complications	3112.17	1614.96
With complications	7847.05	2814.17
Difference		
Without complications	412.17	-1925.04
With complications	5147.05	-725.83

\*Calculated by multiplying mean length of stay for cost of hospital day plus direct cost.

## DISCUSSION

Incisional hernias remain a large problem in general surgery. Despite the introduction of meshes, the recurrence rate has continued to be a major concern. About 13% of patients operated on for incisional hernia undergo one subsequent reoperative repair within 5 years.<sup>10</sup> Mesh repair has proven to be superior to direct suture repair, but recurrence rates remain as high as 24%.<sup>11</sup> Open incisional hernia repair has a high complication rate due to extensive lateral dissection and the need for drainage, which increases infection rates.<sup>8</sup> Moreover, infection is one of the major risk factors in developing recurrent abdominal hernias.<sup>11</sup>

Laparoscopic incisional hernia repair is thought to be superior because it does not require an extensive dissec-

tion of subcutaneous tissue and postoperative drainage. Risk of wound infection should be lower, as should the overall complication rate. Moreover, placement of mesh on the inner layer of the abdominal wall (beneath the peritoneum) is the more physiological method of repair and should allow for a lower recurrence rate.<sup>12</sup>

Since our group started with laparoscopic abdominal and incisional hernia repairs, we have used the same technique. We use tacks in a double ring fashion without stitches at the cardinal points. Other groups advocate that tacks alone are prone to a higher recurrence rate.<sup>8,13,14</sup> The inner ring of tacks should be near the border of the defect, and the mesh must overlap the defect at least 4 cm to 5 cm to lower the risk of recurrence. We feed patients a clear fluid on the first postoperative day and a soft diet on the second.

The characteristics of the patients were not different between the 2 groups, that is, the 2 groups can be considered comparable. It should be remembered, on the other hand, that the LG comprised 7 (23.3%) patients having a primary abdominal hernia (6 umbilical hernias, 1 epigastric hernia). This fact did not have an impact on the diameter of the hernia, even if it could have some impact on the operating time, because it does not imply extensive adhesiolysis. Mean length of stay was dramatically shorter in LG (2.1 days), which is confirmed by many recent studies.<sup>12,15-19</sup> We did not assess postoperative pain or resumption of basic functions, such as oral food intake or bowel movements or return to work, but we can presume that length of stay is an indirect measure of them in favor of laparoscopy.<sup>6</sup> Other series did not experience the same findings,<sup>20,21</sup> presumably because major complications occurred.

We did not experience problems with the mesh: no cases

of intestinal adherence have been documented up to this time.<sup>22</sup> We did not have any cases of trocar-site bleeding. In 4 patients, laparoscopic repair of intestinal serosal tears was required. Serosal tears were repaired with a running stitch of absorbable suture tied with an intracorporeal knot.

We did not use drains in the LG, as compared with drains placed in 96.7% of OG.

In the beginning, we evacuated every palpable seroma. Subsequently, we realized that seromas resolve without intervention in the majority of cases, and we now evacuate only persistent seromas (more than 4 weeks or symptomatic ones).

In 2 cases with an incisional hernia diameter of 4 cm to 5 cm, we performed the operation with mini-trocars (two 3-mm trocars and one 5-mm or 12-mm one) without problems. In both cases, patients were discharged on the first postoperative day and did not encounter problems.

The infection rate was 2%, which is comparable to infection rates in the most recent series,<sup>8,12,17,18</sup> confirming that the decreased dissection of subcutaneous fat and the absence of drains favor wound healing. One series reported no infection.<sup>23</sup>

The recurrence rate was 2% in the LG. It occurred in a patient with a large hernia in which the mesh overlapped the defect by only 2 cm. Recurrence was evident 1 month after the operation. A second laparoscopic repair was done by placing a second mesh over the defect. Other groups experienced higher recurrence rates, perhaps because of a high number of prior attempted hernia repairs.<sup>12</sup>

This study demonstrates that laparoscopic incisional hernia repair has advantages over the traditional anterior approach, namely a shorter operative time, hospital stay, and a lower wound infection rate. Even cost, if we consider total cost, seems to favor laparoscopic repair. Due to the shorter length of stay, laparoscopic repair compensates for the higher direct cost.

On the other hand, some drawbacks must be outlined. The lack of randomization lowers the power of the statistical analysis, and the short follow-up, compared with follow-up for OG could underestimate the problem of recurrences. We believe that recurrence due to technical error should occur within the first year and during the first cases of the learning curve.<sup>12</sup>

We need to further evaluate our patients to rule out a higher recurrence rate than that for OG.

This study also confirms the excellent performance of laparoscopic composite mesh (Parietex Composite Mesh, Sofradim, France) in the treatment of incisional hernia repair.

## CONCLUSION

Laparoscopic incisional hernia repair seems to be superior to open mesh repair, because of the shorter operative time, a shorter hospital stay, and lower total cost. The recurrence rate does not seem to be different, even if follow-up is too short to provide clear evidence of it. We need further study, above all randomized controlled trials, to provide evidence of this conclusion.

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