New Developments in Inguinal Hernia Repair

Release Date
September 1, 2009

Expiration Date
September 30, 2011

Needs Statement
Hernia repair tops the list of the most frequent general surgeries performed in the United States. An estimated 1 million abdominal hernia repairs are performed each year in this country; an estimated 75% of which are inguinal hernia repairs. Inguinal hernias occur in the groin region at a weakened area of the inguinal ring, the opening to the inguinal canal. The lifetime prevalence of inguinal hernias is between 10% and 15% for men and 2% for women. The landscape of hernia-repair techniques and prosthetics has expanded over the past 2 decades, and continues to evolve. Surgeons have a wide variety of open and laparoscopic techniques at their disposal. Ninety percent of procedures now use mesh prostheses (as opposed to primary tissue repair with sutures) and are performed on an outpatient basis. Currently, general surgeons face the challenge of mastering a hernia-repair technique that will serve successfully for most hernia operations, while also gaining familiarity with additional techniques for special circumstances. To that end, the surgeon must ensure the compatibility of both patient and technique and prosthetic and technique. At this time, no operative technique has emerged as the clear choice for all inguinal hernias. An exploration of the various surgical techniques in different clinical scenarios based on size, complexity, and severity of the inguinal hernia will benefit general surgeons.

Accreditation Statement(s)
This activity has been planned and implemented in accordance with the Essential Areas and policies of the Accreditation Council for Continuing Medical Education (ACCME) through the joint sponsorship of AKH Inc. and Applied Clinical Education. AKH Inc. is accredited by the ACCME to provide continuing medical education for physicians. AKH Inc. designates this educational activity for a maximum of 1.0 AMA PRA Category 1 Credit™. Physicians should only claim credit commensurate with the extent of their participation in the activity.

Learning Objectives
At the completion of this activity, participants should be able to:
1. Appraise benefits and risks of various open and laparoscopic techniques in inguinal hernia repair.
2. Delineate the advantages and disadvantages of the different prosthetic meshes (ie, light- vs heavy-weight, biologic) used in inguinal hernia repair.
3. Identify strategies to reduce procedural complications of inguinal hernia repair, especially chronic pain and recurrence.

Target Audience
This activity is intended for general surgeons involved in the surgical repair of inguinal hernias.

Conflict of Interest Statement
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Estimated Time of Completion
This activity should take approximately 60 minutes to complete.

Method of Participation
There are no fees for participating in and receiving credit for this activity. The participant should, in order, read the objectives and monograph and answer the multiple-choice post-test. Participation is available online at CMEZone.com (availability may be delayed from original print date). Enter the project number “IP0948” in the keyword field to directly access this activity and receive instantaneous participation. Or, complete the answer sheet with registration and evaluation on page 12 and mail to: AKH Inc., 320 Corporate Way, Suite 200, Orange Park, FL 32073; or fax to (904) 215-0534. Statements of participation will be mailed to participants. A score of at least 70% is required to successfully complete this program. One retake is allowed. The corrected answer sheet will be provided for comparison with course information. Credit is available through September 30, 2011.

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Joint Sponsorship Statement
Jointly sponsored by AKH Inc. and Applied Clinical Education.

Support Statement
This activity is made possible by an educational grant from Atrium Medical Corporation.
Introduction

By Brent D. Matthews, MD, FACS

Inguinal hernias account for 75% of abdominal wall hernias. Of every 100,000 general surgical procedures performed in the United Kingdom and in the United States, 10 and 28, respectively, involve inguinal herniorrhaphy.1 Techniques to repair inguinal hernias have evolved over the past 30 years from primary tissue repair to open, tension-free mesh-based repairs to minimally invasive approaches. Outcome studies have documented the long-term success rates of these procedures allowing surgeons to individualize treatment based on hernia characteristics, patient comorbidities and surgical history, and surgeon experience and/or expertise. It is the ubiquitous nature of inguinal hernias in a general surgeon’s clinical practice that underscores the importance of understanding open and laparoscopic inguinal herniorrhaphy techniques and specific mesh options.

As open and laparoscopic techniques to repair inguinal hernias have evolved, so too have specialty meshes with differing pore sizes, material densities, and inflammatory profiles. This program will review open and laparoscopic inguinal herniorrhaphy techniques, as well as the types of mesh and mesh systems available. Considerations that help determine which procedure and mesh type should be used will be discussed. Identification and management of complications will be reviewed.

