

## TECHNIQUE AND OUTCOMES OF LAPAROSCOPIC VENTRAL HERNIA REPAIR

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**Abstract:** Laparoscopic repair of incisional hernia has been clearly demonstrated to be safe and efficacious with low rates of conversion to open, a short hospital stay, a moderate complication rate, and low possibility of recurrence. Capitalizing on the benefits of the open retromuscular, sublay repair, the laparoscopic approach provides adequate mesh overlap as well as allowing for the identification of the entire abdominal wall fascia at risk for hernia formation. The fixation of the prosthesis to the abdominal wall is best provided by transabdominal sutures to secure the mesh during the initial phase of incorporation. Long term follow-up data supports the durability of the laparoscopic repair of ventral hernias in regard to reduced rate of recurrence, low risk of mesh infection and applicability of the procedure to difficult patient populations, such as the morbidly obese and those with prior failed attempts at repair.

### INTRODUCTION

One outcome of the greater than 2 million abdominal operations performed in the United States each year is an incisional hernia rate of 3% to 20%<sup>1</sup>. As a result, approximately 90,000 ventral hernia repairs are necessary annually. The increasing number of incisional hernias merely reflects the evolution of surgery with the ability to perform larger abdominal operations such as aortic surgery and colectomy. Factors associated with formation of an incisional hernia include wound infection, morbid obesity, previous operations, immunosuppression, prostatism, and surgery for aortic aneurysmal disease. Abdominal wall defects typically occur within the first 5 years after the surgical incision is made but may develop long afterward<sup>2</sup>. These hernias contribute greatly to the long-term morbidity of conventional surgery. Until techniques for the prevention of hernias are established, the repair of incisional hernias will remain an important concern to the general surgeon.

Several hernia repair methods have been described. Primary tissue repair using a "vest-over-pants" technique requires suture approximation of strong fascia on each side of the defect. Recurrence rates after this type of repair range from 31% to 54% during long-term follow-up<sup>3,4</sup>. The introduction of prosthetics revolutionized hernia surgery with the concept of a tension-free repair. The subsequent rate of recurrence has been lowered to less than 10%<sup>5</sup>. However, the required dissection of wide areas of soft tissue for mesh placement contribute to an increased incidence of wound infections and wound-related complications (12% or higher)<sup>6,8</sup>. These problems have stimulated a continuing search for new techniques for ventral herniorrhaphy.

The laparoscopic repair of ventral hernias is rapidly evolving with patient and surgeon interest in less morbid herniorrhaphies and the appeal of minimally invasive surgery. The technique is based on the open, preperitoneal repair described by Rives and Stoppa<sup>7,9</sup>. The placement of a large mesh in the preperitoneal location allows for an even distribution of forces along the surface area of the mesh, which may account for the strength of the repair and the decreased recurrence rates associated with it. The minimally invasive approach embraces the concept that a

retromuscular mesh repair may be more durable, although the mesh is placed one layer deeper on an intact peritoneum in comparison to the open technique. The technique incorporates other fundamental components of the open repair such as wide mesh overlap of the defect and the use of transabdominal fixation sutures to secure the mesh.

The feasibility of laparoscopic ventral hernia repair has been clearly established with large series of patients and good long-term follow-up<sup>10-12</sup>. The merit of the minimally-invasive approach will be demonstrated with improved rates of recurrence, reduced risks of wound complications, and applicability of the technique for difficult patient populations.

