

# Current Considerations in Laparoscopic Incisional and Ventral Herniorrhaphy

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## ABSTRACT

Laparoscopic ventral and incisional herniorrhaphy is gaining popularity among both surgeons and patients. The key to the success of this procedure is avoidance of complications. In this article, important considerations in the preoperative, intraoperative, and postoperative aspects of this procedure are reviewed, with a particular focus on the repair of incisional defects. Surgical considerations to assist in the prevention of certain pitfalls associated with laparoscopic repair of ventral and incisional hernias are described.

**Key Words:** Laparoscopy, Herniorrhaphy, Incisional hernia, Ventral hernia.

## INTRODUCTION

Laparoscopic ventral and incisional herniorrhaphy is gaining popularity among both surgeons and patients and is less controversial than laparoscopic repair of inguinal hernias. As with any operation, the key to the success of this procedure is avoidance of complications. This article reviews important considerations in the preoperative, intraoperative, and postoperative aspects of this procedure, with a particular focus on the repair of incisional defects because these lesions are the most frequently encountered. I also describe ways to prevent possible pitfalls associated with laparoscopic ventral hernia repair by sharing experience acquired in the more than 200 cases we have done in the 7 years since we first reported the operation.<sup>1,2</sup>

## GENERAL CONSIDERATIONS

Before a surgeon can become proficient at any advanced laparoscopic procedure, he or she must be adept at performing the more common operations using that technique. Advanced procedures require great confidence in one's own laparoscopic skills. Because surgeons are judged primarily by their ability to perform an operation safely, laparoscopic incisional herniorrhaphy should be done only by surgeons with this ability. Therefore, before attempting this procedure for the first time, a surgeon should consider taking a course on the operation that is taught by experienced surgeons and includes a "hands-on" session that uses a human cadaver or a laboratory animal. Additionally, during the first several operations on patients, it is best to have the assistance of a surgeon experienced in performing this procedure. Of course, to optimize outcome, conversion from the laparoscopic technique to the open method should be done at the earliest sign of difficulty. Finally, once past the learning curve, the participation of an assistant surgeon who is knowledgeable in advanced laparoscopic techniques is generally mandatory for repair of all but the smallest defects.

## PREOPERATIVE CONSIDERATIONS

As with any operative procedure, a surgeon must evaluate the overall status of the patient before proceeding

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with a laparoscopic incisional hernia repair. Any patient who is a medically appropriate candidate for an open procedure can also be considered for the laparoscopic approach.

In general, the size of the defect is not a limiting factor, although I restrict my use of the laparoscopic procedure to hernias that are larger than 3 cm in their greatest dimension. The size of the incision required for open repair of a small defect is similar to the combined size of the incisions required for insertion of the laparoscopic trocars. Also, small defects are often repaired without use of a prosthetic material. The occasional exception to this would be the obese patient.

A very large fascial defect may sometimes cause reconsideration of a laparoscopic approach. The operating time required to repair a defect that approximates the entire surface of the abdominal wall could negate the benefits of the laparoscopic method. Patients will have a considerable ileus, regardless of the repair employed. A surgeon may think that the increase in operative time and risk will not justify use of a laparoscopic repair. However, there are currently no "hard and fast" rules about this issue. In patients with very large defects, I generally begin the operation laparoscopically and convert to an open repair if that appears to be the best alternative.

Occasionally, obesity of the patient is a limiting factor because the trocars may not be long enough to achieve adequate access to the abdomen. It is sometimes necessary to convert to open repair because a working channel through the abdominal wall cannot be maintained. In such cases, the open end of the trocars is continually withdrawn into the excessive fatty tissue, thereby eliminating the working channel and obscuring the view of the abdominal cavity.

Most incisional hernias occur in the midline of the abdomen. When a surgeon starts to perform laparoscopic incisional herniorrhaphy, he or she should repair only midline defects to gain confidence in use of the laparoscopic technique. Once this is accomplished, the presence of a nonmidline defect or multiple defects that are not adjacent to each other should not preclude use of laparoscopy. In most cases, the entire abdominal cavity can be approached, with appropriate positioning of the patient and trocars.

