

# Extraperitoneal Laparoscopic Hernia Repair: Experience In 178 Patients

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**T**he evolution of a preferred technique for laparoscopic inguinal hernia repair has been occurring over the past several years. The early work of Ger<sup>1,2</sup> involved a stapled closure of the dilated internal ring using a specialized 12-mm. instrument, which combined the functions of tissue approximation and stapling. This was followed by a prosthetic mesh plug technique of Schultz<sup>3</sup> and Corbitt,<sup>4</sup> which consisted of a free mesh plug occlusion of the inguinal canal, combined with prosthetic patch coverage of the hernia defect.

Early recurrences experienced with unsecured mesh plug repairs prevented these techniques from being adopted by other surgeons. Other investigators employed a mesh onlay placed directly on the peritoneum, overlying the hernia defect, with stapled fixation of the

mesh to prevent its migration.<sup>5,6</sup> Mesh onlay repair has been conducted with and without dissection and ligation of the indirect sac. The mesh onlay approach was also subject to early hernia recurrence and a significant incidence of postoperative neuralgia;

furthermore, surgeons were concerned with the potential for postoperative adhesion formation and subsequent bowel obstruction associated with an exposed intraperitoneal prosthetic mesh.

Wider application of laparoscopic herniorrhaphy has occurred with the adoption of the transabdominal preperitoneal repair.<sup>7</sup> The preperitoneal space is dissected through a transabdominal incision in the peritoneum overlying the hernia defect, and the mesh stapled to the undersurface of the abdominal wall within this space. This repair significantly improves the earlier laparoscopic approaches by coupling the concept of tension-free hernia repair with a more anatomic placement of the mesh patch. The mesh is forced against the undersurface of the abdominal wall and inguinal canal and held in place by intra-abdominal pressure.

The transabdominal preperitoneal approach is presently the most popular form of laparoscopic hernia repair. However, its application remains a controversial topic within the general surgical community. The advantages to this repair cited by surgeons include reduced recovery time, no limitations to postoperative physical activity, decreased postoperative pain, and patient demand. These advantages are offset, when compared to a traditional hernia repair done under local anesthesia, by increased cost, a requirement for general anesthesia, and the potential of injury to intra-abdominal organs.

However, the major objection to transperitoneal laparoscopic hernia repair that remains is the risk of postoperative small bowel obstruction due to adhesions or herniation through an incompletely closed peritoneal defect. Converting a traditional hernia repair to an intraperitoneal operation has been difficult for many surgeons to justify or accept.

Total preperitoneal laparoscopic hernia repair addresses the above-mentioned criticisms associated with the transabdominal laparoscopic approach, while preserving the anatomic and mechanical advantages that preperitoneal placement of the mesh provides. The peritoneum is not violated, and the abdomen is not entered with the totally extraperitoneal approach. This removes the potential for injury to intra-abdominal organs during the course of the operation, and guards against the development of postoperative adhesions or the herniation of small bowel through a peritoneal defect.

In total preperitoneal hernia repair, a working laparoscopic cavity is formed in the space immediately above the peritoneum, with all the surgical dissection and placement and anchoring of the mesh performed within this cavity. Closure of a peritoneal defect is unnecessary in the extraperitoneal approach, since the integrity of the peritoneum has been maintained.

This paper is a summary of personal experience with total preperitoneal laparoscopic hernia repair in 178

patients. These procedures were performed between March, 1992, and May, 1994. In addition, the primary author gained an early experience with the transabdominal preperitoneal approach in 10 patients between September and December, 1991. While this early experience facilitated the transition to a totally preperitoneal approach, the transabdominal repair was abandoned at the beginning of 1992, because of the potential disadvantages associated with this operation. A description of the author's (BNG) technique will be followed by a discussion of the results and the perspective gained during the early learning curve and subsequent development of a standardized surgical technique.

## TECHNIQUE

The vast majority of patients (186 of 188) underwent hernia repair under general anesthesia. A Foley catheter was inserted only in the first few cases, due to the lengthy operating time associated with the early learning curve. Perioperative antibiotics were administered, usually an intravenous cephalosporin. The preperitoneal space was developed manually by blunt dissection in the first 24 patients. Subsequent to this, however, the preperitoneal space was dissected under direct vision using a balloon cannula (Origin MedSystems, Inc.)