### TECHNIQUE

The technique of the laparoscopic ventral hernia repair (LVHR) is based on the open, preperitoneal repair described by Stoppa<sup>7</sup> and Rives<sup>9</sup>. After general anesthesia is induced, the patient is positioned supine with the arms adducted at the patient's side allowing for adequate space for the surgeon and assistants. Two video monitors are placed on each side of the patient over the right and left shoulders. In the majority of cases, the bladder and stomach are decompressed with catheters and a first generation cephalosporin is given as a prophylactic antibiotic. We routinely use an Ioban drape to minimize mesh contact with the patient skin. Instruments used for LVHR include a 30-degree angled laparoscope, 5-mm bowel graspers, scissors, and clip appliers. Initial access to the peritoneal cavity is gained using a cut-down technique usually just inferior to the tip of the eleventh rib, usually on the left side (Figure 1). A total of three trocars are placed under direct vision laterally along the anterior to mid-axillary line with balloon-tipped trocars used if needed to avoid air leakage. Often, a fourth 5-mm port is placed contralaterally to facilitate mesh placement and fixation. Room setup and trocar positions are demonstrated in Figure 2. On entrance to the abdominal cavity, adhesiolysis is performed sharply with limited use of electrosurgery or ultrasonic coagulators. Reduction of the hernia is then performed using blunt graspers and sharp dissection and is facilitated by manual compression from the outside. Once the hernia is reduced, the defect is measured, often requiring the use of spinal needles, to determine the

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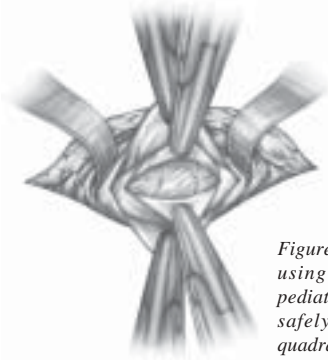


Figure 1. Access to the abdominal cavity using cut-down techniques utilizing pediatric Kocher clamps. This is usually safely accomplished in the left upper quadrant area.

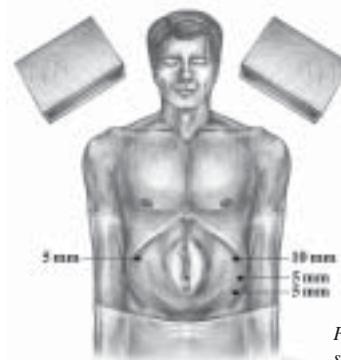


Figure 2. Patient positioning, room set-up, and our trocar strategy.

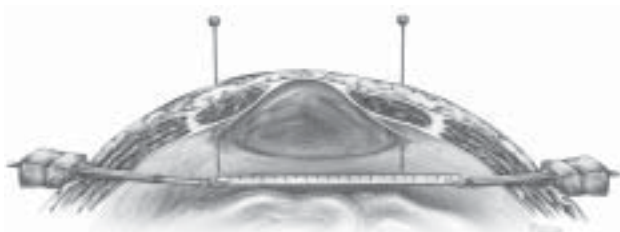


Figure 3. Intracorporeal (direct) measurement of a hernia defect. Spinal needles allow for more precise identification of the edges of the defect. Additional spinal needles may be used for larger than the length of the ruler (typically 12 cm).

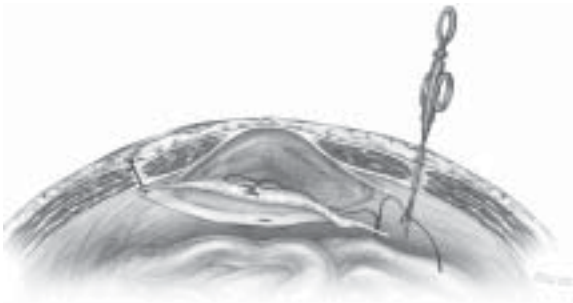


Figure 5. Initial four point mesh fixation.

appropriate size of mesh that is needed. A ruler placed through a 5-mm port is used to measure the dimensions and a mesh is then chosen that will allow at least a 4cm overlap circumferentially (Figure 3).

After the mesh is cut to the desirable size, four size zero permanent monofilament or ePTFE sutures are placed at the mid-point of each side of the mesh and marks are placed to orient the mesh. The mesh is then rolled up from both edges and placed through a 5- or 10-mm trocar (Figure 4). Two Maryland graspers are then used to unroll the mesh making sure to maintain proper orientation. The sutures are then pulled through the abdominal wall using a suture passer and a 4cm overlap of mesh is confirmed (Figure 5). Sutures are then brought up against the abdominal wall and tied with the knots buried in the subcutaneous tissue making sure to keep the mesh taut. The perimeter of the mesh is then stapled to the posterior fascia using a 5-mm spiral tacker at approximately 1 cm intervals (Figure 6). Additional full thickness sutures are placed circumferentially every 3 to 6 cm by using the suture passer. This