References


Section I. Laparoscopic Inguinal Hernia Repair

By Kristi L. Harold, MD, FACS

Despite the low recurrence rates found with placement of a large prosthesis in the preperitoneal space and the use of modern techniques to perform a similar repair laparoscopically, less than 15% of all inguinal hernias are repaired laparoscopically in the United States. However, in many instances (recurrent hernia, bilateral hernias, etc), the laparoscopic approach is viewed as ideal and should be in the armamentarium of experienced general surgeons.

Techniques currently used for the laparoscopic repair of inguinal hernia were developed in the early 1990s and are based on the open repair method originally popularized by Stoppa.4 In 1991, Toy and Smoot reported an intra-abdominal onlay mesh technique. They affixed polytetrafluoroethylene to the peritoneum for coverage of the inguinal hernia defect. Hernia recurrence was inordinately high because surgeons were unable to see the important preperitoneal structures necessary for anchoring the mesh.5 Subsequently, several investigators described laparoscopic approaches that improved the identification of important preperitoneal structures. These techniques included trans-abdominal preperitoneal (TAPP) mesh placement and the totally extraperitoneal (TEP), minimally invasive approach, both of which offer a demonstrably lower risk of hernia recurrence.

Choice of Surgical Approach

The main difference between the TEP and TAPP approaches involves the methods used to access the preperitoneal space. In the TEP approach, a balloon is typically used to dissect the preperitoneal space. This lowers the risk for injury to intra-abdominal structures with the tradeoff of being higher cost for the instrumentation needed to perform the procedure. In the TAPP approach, the peritoneal cavity is traversed with the risk for rare but possible injury to its contents. The result, however, is an arguably better view of the anatomy and the ability to perform additional surgical procedures if needed.

TEP

In the TEP approach, the preperitoneal space is accessed via an infra-umbilical incision. The anterior rectus fascia is incised and the rectus muscle retracted laterally, allowing placement of a dissecting balloon in the preperitoneal space. After the balloon is inflated, it is removed and replaced with a 10-mm trocar. Two additional 5-mm trocars are placed in the midline between the infra-umbilical port and the pubic symphysis. Small direct hernia sacs may be completely reduced by the dissecting balloon. Indirect sacs are identified along the cord structures and bluntly dissected away from the cord. Cooper’s ligament is identified and cleared. A large (12 × 15-cm) synthetic mesh is placed in the preperitoneal space to cover any potential indirect, direct, or femoral hernia defects. The mesh is typically affixed to Cooper’s ligament with tacks, although some surgeons use glue and others advocate no fixation. Any holes in the peritoneum should be closed to prevent bowel entrapment. The trocars are removed and the incisions closed.6

The TAPP approach may not be possible in patients who have peritoneal scarring from previous lower abdominal surgery. During the TEP approach, if large tears in the peritoneum occur, conversion to a TAPP approach may be necessary.

TAPP

In the TAPP approach, the peritoneal cavity is entered via an incision at the umbilicus, where a 10-mm trocar is placed. Two 5-mm trocars are placed, one on each side of the abdomen, just lateral to the epigastric vessels. The medial umbilical ligament is grasped and the peritoneum is incised several centimeters above the hernia defect and carried in a horizontal line laterally toward the anterior superior iliac spine. The peritoneum is bluntly stripped down from the abdominal wall proceeding medially until Cooper’s ligament is identified. Typically, direct or femoral hernias are easily reduced. Indirect sacs are carefully dissected away from the cord structures. Large indirect sacs may be divided, leaving the distal end in place if it cannot be safely reduced. The peritoneum must be dissected back from the cord structures far enough to allow for placement of a large piece of mesh and for closure of the peritoneum over the mesh. A 12 × 15-cm synthetic mesh is placed in the preperitoneal space and secured to Cooper’s ligament with tacks or glue. The peritoneum is then closed back over the mesh, using tacks, glue, or sutures. Any holes in the peritoneum should be avoided to prevent mesh exposure to visceral or the possibility of bowel herniation and entrapment in the preperitoneal space.