The procedure begins with a 15-mm. curvilinear incision at the inferior border of the umbilicus. The anterior surface of the rectus sheath is exposed just off the midline and incised transversely for a length of 13 mm. The underlying rectus muscle is retracted laterally to expose the posterior rectus sheath. An index finger is then inserted into the incision and directed inferiorly, initiating a tunnel of dissection behind the rectus muscle on top of the posterior rectus sheath.

The balloon cannula is then advanced through this tunnel to the symphysis pubis with a slight twisting motion (Figure 1). Care is taken to keep the balloon cannula parallel to the plane of the abdominal wall; directing the cannula upwards, toward the abdominal wall, will embed the cannula into the rectus muscle. This will tend to displace the inferior epigastric vessels inferiorly off the rectus muscle. Forcing the cannula posteriorly may cause it to puncture the posterior sheath and the peritoneum, resulting in intraperitoneal placement of the dissection balloon.

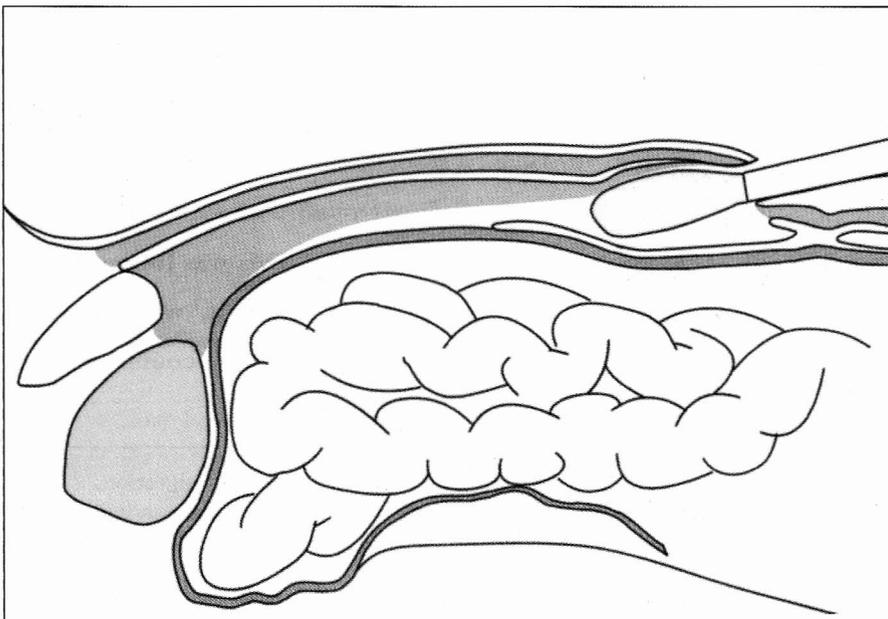


Figure 1. Following incision and finger dissection of the rectus muscle down to the level of the posterior rectus sheath, the balloon dissection cannula is inserted and advanced towards the pubic symphysis.

For unilateral hernia repair the balloon dissection cannula is advanced down to the involved side. For bilateral hernia repair the cannula is positioned in the midline. The tip of the cannula may be palpated to determine its correct location at the pubic symphysis. Following insertion of the balloon cannula, the blunt obturator is removed and replaced with a 10-mm. laparoscope. Endoscopic visualization of yellow, fatty material outside the transparent balloon verifies correct positioning of the cannula in the preperitoneal space. A reddish appearance indicates that the tip of the cannula is embedded into the rectus muscle, and the cannula should be withdrawn from the incision and redirected into the proper plane. If the cannula has punctured through the peritoneum, bowel will be observed by the endoscope. If this occurs, the balloon can be deflated and the cannula removed, the incision in the anterior rectus sheath closed, and the entire procedure repeated through the opposite rectus sheath.