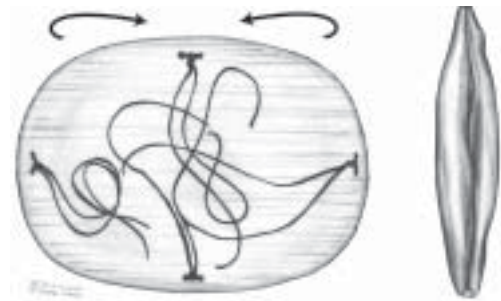


Figure 4. Rolling of the mesh before its introduction into the abdominal cavity.

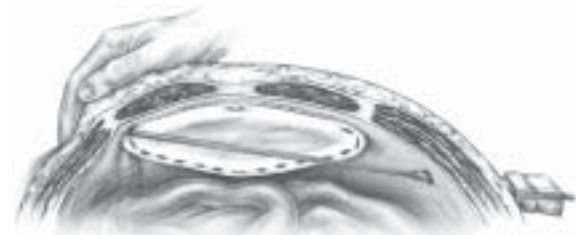


Figure 6. Placement of tacks is done circumferentially along the whole length of the mesh to avoid bowel incarceration. External palpation of the abdominal wall facilitates placement of the tacks and helps to avoid tacking the mesh below the inguinal ligament and above the costal margins.

transabdominal fixation is crucial to ensure that the mesh will not be displaced over time. The knots are tied in the subcutaneous tissue and the skin is released to avoid dimpling.

## OUTCOMES TALK

**Recurrence:** The rate of recurrence following hernia repair depends on many factors including type and technique of repair. In a recent review of the recent larger series with mean follow-up more than 12 months, the overall rate of recurrence for LVHR is 4.3%<sup>13</sup>. One of the most critical technical points of the laparoscopic repair that may significantly impact the rate of recurrence is the method of mesh fixation. While the most widespread technique used in LVHR utilizes transfascial sutures and tacks to adequately fixate the mesh, described above, some surgeons have tried to reduce operating time and possible postoperative discomfort by eliminating, or decreasing the use of transfascial sutures and relying on the laparoscopic tacker for fixation<sup>12,14</sup>. Carbajo and associates<sup>12</sup> have the largest series without suture fixation with over 270 repairs

using two layers of tacks to fix the mesh, the so called “double-crown” technique. With an average follow-up of 44 months, they reported 12 recurrences (4.4%)<sup>12</sup>. While this represents and acceptable recurrence rate, the authors believe that transfascial sutures remain essential for adequate mesh fixation.

The physics of mesh fixation during laparoscopic ventral hernia repair do not support the sole placement of tacks. The majority of meshes used for laparoscopic ventral hernia repair are roughly 1mm thick and the spiral tacks used are 4mm long and take up a 1mm profile on the surface of the patch. A perfectly placed tack can be expected to penetrate only 2mm beyond the mesh. With the large number of obese patients undergoing hernia repair and with the subsequent large amount of preperitoneal fat, it is unlikely that a 2mm purchase of tack will reach the fascia in most cases. The strength of transfascial sutures and tacks has been studied by our group and other authors<sup>15,16</sup>. Van’t Riet and coauthors demonstrated in a porcine model that the tensile strength of sutures in transabdominal mesh is 2.5 times greater than that of tacks<sup>16</sup>.

Another recognized cause of recurrence following ventral hernia repair is a missed hernia. The laparoscopic approach affords the surgeon the ability to clearly and definitively define the margins of the hernia defect and to identify additional defects that may not have been clinically apparent preoperatively. Complete visualization of the fascia underlying the previous incision allows identification of smaller “Swiss-cheese” defects that could be missed in an open approach<sup>17</sup>.