Table 1. Commonly Used Methods for Inguinal Hernia Repair

<table>
<thead>
<tr>
<th>Name</th>
<th>Year*</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mesh-Free Approaches</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bassini</td>
<td>1890</td>
<td>Open anterior approach, fixation of the m. obliquus internus, m. transversus abdominus, and the fascia transversalis to the inguinal ligament</td>
</tr>
<tr>
<td>McVay Cooper Ligament Repair</td>
<td>1942</td>
<td>Open anterior approach, fixation of the m. obliquus internus, m. transversus abdominus, and the fascia transversalis to the Cooper’s ligament, if the caudal margin of the fascia transversalis is absent</td>
</tr>
<tr>
<td>Shouldice Operation</td>
<td>1945</td>
<td>Open anterior approach, doubling running suture of the fascia transversalis and doubling suture of the m. obliquus internus to the inguinal ligament</td>
</tr>
<tr>
<td><strong>Mesh-Based Approaches (Tension-Free)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rives</td>
<td>1965</td>
<td>Open posterior approach, trans-inguinal preperitoneal meshplasty</td>
</tr>
<tr>
<td>Stoppa</td>
<td>1968</td>
<td>Open posterior approach with mesh, bilateral hernias</td>
</tr>
<tr>
<td>Lichtenstein Procedure</td>
<td>1970</td>
<td>Open anterior approach with mesh, implantation of mesh behind the aponeurosis of the m. obliquus externus (onlay patch)</td>
</tr>
<tr>
<td>Wantz</td>
<td>1989</td>
<td>Open posterior approach with mesh; unilateral hernia</td>
</tr>
<tr>
<td>TAPP</td>
<td>1991</td>
<td>Laparoscopic posterior approach with mesh, transabdominal preperitoneal meshplasty</td>
</tr>
<tr>
<td>TEP</td>
<td>1991</td>
<td>Laparoscopic posterior approach, total extraperitoneal meshplasty</td>
</tr>
</tbody>
</table>

* Year first performed.

Outcomes

The VA Cooperative Study, a recent prospective, randomized controlled trial (RCT), compared laparoscopic inguinal hernia repair with open mesh repair and concluded the latter technique was superior. This may explain the low rate of adoption of laparoscopic repair.2 However, this conclusion was based on the higher rates of hernia recurrence and complications seen in the laparoscopic group (10% and 39%, respectively) compared with the open mesh group (4.9% and 33%, respectively). Many other large trials have failed to demonstrate a difference in the inguinal hernia recurrence rate in repairs using laparoscopic versus open mesh approaches, with reported recurrence rates for each closer to 3%.2,7 Systematic reviews of studies involving laparoscopic versus open repair of inguinal hernia have found that overall recurrence rates do not differ between the techniques and there is a trend toward less postoperative pain and earlier return to activity with the laparoscopic repair. However, the laparoscopic repair may have the risk for rare but more serious complications such as visceral and vascular injury.6 To date, only one RCT has compared TEP with TAPP. This study showed no differences in time to perform the procedure, rate of hematoma, hospital length of stay, return to activity, or recurrence. A review of nonrandomized studies suggests an increased number of port-site hernias and visceral injury with TAPP and an increased number of conversions to open surgery with TEP.

References

Section II. Open or Non-Laparoscopic Approaches

By Robert G. Fitzgibbons, MD, FACS

As noted previously, non-laparoscopic or open procedures remain the standard of care in the United States and worldwide. More than 70 named hernia approaches have been described in the literature; however, many are relatively minor modifications of other approaches. Indeed, several basic steps are common to all anterior conventional repairs, the most common of which are described in Table 1.1

Anterior, Nonprosthetic Approaches

The Marcy Procedure. In the simplest of these repairs, an indirect inguinal hernia sac is reduced and the internal ring tightened with 1 or 2 stitches medial to the cord. Although this technique is appropriate in the pediatric population, it is rarely used in adults.2

The Bassini Approach. In this procedure, reconstruction of the posterior wall is accomplished by suturing the transversalis fascia, the transversus abdominis muscle, and the internal oblique muscle (Bassini’s famous “triple layer”) to the inguinal ligament. A critical feature outlined in Bassini’s original description was division of the transversalis fascia in the floor of the inguinal canal for its full length to create the deepest component of his triple layer.3