The balloon is inflated using a squeeze bulb, while the progress of the dissection is monitored laparoscopically (Figure 2). Balloon inflation is continued until identifying landmarks become visible. The pubic symphysis can be found in the midline, and the white arc of Cooper's ligament extends bilaterally from this point in an inferior and lateral direction. The balloon dissection should continue until Cooper's ligament has been clearly identified. The inflated balloon is left in place for two minutes to taponade any minute bleeding sites visible through the endoscope, following which the balloon is deflated, the cannula removed, and a blunt-tipped cannula (Origin MedSystems, Inc.) is inserted into the periumbilical incision. The extraperitoneal space is then inflated to a pressure of 14 mm. of Hg (Figure 3).

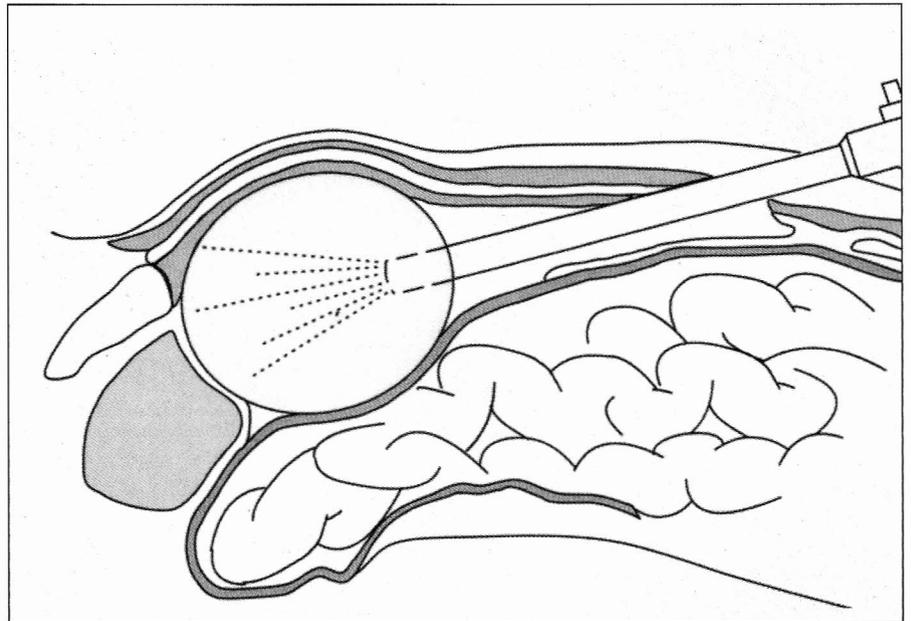
The surgeon stands on the side opposite the hernia, and the patient is rolled toward the surgeon. A 30-degree-angled, 10-mm. laparoscope is inserted into the preperitoneal space through the umbilical incision, and two additional instrument ports are then inserted in the midline, a 5-mm. suprapubic port placed immediately above the pubic symphysis, and a 10-mm. port placed halfway between the symphysis pubis and the umbilicus. Midline port placement permits two-handed dissection

and facilitates bilateral repairs, but working ports may be placed off the midline if the surgeon prefers.