**Mesh Infection:** One of the greatest benefits of the LVHR is the reduction in wound and mesh infectious complications. In open ventral hernia repairs wound problems are not unexpected secondary to the large amount of soft-tissue dissection required for retromuscular placement of large pieces of mesh. Dr. Stoppa reported a 12% “wound sepsis” rate in his classic article on inguinal and incisional hernia repairs<sup>7</sup>. While overall infectious complications are reported to be low, they remain a serious complication with severe consequences. Skin pathogens are responsible for most mesh infections and the use of an iodine-impregnated, adhesive drape on the abdomen may help in avoiding contact with the mesh to the skin. Infections of polypropylene mesh can usually be managed locally with surgical drainage and excision of exposed, unincorporated segments, while meshes containing expanded polytetrafluorethylene (ePTFE) typically require entire removal of the mesh prosthetic. There is one reported success, however, of local drainage of ePTFE and placement of a vacuum-assisted wound device<sup>18</sup>. When evaluating wound and mesh infectious complications from series with at least 50 patients the overall rate of occurrence is 1.7%<sup>13</sup> (Table 1) and compares favorable to the reported range of 12% to 18% found after open hernia repair<sup>7, 8, 19, 20</sup>.

**Seroma:** Seroma formation is not unique to the laparoscopic approach. Most seromas develop above the mesh and within the retained hernia sac. The rate of seroma formation in reported series varies depending on when the investigators evaluate for it. The mean incidence of seroma formation at a range of 4 to 8 weeks is 11.4% in the large reported series<sup>13</sup> (Table 1). Whether these are aspirated under sterile condition or allowed to resolve, seromas rarely result in long-term problems. It is imperative that surgeons inform their patients preoperatively about the likelihood of a seroma and subsequent treatment entailed. Large seromas are fortunately

**Table 1.** Wound and mesh complications in large series of laparoscopic ventral hernia repairs (e”50 patients)

Series	Year	Pts	Wound	Mesh Infection	Wound Infection	Seroma
Stoppa <sup>7</sup>	2004	91	6	0	0	0
Stoppa <sup>8</sup>	2004	264	13	1	1	0
Cherney <sup>9</sup>	2003	200	13	4	0	0
Stoppa <sup>10</sup>	2003	186	1	2	0	0
Stoppa <sup>11</sup>	2003	74	0	0	0	0
Stoppa <sup>12</sup>	2003	58	0	0	0	0
Cherney <sup>13</sup>	2003	276	11	0	0	1
Stoppa <sup>14</sup>	2003	100	4	1	4	0
Stoppa <sup>15</sup>	2003	100	21	0	0	0
Stoppa <sup>16</sup>	2003	174	23	0	4	2
Stoppa <sup>17</sup>	2003	46	3	0	0	0
Stoppa <sup>18</sup>	2003	56	1	1	1	0
Stoppa <sup>19</sup>	2003	180	11	0	0	0
Cherney <sup>20</sup>	2003	100	2	0	0	0
Stoppa <sup>21</sup>	2003	183	100%	2	2	0
Stoppa <sup>22</sup>	2003	100	134	0	0	0
Stoppa <sup>23</sup>	2003	24	2	0	2	0
Cherney <sup>24</sup>	2003	202	49	0	0	0
Stoppa <sup>25</sup>	1998	144	13	1	1	0
<b>TOTAL</b>		<b>3276</b>	<b>361 (10.4%)</b>	<b>20 (0.6%)</b>	<b>4 (0.1%)</b>	<b>3 (0.1%)</b>

uncommon, however can place tension on the skin which can cause necrosis and be associated with risk of mesh infection. Aspiration is recommended for seromas that enlarge or persist before they reach these extremes<sup>10</sup>.

**Persistent Pain :** After laparoscopic ventral hernia repair, patients will occasionally complain of persistent pain and pint tenderness at a transabdominal suture site. Transabdominal suture site pain after laparoscopic ventral hernia is not uncommon and occurs in 1% to 3% of patients in the reported series using transabdominal sutures<sup>10,11,21,22</sup> and typically resolves within 6 to 8 weeks<sup>23</sup>. While little is known regarding the etiology of this pain, possible explanations include local muscle ischemia or that the transabdominal suture entraps an intercostal nerve as it courses through the abdominal muscles. The first line of treatment can be a course of nonsteroidal anti-inflammatory therapy or simply additional time. If the pain persists, injecting local anesthesia at the painful suture sites has good results. In a study conducted by the authors, 92% of patients undergoing treatment with an injection had complete relief of their symptoms<sup>24</sup>.