The McVay Cooper Ligament Repair. Rather than suturing the medial elements to the inguinal ligament, in this procedure Cooper’s ligament is used medially with a single transition stitch that incorporates both Cooper’s ligament and the inguinal ligament medially to the femoral vein. The repair is then continued laterally as with the Bassini technique.4

Anterior, Prosthetic Approaches

The Lichtenstein Procedure. This is the most commonly performed inguinal herniorrhaphy. Because a prosthetic mesh is used to bridge the defect in the inguinal floor, it is not necessary to approximate tissues that are not naturally in apposition. A polypropylene or polyester mesh prosthesis, approximately 15 x 11 cm, is sutured to the anterior rectus sheath 2 cm medial to the public tubercle. This same suture is continued in a running fashion, approximating the edges of the posterior rectus abdominis muscle and the transversus abdominis muscle medially and the inguinal ligament laterally. Although the surgeons at the Shouldice Clinic in Canada report outstanding results with this technique, other surgeons rarely are as successful, unless they are trained at Shouldice.5

The Shouldice Operation. This technique is considered the gold standard for tissue repairs. Imbrication of the floor of the inguinal canal is accomplished with 4 lines of continuous sutures between the internal oblique and transversus abdominis muscle medially and the inguinal ligament laterally. Although the surgeons at the Shouldice Clinic in Canada report outstanding results with this technique, other surgeons rarely are as successful, unless they are trained at Shouldice.5

The Kugel and Ugahary have described preperitoneal repairs that access the space through a 3-4 cm incision just above the internal ring. The preperitoneal space is then developed bluntly. In the Kugel procedure, a specifically designed prosthesis is used to create a preperitoneal space. The prosthetic material is then secured to the posterior rectus sheath. The inferior epigastric vessels are preserved and the peritoneum is plicated, separating the ductus deferens from the spermatic vessels. A 12 x 16-cm piece of mesh is placed deep to the inferior epigastric vessels and secured with 3 single sutures to the pubis, Cooper’s ligament, and the poas muscle laterally.6

In a procedure popularized by Wanzot, Stoppa, and Rives principally for bilateral hernias—often referred to as the giant prosthetic reinforcement of the visceral sac—a lower midline, transverse, or Pfannenstiel incision can be used according to surgeon preference, allowing for entrance into the preperitoneal space.7

In the Read-Rives repair, a groin incision is made slightly lateral to the cord structures between the rectus abdominis, the internal oblique muscle, the transversus abdominis, and the posterior rectus sheath. The inferior epigastric vessels are preserved and the peritoneum is plicated, separating the ductus deferens from the spermatic vessels. A 12 x 16-cm piece of mesh is placed deep to the inferior epigastric vessels and secured with 3 single sutures to the pubis, Cooper’s ligament, and the poas muscle laterally.8

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The preperitoneal space is an ideal location for a prosthetic material. The utilization of a mesh in the preperitoneal space is considered a precursor to the mesh repairs.9

Combination Anterior and Preperitoneal Prosthetic Approaches

The theory behind this type of approach to repair of an inguinal hernia is that using both the anterior and preperitoneal space can result in the “best of both worlds.” A specifically designed dunnell-shaped prosthesis consisting of 2 flat pieces of polypropylene mesh connected by a cylinder of the same material is required. The anterior aspect of the prosthesis is fashioned over the Lichtenstein operation but then, through the hernia defect, the posterior space is bluntly dissected to accommodate the deep part of the bilayered prothesis. The procedure has proven effective in the hands of its proponents, but some question the rationale of violating both spaces when modern procedures in either space independently have achieved a recurrence rate of less than 1%.9

References


Section III. Synthetic Mesh for Inguinal Hernia Repair

By Michael J. Rosen MD, FACS

The use of synthetic mesh for both inguinal and ventral hernia repairs has gained nearly universal acceptance among surgeons. Modern mesh products were first introduced in 1958; today, the abundance of mesh products available makes it difficult for surgeons to understand the advantages, disadvantages, and indications for each of the available options. The lack of a clear, simplified classification system largely is based on the paucity of comparative data evaluating different synthetic products.