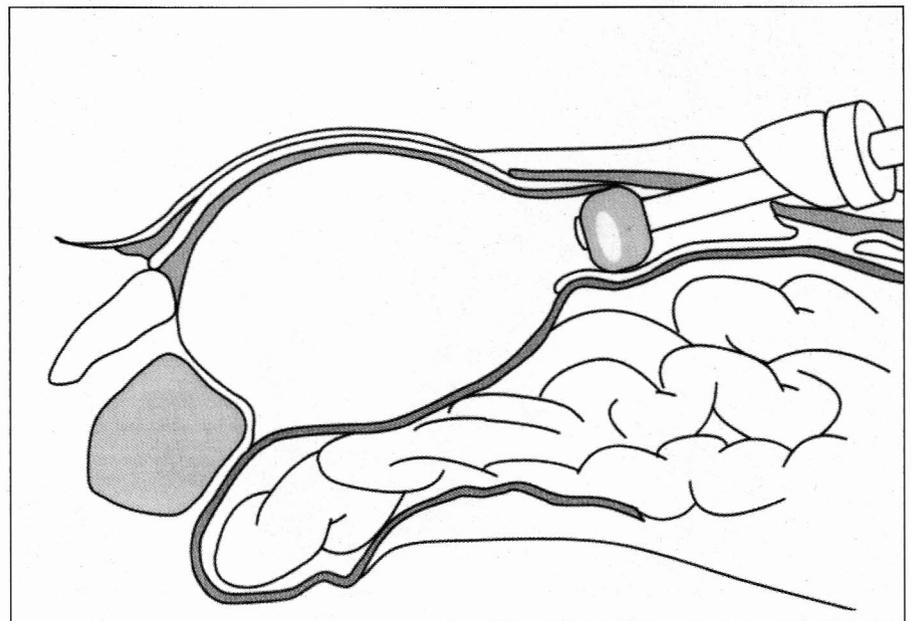
Dissection is initiated in the midline, and using laparoscopic graspers and liberal use of electrocautery, the preperitoneal tissue is removed first from Cooper's ligament (Figure 4). The dissection of Cooper's ligament is carried laterally to identify the iliac vein. Returning medially, the preperitoneal fat is then cleared from the undersurface of the abdominal wall, the transverse abdominal arch, and the iliopubic tract, extending from the pubic tuber-

cle laterally to the inferior epigastric vessels. If a direct hernia or femoral hernia is present, it is reduced into the preperitoneal space with the use of graspers. Generally, the herniated structure is simply preperitoneal fat; although occasionally, bowel is included in the hernia defect and needs to be carefully reduced.

The plane is then developed between the transversalis fascia and the undersurface of the abdominal wall above and the peritoneum below. This plane is most easily entered immediately lateral to the inferior epigastric vessels directly



**Figure 2.** The dissection balloon is inflated with the laparoscope in place within the cannula. The peritoneum is displaced by the balloon to allow visualization of the dissected preperitoneal cavity.



**Figure 3.** A blunt tipped cannula is used to seal the incision tract and allow gas insufflation into the preperitoneal space. Additional working ports may be introduced into the extraperitoneal working cavity.

underneath the abdominal wall, and is dissected using the closed jaws of two laparoscopic graspers. The graspers are levered in an anterior-posterior direction to separate the peritoneum from the abdominal wall. If an indirect hernia sac is present, it will be displaced downward during this dissection, along with the cord structures, until the iliopubic tract is encountered lateral to the internal ring and inferior epigastric vessels.

During this dissection, it is important not to pick up or grasp tissues lateral to the epigastric vessels and inferior to the iliopubic tract. This will

prevent inadvertent injury to the genitofemoral nerve or lateral femoral cutaneous nerve, both of which are located in this area. The cord is then separated from the underlying iliac vessels and skeletonized. Graspers are used to elevate the cord anteriorly, and the plane between the cord and the iliac vein is then developed at the internal ring.

The hernia sac, if one is present, lies along the anteromedial aspect of the cord structures. The testicular vessels will be found posterior and lateral to the sac and the vas deferens lies along the medial edge of the sac and arches over