**Morbid Obesity:** The morbidly obese population represents a significant portion of the patients that present for repair of a ventral hernia. Obesity has been clearly established as a risk factor for development of incisional hernias. Sugerman and colleagues reported that severe obesity (BMI e”35 kg/m<sup>2</sup>) was a greater risk factor for incisional hernia and recurrence than chronic steroid use<sup>25</sup>. This group has shown that severely obese patients, and especially those with *central obesity*, have increased intraabdominal pressure<sup>26</sup>. This higher pressure creates more strain on the mesh placed for the hernia repair, which is probably responsible for the increased incidence of *incisional hernia* and rate of recurrence following repair. The laparoscopic approach is ideal in the obese patient due to the smaller wounds and theoretically, decreased wound complications<sup>27</sup>.

*Complications of ventral herniorrhaphy such as wound infection and recurrence* are elevated in the obese population. Laparoscopic ventral hernia repair can be safely performed in the morbidly obese

patient. The morbidly obese (BMI  $\geq 40$ ) have significantly longer operative times, larger hernia defects, and higher rates of recurrence. Over a nine-year period, Heniford and colleagues demonstrated that this population was nearly four times more likely to have a recurrence after laparoscopic ventral hernia repair (7.8% versus 2.0%)<sup>10</sup>. Birgisson et al. reported an increase in operative times and defect sizes as well. In their experience, sixteen patients with a body mass index  $\geq 40$  had 5 minor complications (31%) but no major complications or recurrences at a mean of 8.5 months<sup>28</sup>.

## PREVIOUS FAILED REPAIRS

The laparoscopic approach is an excellent choice for recurrent hernias that have failed prior attempts at repair. Laparoscopic entry into the peritoneal cavity avoids dissection through the previous operative site. This technique is ideal for patients with failed preperitoneal or onlay repairs using prosthetics because the dissection avoids disrupting these meshes and risking infection. However, the "battlefield abdomen" with numerous failed repairs and several pieces of mesh complicated by infection may be better served by an open repair. Multiple defects resulting in the "Swiss cheese" abdomen are well suited for laparoscopic hernioplasty. The intraabdominal view better identifies all of the defects and allows for better prosthetic coverage.

Patients with failed prior open attempts at repair demonstrate significantly longer operative times (134 minutes versus 111 minutes). Those with previous repairs have a higher rate of complications (17.8% versus 10.4%) and a greater than 3 times increased risk of hernia recurrence (7.1% versus 2.3%). The rate of conversions to open surgery is no different<sup>10</sup>. Patients with failed open repairs and previously placed intra-abdominal mesh frequently present for laparoscopic repair. In the larger series, those with prior repairs range from 21% to 34%<sup>10, 12, 21</sup> and the number of previous repairs ranges from 1 to 11<sup>10</sup>. These patients are more technically challenging, but they can be safely treated with a laparoscopic approach to their recurrent defect.

## QUALITY OF LIFE

Outcomes following hernia repair typically center around recurrence and infection rates. With improvement in these traditional outcomes more emphasis is now being placed on functional outcomes such as quality of life. We recently reviewed our preliminary data on quality of life outcomes of laparoscopic and open ventral hernia repairs. We found that at six months postoperatively, LVHR afforded a significantly better quality of life than open hernia repair using both a generic and hernia specific quality of life survey<sup>29</sup>. Quality of life information will continue to be an important outcome measure in regards to hernia repair especially evaluating different types of mesh prosthesis and different techniques of repair.

## CONCLUSION

Laparoscopic repair of incisional hernias results in a low rate of conversion to open surgery, a short hospital stay, and an acceptable overall complication rate. Additionally, the procedure results in extremely low risk of infection and a low risk of recurrence. The laparoscopic approach appears to be effective in complex patients, especially those who are obese and who have had failed prior open repairs. With sufficient long term follow-up to support the durability of the procedure, laparoscopic ventral hernia repair should be considered the standard of care.

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