Previous intra-abdominal surgery is a major consideration

in evaluating a patient for a laparoscopic procedure. The number and type of earlier operations influence the choice of patient position, the abdominal entry method, trocar placement, and the view provided by the monitors. Decisions regarding these factors should be made when the patient is on the operating table or just after the introduction of anesthesia. The larger the previous operation or operations, the greater the likelihood of finding adhesions that will require lysis during surgery. Patients in whom a previous repair used a polypropylene prosthesis may have dense scarring in all areas in which the material was not covered by omentum; however, this should not deter experienced surgeons from attempting a laparoscopic approach.

Increasingly, patients with incisional hernias have additional surgical problems. In many instances, it is preferable to perform the other procedures these patients require concomitantly with the hernia repair. For patients with problems outside the abdominal cavity, this is not a matter of concern (unless there is an infection); the other procedure that is needed is secondary and should be begun after completion of the herniorrhaphy. The difficult decisions occur for patients who need a procedure that involves an intra-abdominal organ, usually a cholecystectomy, Nissen fundoplication, or biopsy. Protocols for laparoscopic incisional hernia repair in such cases are described later.

Laparoscopic incisional herniorrhaphy should be individualized in patients with known ascites because it is impossible to close the trocar sites in a consistently watertight manner and prevent ascitic leaks. Moreover, these patients usually have a metabolic problem (eg, chronic renal failure or hepatic disease) that can cause poor healing and predispose them to development of multiple hernias at the trocar sites. The use of the 5-mm trocars, however, has made this less problematic, and these patients may also be considered on occasion.

Repair of incisional hernias with the laparoscopic method is done from the day-surgery unit, and all patients are considered for discharge on the day of surgery. The type of hernia and the amount of dissection required determine whether a patient remains in the hospital overnight or longer. Many patients now undergo laparoscopic incisional hernia repair in an ambulatory surgery center. Minimal preoperative preparation is required at the center. Patients are routinely given an antibiotic preoperatively, but if the biomaterial that will

be implanted contains antimicrobial agents, antibiotic prophylaxis may not be mandatory.

## **INTRAOPERATIVE CONSIDERATIONS**

### **Patient Preparation and Positioning**

Laparoscopic incisional repair requires use of general anesthesia to achieve the necessary degree of relaxation and sedation. In most cases, it is not necessary to use a nasogastric tube or urinary catheter, unless the operative sites are close to the stomach or bladder or the procedure will be lengthy. Insertion of a nasogastric tube for procedures in which extensive dissection of the bowel is necessary may help reduce the postoperative ileus that is likely to develop.

Most patients should be placed in the prone position. Operations on lateral defects, such as those in a subcostal or flank incision, will be facilitated by use of a semidecubitus or full decubitus position. Use of the tilt capabilities of the operating table will assist manipulation of the bowel during dissection. The patient's arms should be tucked in close to the body to allow sufficient room to move around the patient; this is especially important if the defect is in the lower abdomen. Use of a protective transparent adhesive drape is optional; I do not consider it necessary.

### **Entering the Abdomen**

The method used to gain access to the abdomen must be the safest approach possible in the patient. In a patient with an isolated defect, a Veress needle may be used for insufflation before introduction of the first trocar. A "safe" area for needle insertion is usually in the right upper quadrant because it is generally free of adhesions and bowel. Often, however, surgeons prefer to use an "optical" trocar for abdominal entry because it allows visualization of the entire passage through the layers of the abdominal wall. Others will use an open type of entry because it is familiar, but this may result in injury to the intestinal tract. An open entry may also produce a poor seal around the trocar, resulting in poor insufflation and difficult visualization throughout the procedure.

The view of the abdomen is generally obscured by adhesions. To enhance visualization and free up enough space for placement of additional trocars, blunt dissection of these adhesions is often done with the laparoscope itself. After each new trocar is introduced, the laparoscope should be placed through it to provide a

view of the abdomen from that new vantage point and to obtain information needed for optimal placement of other trocars. Additionally, the collection of views provided by placing the laparoscope in multiple trocars can be used during the dissection to ensure that the bowel is not threatened by the necessary surgical maneuvers. This is extremely important because, in some cases, neither the surgeon nor the assistant can appreciate the proximity of the bowel during adhesiolysis.