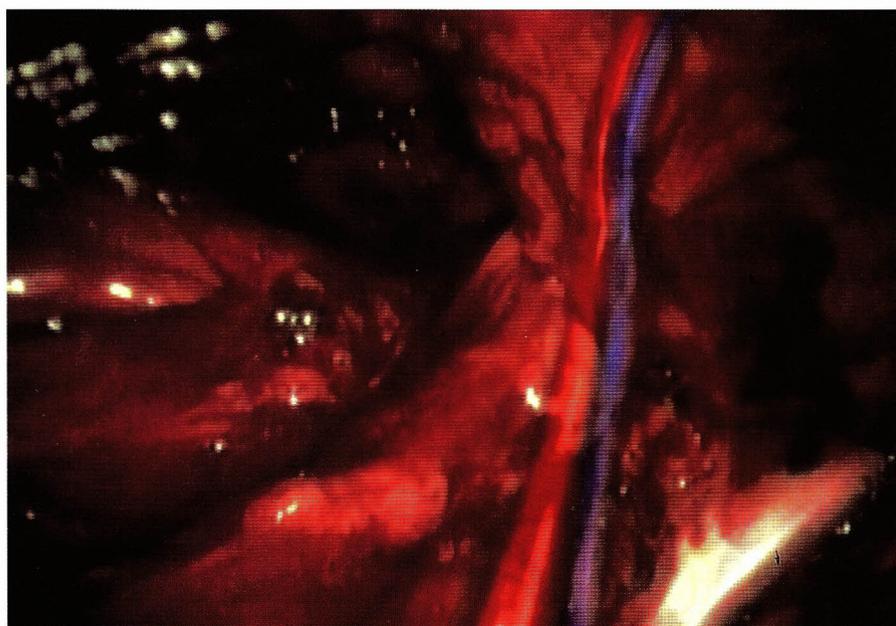
the iliac vein and Cooper's ligament to disappear into the pelvis medially. The hernia sac is then dissected from the testicular vessels and vas deferens by picking up the sac with graspers and pulling it in a direction perpendicular to the long axis of the cord.

The first grasper is used to elevate the sac anteriorly, and the second grasper used to peel off tissues adherent to the sac and displace that tissue posteriorly. The graspers are then applied in a stepwise fashion to the sac as the dissection proceeds, one grasper elevating the previously dissected sac anteriorly and the other grasper stripping away adherent tissue from the sac. This technique results in the sac being rotated and twisted off of the cord structures as the dissection of the sac from the cord progresses. This technique results in a complete separation of the sac from the cord and ensures that an occult hernia sac does not remain postoperatively.

If the sac is small it can be completely dissected from the groin in this fashion and returned to the preperitoneal space. The sac can be left in this location or occluded with an endoloop and amputated, depending on the surgeon's preference. If the sac is large, it can be ligated in continuity with a free suture, divided distal to the suture, and the distal segment left undisturbed in the groin. Alternatively, the neck can be divided at the internal ring, and the open abdominal end of the sac closed with a pre-tied endoloop. This has the disadvantage of allowing insufflation of the peritoneal cavity and can compromise exposure. It also creates a violation of the peritoneum which can be avoided completely by discontinuity ligation of the sac.

A 4-inch-by-6-inch piece of mesh is then used for the repair. It is important that a sufficient preperitoneal space has been dissected to accommodate the mesh without restriction, particularly lateral to the internal ring and inferior to the iliopubic tract on top of the iliopsoas muscle. If this is not done positioning of the mesh can be difficult, and the mesh will not lie flat against the undersurface of the abdominal wall and inguinal canal.

The mesh should be large enough to extend approximately 4 cm. lateral to the internal ring, and the medial and inferior corner of the mesh can be trimmed in a curve to follow Cooper's ligament. After laying the mesh on top of the cord, it is stapled first to



**Figure 4.** The anatomy of the left inguinal preperitoneal region is illustrated. Cooper's ligament is highlighted in white, the origin of the epigastric vessels from the iliac artery and vein are demonstrated in red and blue, and the internal inguinal ring is encircled in blue.

Cooper's ligament, fixing the inferior and medial corner of the mesh in place. The mesh is then stapled to Cooper's ligament up to the iliac vein. There is commonly an accessory obturator vessel arching over the top of Cooper's ligament just medial to the iliac vein, and care should be taken not to place staples through this vessel if it is present.

The periphery of the mesh is then stapled to the undersurface of the abdominal wall, medially from the pubic tubercle along the transverse abdominal arch, up to the inferior epigastric vessels. Staples are then applied lateral to the inferior epigastric vessels, fixing the mesh to the transversalis fascia down to, but not below, the iliopubic tract. At least 2 centimeters of the mesh should lie medial and superior to the edge of the defect if a direct hernia is present. If the direct defect is large, a more secure repair can be obtained by placing a second piece of mesh over the first piece, orienting it transversely, and stapling it to Cooper's ligament below and the undersurface of the abdominal wall above. The unstapled inferior and lateral edge of the mesh overlying the iliac vessels and the iliopsoas muscle is placed to make certain that it extends underneath the dissected peritoneal envelope. The preperitoneal gas is then released under direct endoscopic vision while a grasper is used to hold the unstapled edge of the mesh underneath the peritoneal envelope. The patient's testicles are pulled down into the scrotum, and the scrotum compressed to squeeze any remaining gas into the preperitoneal space, minimizing postoperative discomfort and scrotal swelling. The fascia of the two 10-mm. port sites is then sutured closed, and the three incisions closed with subcuticular absorbable sutures.