Modern synthetic mesh is typically composed of polypropylene, polypropylene, or expanded polytetrafluoroethylene (ePTFE). Mesh systems also differ based on pore size, prosthesis material weight, or water angle (ie, hydrophobic or hydrophilic). Each of these characteristics can elicit a different response from the patient and can result in variable rates of prosthetic shrinkage, encapsulation, inflammation, loss of abdominal wall compliance, visceral erosions, and infection. A multitude of animal studies have been published evaluating synthetic mesh products for abdominal wall reconstruction. Drawing any firm conclusions as to the superiority of one product over another is not possible, as authors use various models with little clarity as to the definitions of the outcomes measured.

Polyester Mesh

Over the years, a number of animal studies have confirmed minimal shrinkage and better tissue incorporation with the use of polyester mesh systems.1 Based on this data, polyester-based mesh was the prosthetic of choice for Shouldice.2 Today, polyester mesh is not used for inguinal hernia repair, published in 1998.3 However, some groups have reported high rates of infection and erosion with this mesh when placed in an anterior position.4 These issues led to the development of alternative materials for prosthetic meshes.

Polypropylene Meshes

Today, polypropylene-based meshes are the most commonly used prosthetics worldwide for the repair of inguinal hernia (Table 2). One of the benefits of polypropylene mesh is that it creates an intense inflammatory response within the hernial sac.5 However, this also can result in a scar plate forming around the mesh, producing a firm contracted mesh. Addressing this potential problem, manufacturers have reduced the density of the polypropylene filament that compose the mesh. With these new prosthetics, the age of “light-weight mesh” was initiated.6

High-density polypropylene meshes contain a large volume of base material (>90 g/m²). Medium-weight mesh typically contains approximately half of the polypropylene content of heavy-weight mesh and, as a result, has larger pores. Finally, light-weight mesh contains approximately one-third of the polypropylene found in heavy-weight mesh and has larger pores. These products often have an absorbable component of mesh woven into the polypropylene that provides initial structural stability to make handling easier during placement. It is important to point out that the cutoff points chosen to delineate light- and heavy-weight mesh are
actually arbitrary and have not been clearly linked to measurable differences in clinical outcomes.\(^{12}\)

For inguinal hernia repair, a mesh that is less dense with less tensile strength offers a theoretical advantage, particularly given the setting of the repair—the highly dynamic groin area. It is unclear whether the increased ingrowth and compliance observed with these newer light-weight meshes is the result of the actual weight of the material or of the larger pores created in the process of removing the bulk of the polypropylene.\(^{10}\) Welty and colleagues noted 58% of patients with heavy-weight meshes placed during incisional hernia repair complained of paresthesia, whereas only 4% of those with light-weight mesh had similar complaints.\(^{11}\) A large, prospective randomized trial of 165 patients undergoing incisional hernia repair with either light-weight or standard polypropylene or polyester mesh found no significant difference in postoperative pain at follow-up to 2 years after the procedure.\(^{12}\) There is some question as to the durability of light-weight mesh, however. The study authors found a higher rate of hernia recurrence when light-weight mesh systems were used (17%) rather than heavy-weight systems (7%; P=0.052); the difference was not significant, but is clinically relevant.

Several prospective randomized trials of light-versus heavy-weight mesh for inguinal hernia repair also have been reported, with follow-up ranging from 6 months to 3 years.\(^{11}\) Most of these studies report less pain and less foreign body sensation in patients in whom light-weight mesh was used; however, one study again noted a higher recurrence rate in the light-weight mesh group.\(^{13}\)

Based on these findings, the reduction in prosthetic material seems to reduce postoperative discomfort for most patients; whether the reduction in the strength of the prosthetic effects recurrence rates, particularly in larger direct hernias, or wide bridges of incisional hernias, remains unresolved at this time.

### PTFE Meshes

In certain circumstances—during a laparoscopic repair, for example—the peritoneum cannot be reapproximated to exclude the mesh, and the prosthetic is placed in an intraperitoneal position. This is typically referred to as an intraperitoneal onlay mesh repair. Synthetic meshes designed for intraperitoneal placement are engineered so that one side of the mesh promotes tissue ingrowth (parietal), while the other side is designed to resist adhesions (visceral).