In determining the best locations for the trocars, surgeons must be aware of "mirror imaging." It is frequently necessary to place and manipulate instruments from the side in direct opposition of the viewing laparoscope. This produces a mirror image of any manipulation that is viewed from that port; for example, a move to the left will be seen as a move to the right. To avoid this problem, I place the laparoscope in the midline when possible. Other surgeons insert an additional trocar into the side of the patient in order to work with the view on the same side as the operator. This does not always completely eliminate mirror imaging. With practice, this technical problem can be overcome without the use of additional trocars. Most of this difficulty can be eliminated if the assistant surgeon can use the instruments from his or her side of the patient. On the other hand, additional trocars should be used when the problem cannot be corrected easily to ensure accurate assessment of intra-abdominal contents.

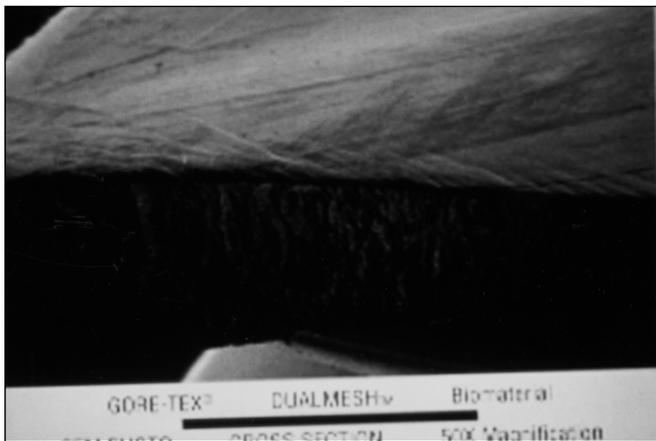
### **Instruments and Prosthesis**

The choice of laparoscope (0, 30, or 45 degree) used for incisional hernia repair depends upon the familiarity of the operating team with the instruments, the planned position of the trocars, and the habitus of the patient. Because thin patients with good muscle tone do not accommodate as much distention as do obese patients with poor muscle tone, a 30-degree laparoscope may provide a better view in thin patients. The size of the laparoscope itself is not important as long as the view is the best available. Smaller scopes permit use of smaller trocars, which may decrease postoperative pain. Experienced surgeons typically find that 5-mm laparoscopes perform as well as do the 10-mm laparoscopes. However, an instrument with a port of at least 10 mm may be necessary for the introduction of a large patch of prosthetic material.

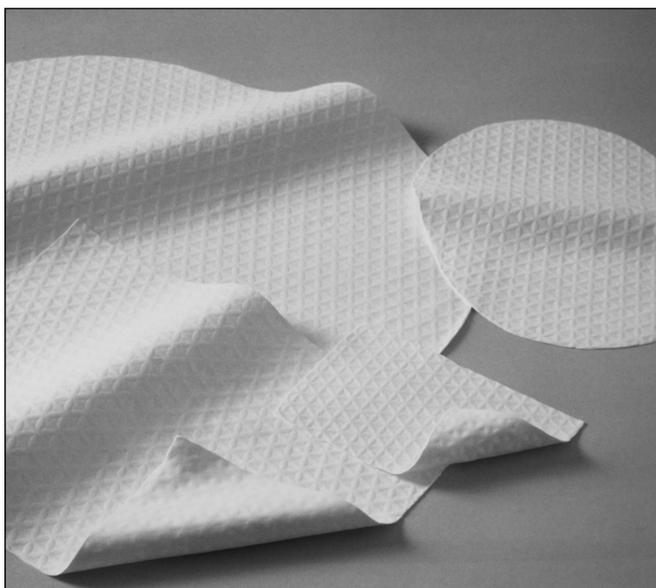
The riskiest portion of a laparoscopic incisional herniorrhaphy is the dissection involving the bowel.