## RESULTS

A total of 223 hernias were repaired laparoscopically in 188 patients, between September, 1991, and May, 1994 (Table 1). The first 10 patients underwent a transabdominal preperitoneal repair. The potential for intra-abdominal complications associated with violating the peritoneal cavity led the primary author to abandon this approach in early 1992, and adopt a total extraperitoneal repair. This approach was used in the remaining 178 patients between March, 1992, and May, 1994. 115 were indirect, 104 of these hernias were direct, 35 were

bilateral, and 4 were femoral. There were 28 recurrent hernias, one of which was a fourth-time recurrence, and the patients ranged from 21 to 83 years in age with a mean of 57 years.

The male-to-female ratio was 166 to 22. Three patients had the laparoscopic approach converted to an open procedure. Two of these patients had incarcerated hernias, in which laparoscopic reduction appeared unwise. A third patient with a large sliding hernia underwent conversion to an open repair due to concomitant morbid obesity and failure to make significant progress during the laparoscopic approach. All but two of the procedures were performed under general anesthesia; two patients received epidural anesthetics with the liberal use of intravenous sedation.

Follow-up of the first 100 patients is one year or greater. The remaining patients have been followed for less than one year. These patients are routinely being recalled for reexamination every six months, and to date, one hernia has recurred. This patient was the eighth total preperitoneal laparoscopic repair in this series. The mesh was split superiorly in this patient and wrapped underneath the cord, but otherwise there were no distinguishing features associated with this operation.

The most frequent complication experienced in this series was the formation of a seroma in the inguinal canal. This occurred in 12 patients (7 percent). Transient paresthesias in the thigh occurred in 3 patients, and a

retroperitoneal hematoma developed in one patient.

## DISCUSSION

This series illustrates one surgeon's experience with and perspective on laparoscopic herniorrhaphy. The first ten procedures were performed using a transabdominal preperitoneal approach. This experience certainly facilitated the development of a good understanding of retroperitoneal anatomy and dissection techniques, but was purposefully abandoned because of the potential complications associated with this approach.

Early in the experience, reservations remained regarding the overall benefit of laparoscopic hernia repair when compared to traditional open procedures performed in the office or outpatient setting. In addition, the large peritoneal incision required for a transperitoneal repair was a major concern to the primary author since this peritoneal violation does not occur with a traditional herniorrhaphy.

The total extraperitoneal approach theoretically offers the benefits of a laparoscopic hernia repair, but should avoid both the potential for postoperative adhesion formation in the area of the peritoneal incision associated with the transabdominal approach as well as the port site hernias which are being reported with increasing frequency. Our data would seem to support this contention in that no postoperative

### Laparoscopic Herniorrhaphy Series Summary

Study Period	September 1991 - May 1994	
Patient Distribution	166 male	22 female
Patient Age	57 average	21 - 83 range
Surgical Approach	178 extraperitoneal	10 transabdominal
Hernia Types	115 indirect	104 direct
	35 bilateral	4 femoral
Anesthesia	186 general	2 epidural + IV sedation
Recurrences	One	
Complications	12 seromas	3 nerve injuries
	1 retroperitoneal hematoma	

Table 1.

small bowel obstructions have developed in any of these patients, nor have any required laparotomy to deal with a postoperative complication.

There is however a significant learning curve associated with initially performing total preperitoneal laparoscopic herniorrhaphy. More dissection is required to bring familiar landmarks into view, making the anatomy more difficult for the inexperienced surgeon to understand. Isolation of the hernia sac is much more difficult, and this operation cannot be done without two-handed dissecting techniques. However, once these obstacles are overcome, an uncomplicated repair can easily be accomplished within 30 to 45 minutes.

Early in this series, the use of total extraperitoneal laparoscopic hernia repair was reserved for patients with recurrent or bilateral hernias. Patients in these two categories have compelling indications for laparoscopic repair, and in our hands this operation has now become the procedure of choice in this group of patients. The extraperitoneal space is generally undisturbed in patients undergoing traditional hernia repair, and can be used to avoid most of the scar tissue associated with repairing a recurrent hernia. This approach also allows placement of the mesh in the preperitoneal space. This should result in a more physiologic repair and one that is mechanically more sound, since increased intra-abdominal pressure will tend to stabilize the repair by pushing the prosthetic mesh against the undersurface of the abdominal wall.

This approach is ideal for patients with bilateral hernias. It is easy to extend the preperitoneal dissection to include both sides, and bilateral repairs can be done without additional incisions and with little, if any, in the way of increased postoperative discomfort or prolongation of recovery. This is in marked contrast to the patient undergoing bilateral open traditional inguinal hernia repair.

Typically patients undergoing this type of hernia repair have 24 to 48 hours of significant pain requiring oral narcotics, but by the third postoperative day most patients are off all prescription pain medication, having little incisional discomfort, and are able to resume unrestricted physical activity within seven to ten days. We have placed no

specific restrictions on these patients postoperatively, letting the patients' individual response to pain guide their degree of physical activity. Three patients required an overnight stay, two related to delayed recovery from anesthesia and one for postoperative pain control.

We have paid particular attention to those 28 patients who underwent laparoscopic repair of recurrent hernias and to those patients who underwent laparoscopic repair on one side who had previously had a traditional open repair on the other. When patients in these two groups compare their experience with laparoscopic hernia repair on one hand with the open traditional repair on the other, the benefits of the laparoscopic approach become very clear in almost every patient.

It is our experience with these two groups of patients that led us to adopt laparoscopic hernia repair as the treatment of choice for routine herniorrhaphy. This series has avoided the complications associated with violation of the peritoneal cavity inherent in the transabdominal laparoscopic repair and lends support to selecting the total extraperitoneal laparoscopic hernia repair as the approach of choice. The laparoscopic preperitoneal buttress repair is relatively new and follow-up data, of necessity, very brief. To date there has been one early recurrence in 225 repairs, but continued follow-up is certainly necessary and will determine the durability of this operation.

There were few complications in this study group, and fortunately all resolved with conservative treatment over time. The most common complication was the development of a seroma in the inguinal canal. These all resolved over time with either expectant therapy or needle aspiration. The incidence of seroma in this series may well be related to the extent of dissection of the cord from the hernia sac and the underlying iliac vessels. The three patients experiencing postoperative neuralgias were operated early in the series; their symptoms were transient and resolved over four to six weeks of observation, and this complication has not occurred since a clear understanding of the relationship of the genitofemoral and lateral femoral cutaneous nerves to the iliopubic tract

has been clearly understood. The mesh is no longer stapled to the iliopsoas muscle lateral to the internal ring and inferior to the iliopubic tract, and blunt tissue dissection with two closed laparoscopic graspers is emphasized in this area to minimize the opportunity of nerve injury.

The preperitoneal approach offers the potential for laparoscopic hernia repair under regional anesthesia since intraperitoneal insufflation is unnecessary. Sufficient carbon dioxide, however, frequently escapes into the abdominal cavity during dissection of the hernia sac to cause significant patient discomfort, and intravenous sedation was required in the two patients in this series undergoing operation under regional anesthesia. This operation should be done under regional anesthesia only after the surgeon gains substantial experience with this approach.

## SUMMARY

Experience over the past three years with laparoscopic herniorrhaphy has led to the adoption of this operation as the treatment of choice for routine inguinal hernia repair. This operation is particularly well-suited to patients with recurrent and bilateral inguinal hernias. The total extraperitoneal approach has theoretic advantages to the transperitoneal laparoscopic repair, and our data supports continued use of this approach as the preferred technique for laparoscopic hernia repair. **STI**

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