Electrocautery is useful only in the minority of cases in which the adhesions are few or filmy. In most cases, dissection of omentum and bowel from abdominal wall is most safely done with the Harmonic® scalpel (Ethicon Endosurgery®, Inc., Cincinnati, Ohio). Scissors without cautery can be used for dissection on the bowel itself. If a rent (ie, a tear that does not result in spillage of the intestinal contents) of the bowel occurs, it should be

repaired if necessary, and the repair should proceed as planned if the surgeon desires. If spillage occurs, no prosthesis should be placed or the operation should be terminated and the patient returned to the operating room after a few days to proceed with the operation as originally intended. Occasionally, the hernia contents cannot be reduced with dissection, particularly if they are incarcerated. In such cases, the fascial defect must be enlarged to allow reduction of the involved organs in the same manner as is done in open repair.



**Figure 1.** Cross sectional view of the DualMesh® Biomaterial.



**Figure 2.** DualMesh® Plus Biomaterial.

Many surgeons prefer an expanded polytetrafluoroethylene (ePTFE) prosthesis (DualMesh® Biomaterial, W.L. Gore & Associates, Flagstaff, AZ). This material has two different surfaces. The “visceral” (smooth) surface has interstices of 3 mm, which inhibit development of adhesion formation in the abdomen (**Figure 1**). The “parietal” (rough) surface has interstices of 22 mm, which permit ingrowth of fibroblasts and collagen deposition. This permits a healing process that provides strong fixation to the abdominal wall musculature without dense scarring.<sup>3-5</sup> The 1-mm thick form of this prosthesis (**Figure 2**) is easier to manipulate than the 2-mm version. To prevent inadvertent reversal of the patch after it has been inserted into the abdomen, the parietal surface of the patch should be marked before insertion. Some ePTFE patches (DualMesh Plus®, W.L. Gore & Associates) are impregnated with the antimicrobial agents silver and chlorhexidine, which impart a light brown color to the visceral surface (**Figure 2**). These agents are absorbed within seven days after implantation and do not produce adverse effects.<sup>6</sup> The light brown color of these patches make them relatively easy to see within the abdomen. In the early part of the year 2000, a newly modified DualMesh® Plus with larger interstices will be released.

### **Preparing to Place the Prosthesis**

Before insertion of the prosthesis, the entire fascial defect(s) must be uncovered. This usually requires removal of all the adhesions within the abdomen, especially those attached to the anterior wall. Complete removal of adhesions ensures that placement of the prosthesis is not compromised by inclusion of these adhesions. If adhesions interfere with the patch fixation, the procedure must be stopped to allow further adhesiolysis. This process can be quite difficult if the patch is partly affixed to the abdominal wall.

It is not necessary to remove the hernia sac. Dissection of the sac is difficult and causes a marked amount of

bleeding but does not produce any appreciable benefits for the patient. I also do not close the fascial defect because I believe that the security of the repair depends on use of the appropriate patch size and adequate patch fixation rather than closure of the hernial orifice.

The defect is most accurately measured with the insufflation pressure reduced from the working amount of 14 mm Hg to near zero. Reducing the pressure prevents the inflation artifact (distension of the abdominal wall) that can substantially increase the apparent size of the defect because the measurement is done on the external rather than the interior abdominal wall. After desufflation, the defect is outlined on the skin over the abdomen with a skin-marking pencil. The entire circumference of the defect should be identified to ascertain its maximum dimensions. To ensure adequate coverage with the prosthesis, 3 cm is added to the measurement in all directions.

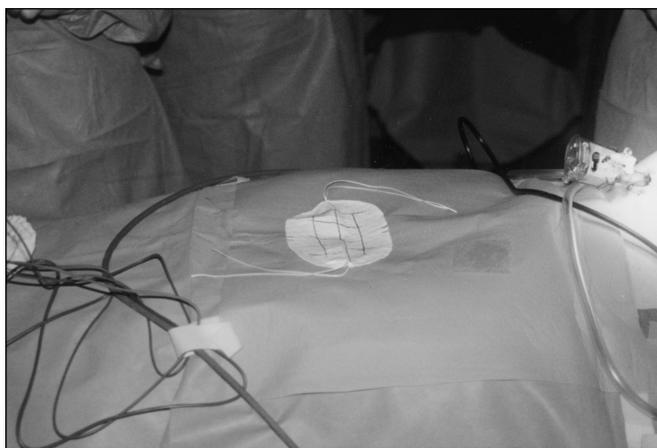
Several different techniques may be used before patch insertion to ensure that the prosthesis will be oriented properly and cover the defect adequately. I place ePTFE sutures at either side of the midpoint of the long axis of the patch and mark both sides of the midpoint of its short axis with a marking pencil prior to its insertion into the abdominal cavity. This ensures correct axial orientation at fixation to the abdominal wall. Some surgeons mark the short axis by placement of a contrastingly colored nonabsorbable suture. Others place four or more

sutures at the corners of the patches, but I find that either of these techniques creates a tangle of suture material that is cumbersome to work with in the limited space available (**Figure 3**). The ePTFE patch, with its attached sutures, is rolled for introduction into the abdomen. Most patches can be inserted through a 10- or 12-mm port; however, the largest ones must be rolled tightly. If insertion is difficult, an instrument passed through a trocar on the opposite side of the abdomen can be used to grasp the patch. When the trocar is removed, the material will be pulled into the cavity. The pliability of the abdominal wall musculature allows insertion of the largest ePTFE patches available (24 cm x 36 cm). With experience, even these larger biomaterials can be pulled through a 5-mm trocar site.

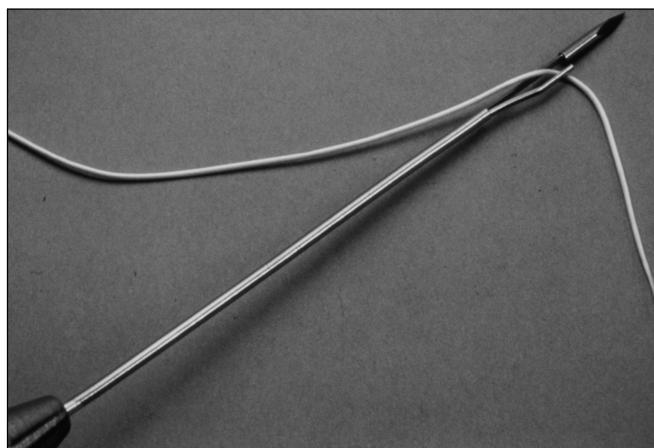
**Placement of the Prosthesis**

After insertion, the prosthetic patch is unrolled onto the viscera of the abdomen. It is desirable to unroll it completely to facilitate fixation of the material to the abdominal wall. However, this cannot always be accomplished because of the limited size of the insufflated abdomen, the patient's habitus, or the size of the patch. In such cases, it may be easier to unroll the prosthesis after one or both of the initial sutures have been passed through the abdominal wall.

The initially placed sutures are pulled through the entire abdominal wall with use of a sharp suture-passing instrument inserted through a small skin incision (**Figure 4**).



**Figure 3.** DualMesh® with marks on the parietal surface and initial sutures placed at the midpoints of the patch.



**Figure 4.** Suture placement within the Gore-Tex® Suture Passer®.

I then confirm that the patch is centered over the defect by moving the laparoscope to another port, if necessary. The sutures are not tied at this point but are merely pulled up to hold the patch against the abdomen. This maneuver allows the surgeon to verify that the patch overlaps the defect by at least 3 mm. If it does not, the sutures are repositioned. When the optimal position is achieved, the sutures are tied. Even in large patients, the knots can be pulled down to the level of the fascia. During this process, a dimple sometimes develops at the skin exit site of a suture. Placing a hemostat or skin hook into the incision and lifting the skin off of the dimple can eliminate this.

To confirm correct orientation along the short axis of the patch, each unattached patch side is grasped—one by the surgeon and the other by the assistant—at the previously marked midpoints. The material is then positioned over the desired final location. A spiral tacker is used to fix the midpoint of one side then the other side sequentially. Only one tack is fired at each point to allow a final inspection to be made before placement of the numerous tacks and sutures that will hold the patch in place. After the inspection, the tacks are deployed in a circular manner around the edge of the prosthesis; tacks are placed approximately 5 to 10 mm from the edge of the patch, 1 to 1.5 cm apart. This fixation method appears to be superior to techniques using “box-type” staples.<sup>7</sup>

Tacking is followed by through-and-through placement of permanent sutures. First, planned sites of placement about 5 to 10 cm apart are palpated externally. A suture is grasped with the suture-passing device, which is then inserted through a small skin incision. The suture passer pierces the patch at the appropriate place, and the suture is retrieved by the assistant on the opposite side of the abdomen with a grasping instrument. The suture passer is then withdrawn into the subcutaneous tissue and reinserted through the patch approximately 1 cm from the site of the previous puncture. The previously inserted suture is retrieved and withdrawn from the abdomen. These maneuvers are repeated along the entire edge of the patch. Afterward, all the sutures are tied. The patch should then lie flat thereby obliterating the fascial defect. Sometimes, in an effort to diminish seroma development, a surgeon will outline the edge of the defect beneath the patch with a row of tacks.

The trocar cannulas are removed under direct vision. Any port sites larger than 5 mm are closed by using the

suture passer to pass an absorbable suture. The skin incisions are closed with either a subcutaneous suture or Steri-Strips alone. The site of the hernia protrusion is covered with a bulky dressing and taped, with foam tape or an abdominal binder is used; this is left in place for at least 72 hours. Use of this dressing appears to prevent the development of a postoperative seroma.

## **IMMEDIATE POSTOPERATIVE CONSIDERATIONS**

After the recovery period, patients are transferred to the day-surgery unit. Many are discharged on the same day. In our practice, the average length of stay is 1.24 days. Patients can consume liquids the day of surgery and resume taking any regular medications. Oral and parenteral sedatives are given if necessary. Patients generally receive ketorolac while in the postanesthesia care unit.

Postoperatively, most patients have some degree of abdominal distension. This is generally proportional to the amount of dissection performed, particularly if there was considerable manipulation of the bowel. Most patients can resume a regular diet the day after the operation. Occasionally, a patient will have prolonged ileus, which should be managed in the usual manner; use of a nasogastric tube may be beneficial. If abdominal radiographs are obtained, any “free air” observed on the films must be interpreted carefully because the carbon dioxide from the laparoscopic procedure may remain in the abdomen for as long as a week.

Patients experience more postoperative pain than a new practitioner of laparoscopic incisional hernia repair might anticipate. All have more discomfort than a patient who has undergone laparoscopic cholecystectomy. The pain is usually described as a pulling sensation; there is generally little pain at the trocar insertion sites. Some patients have the sensation of pain in the shoulder that is common after laparoscopic procedures. Most pain can be controlled with an oral sedative. It is sometimes useful to give a dose of a nonsteroidal anti-inflammatory agent between doses of narcotic medications, if necessary.

Pain may be used as the guide to determine when patients can resume their normal activities. Patients may return to their daily activities, including work, as soon as they can do so without marked pain. Most are able to

drive within a week and resume job-related activities in 7 to 14 days.

The bulky dressing applied at the completion of the operation is removed by the patient after 72 hours. After removal of the dressing, many patients note a firm bulge at the hernia site. Others describe their abdominal wall as "flat" or "tight" because of the change in habitus caused by the prosthetic patch. The bulge may represent a seroma, but usually the area is simply undergoing the cicatricial event that occurs after any hernia repair. In patients who have undergone laparoscopic herniorrhaphy, this area responds differently because of the lack of a large incision. Seroma formation does occur in approximately 4% to 16% of cases.<sup>8,9</sup> However, it is rarely, if ever, necessary to aspirate these fluid collections; almost all will resolve without intervention.

### **LATE POSTOPERATIVE CONSIDERATIONS**

Most patients who have undergone laparoscopic incisional hernia repair require one or two postoperative visits, but it is beneficial to the surgeon's education if the first several patients are followed for a longer period so that he or she can learn about the postoperative course in uncomplicated cases. In most patients, any firm cicatrix at the hernia site will resolve in one or two months, depending on the size of the hernia and its contents. It is not uncommon for the skin on the abdominal wall in this area to become erythematous, usually in association with a distinct surface firmness but with little tenderness and no fever, chills, or leukocytosis. This situation may persist for a few weeks and should not automatically be considered to represent infection. It is more likely the result of resorption of fatty tissue left in place during the operation or possibly the hernia sac itself. This appears to be more common after the repair of hernias that have minimal soft tissue between the skin and peritoneal sac and/or involve incarceration.

After two months, the abdominal wall will have nearly completed its postoperative changes. Infrequently, an apparent seroma is still noted. This could be evaluated by ultrasonography. Generally, this assessment, rather than confirming the presence of a seroma, indicates occurrence of a conformational change in the abdominal musculature, especially in older patients with minimal abdominal muscle tone and patients who normally had a protuberant abdomen preoperatively. The patient and surgeon must be reassured by this evaluation and con-

sider that the abdomen's appearance will be less likely to change further.

Infrequently, a patient has a prolonged (> 3 months) pulling sensation at the site of the through-and-through sutures. If this persists, a surgeon might consider performing a laparoscopic examination to inspect the patch and sutures. However, this is rarely necessary; I have never felt it to be necessary in a patient who underwent a laparoscopic procedure, and I have done it in only one patient who had open surgery.

Recurrence is the standard by which all hernia repairs are judged. There have been no recurrences in my patients in the four years since I began to use the operative method described here. In published studies of laparoscopic incisional and ventral hernia repairs using a variety of methods, recurrence rates have ranged from 0 to 10%, with most reported rates being less than 4%.<sup>8,10-16</sup>

### **CONSIDERATIONS FOR SPECIAL CIRCUMSTANCES**

Surgeons who have mastered the "usual" laparoscopic incisional herniorrhaphy may expand their use of the procedure to uncommon hernias. One such defect is a hernia very high in the midline, perhaps at the exit site of a mediastinal tube used for open-heart surgery. Repair of this defect may require that the prosthetic patch be placed near the diaphragm or pericardium. For a defect in the pericardial area, it is advisable to use only sutures to secure the patch in order to avoid penetration of tacks into the myocardium or development of pericarditis requiring removal of the tacks. In other locations on the diaphragm, the muscle is generally thick enough to allow tack placement, but it may be difficult to achieve the degree of external pressure required for adequate penetration of the tacks. Therefore, sutures should be used.

Very low abdominal hernias that extend to the symphysis pubis or incisional hernias associated with an inguinal hernia also present a challenge. In repairing these defects, it is usually necessary to attach the lower part of the patch to Cooper's ligament to ensure adequate fixation. It is preferable to take down the bladder in the same manner as in a transabdominal preperitoneal inguinal hernia repair to provide for development of a strong attachment of the patch to the muscle wall and periosteum of the pubis. If preperitoneal fat and peri-

toneum are allowed to remain between the patch and muscle, subsequent tissue attachment may be compromised because of migration of these tissues due to their inherent weakness and because it is impossible to place through-and-through sutures in this area. Attachment to Cooper's ligament with take-down of the bladder will permit the bladder to distend normally; if the patch is placed behind the bladder, it may not fill to capacity. After the patch is secured, I raise the preperitoneal flap and secure it in its native position to the extent possible in order to cover the vascular structures and allow normal bladder distension.

Incisional hernias along the sidewalls of the abdominal cavity may present problems in positioning the patient during surgery and obtaining adequate working space in the abdomen. Patients with such defects should be placed in a lateral decubitus position on a "bean bag." Defects along the upper flanks that involve denervation and weakened musculature rather than a true fascial lesion require a very large patch that is secured tightly with more than the usual number of sutures to achieve an acceptable cosmetic result.

The presence of a tube in the abdominal cavity, such as a peritoneal catheter, shunt, or feeding tube, predisposes patients to development of a hernia in either the incision used to insert the tube or at the site of the exit of the tube from the abdomen. During laparoscopic repair of such a hernia, it is important to prevent migration of any carbon dioxide into the catheter. Surgeons must also be aware that there will be a slight increase in the risk of infection of the patch in these patients because of the presence of an opening in the skin that cannot be closed. If the hernia is at the site of the tube exit rather than in the incision, the patch usually must be cut and wrapped around the tube, although it is sometimes possible to cut a small hole in the patch and put the tube through it. Purse-string suturing should be done at that site to prevent migration of tissue in the defect.

Hernias that develop alongside an ostomy are difficult to repair, regardless of method. Although it is best to avoid using a prosthetic patch in these cases, a patch is required in patients with a massive defect or multiple recurrent hernias. The laparoscopic repair procedure should be carried out from behind the opening of the bowel rather than adjacent to it. The ostomy is temporarily closed or covered to prevent spillage, and the prosthesis is introduced at a site distant from it. The

patch can be cut to the approximate size of the bowel before insertion. The prosthetic size should be made larger than usual to provide an extensive surface area to distribute the intra-abdominal pressure and to allow placement of sutures at sites more distant than in the repair of "clean" hernia defects. Once the patch is in the abdomen, it is secured in a manner similar to that used in the standard operation. The part of the patch lying immediately adjacent to the bowel must be secured to the organ with sutures. Either a running suture or several interrupted sutures can be used. These must be placed carefully, without gaps between the patch and the bowel.

<b>Table 1.</b> Characteristics of Initial 100 Patients.
Recurrent hernias – 18
Incarceration – 14
Additional procedures – 16
Cholecystectomy (2);
Enterotomy repair (1);
Other hernia repairs (10)
Conversion to open laparotomy – 4
Average defect size – 155 cm
Average patch size – 215 cm

Many patients who present for laparoscopic incisional hernia repair also require surgical treatment of cholelithiasis, inguinal hernia, or gastroesophageal reflux disease, or need a biopsy of an intra-abdominal organ. In such patients, the primary procedure generally is not the incisional hernia repair. If the primary operation is accomplished without any contamination of the abdominal cavity by intestinal contents, the hernia repair can then be performed. If contamination occurs, the hernia repair is either not done at all at that point or is done as an open repair without insertion of a prosthetic material. Preoperative discussions with the patient will determine which option is chosen, but it is preferable for the patient to recover from the primary procedure and subsequently undergo laparoscopic incisional hernia repair using a prosthesis. In cases in which the hernia repair can be done at the same time as the primary procedure, placement of additional trocars may be necessary. These should be put in the locations most appropriate for the herniorrhaphy: one should not avoid using more trocars

if doing so would result in a perilously difficult operation. On the other hand, the primary operation should not be compromised by an overemphasis on consideration of trocar placement for the hernia repair.

## RESULTS

The follow-up of our initial 100 patients has recently been completed, with an average time period of 51 months. Ninety percent of these hernias were incisional hernias, of which 80 were in the midline of the abdomen. Additional data is provided in **Table 1**.

The recurrence rate in this group of patients was 9.3%. In each of these cases, no sutures were used. In five, it appeared that the prosthetic material used was inadequately sized. The recurrence rate for the use of either staples or tacks alone was 13%. With the additional use of sutures, there were no recurrences. The historical data that has been attained has provided for the discussion of the operative procedure that is within this article.

## CONCLUSION

Laparoscopic repair of incisional hernias of the abdominal wall is gaining in popularity because, in many respects, it is superior to open repair.<sup>8,13</sup> Surgeons who perform this advanced operation must have a thorough understanding of factors to be considered when assessing specific patients for the repair and the equipment and techniques required to facilitate the procedure. The surgeon should be able to achieve a good outcome, with appropriate patient physiologic responses to the operation. Proper follow-up monitoring is necessary to assure that the long-term results are satisfactory.

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