The original mesh designed for intraperitoneal placement was ePTFE; it contains a visceral side (microporous) that promotes tissue ingrowth. This mesh has demonstrated minimal intraperitoneal adhesion formation; however, tissue ingrowth has been limited despite the macroporous side.\(^{11}\)

Dual-layered composite meshes initially combined the antiadhese properties of PTFE with the ability of polypropylene to promote ingrowth on the parietal surface. Newer composite meshes use an absorbable antiadhesive barrier; however, tissue ingrowth has been limited due to the macroporous side.\(^{11}\)

Table 2. Commonly Used Polypropylene and/or Composite Mesh Systems for Inguinal Hernia Repair

<table>
<thead>
<tr>
<th>Brand Name(s)</th>
<th>Vendor</th>
<th>Density of Polypropylene in Mesh</th>
<th>Average Pore Size</th>
<th>Implant Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surgipro (nonabsorbable)</td>
<td>Covidien</td>
<td>110 g/m²</td>
<td>&lt;1 mm</td>
<td>0.57 mm</td>
</tr>
<tr>
<td>Prolene (preshaped)</td>
<td>Ethicon</td>
<td>105 g/m²</td>
<td>1.1-1.6 mm</td>
<td>0.55 mm</td>
</tr>
<tr>
<td>Bard Mesh/Bard Soft Mesh/Martex/3DMax/Viselex</td>
<td>Davo/Bard</td>
<td>80-95 g/m²</td>
<td>0.1-0.8 mm</td>
<td>0.66-1.5 mm</td>
</tr>
<tr>
<td>C-Qur (OSFA-absorbable tissue coating)</td>
<td>Atrium</td>
<td>85 g/m²</td>
<td>0.8 mm</td>
<td>0.48 mm</td>
</tr>
<tr>
<td>ProLite (preshaped, self-forming plugs)</td>
<td>Atrium</td>
<td>85 g/m²</td>
<td>0.8 mm</td>
<td>0.48 mm</td>
</tr>
<tr>
<td>C-Qur Lite (OSFA-absorbable tissue coating; preshaped)</td>
<td>Atrium</td>
<td>50 g/m² on sizes ≤15 cm; 85 g/m² on sizes ≥15 cm</td>
<td>0.75 mm</td>
<td>0.41 mm</td>
</tr>
<tr>
<td>ProLite Ultra (preshaped, self-forming plugs)</td>
<td>Atrium</td>
<td>50 g/m²</td>
<td>0.75 mm</td>
<td>0.41 mm</td>
</tr>
<tr>
<td>Prolene Soft (preshaped)</td>
<td>Ethicon</td>
<td>45 g/m²</td>
<td>3.4 mm</td>
<td>0.41 mm</td>
</tr>
<tr>
<td>Ultrapro (partially absorbable)</td>
<td>Ethicon</td>
<td>28 g/m²</td>
<td>3.4 mm</td>
<td>0.5 mm</td>
</tr>
<tr>
<td>TiMesh (titanized surface)</td>
<td>GFE</td>
<td>16 g/m²</td>
<td>&lt;1 mm</td>
<td>0.2 mm</td>
</tr>
<tr>
<td>Gore-Tex DualMesh (2-surface design)</td>
<td>W.L. Gore</td>
<td>n/a (ePTFE)</td>
<td>0.005-0.03 mm</td>
<td>0.99-2.01 mm</td>
</tr>
</tbody>
</table>

By Andrew Kingsnorth, MD

Clinicians should consider 4 factors when assessing recovery from inguinal hernia surgery: wound complications, recovery time, postoperative pain (inguinodynia), and sexual dysfunction.\(^{1}\)

### Wound Complications

Based on a review of the present literature, the incidence of wound hematoma is low; however, the actual incidence is rarely documented in clinical studies. If bruising is mild, spontaneous resolution will occur; however, the occasional large hematomas will require surgical drainage.

There is insufficient evidence to support the routine use of antibiotic prophylaxis in inguinal hernia repair. Wound infection occurs in a low percentage of patients and its prevention is contentious.\(^{2}\) A systematic review comparing prophylactic antibiotics versus placebo in groin hernia surgery identified 6 randomized controlled trials suitable for meta-analysis. The incidence of infection was 3% in the placebo group and 1.5% in the antibiotic group, with no significant difference between the 2 groups (number needed to treat was 74). Mesh removal was very rare, occurring in only 2 to 3 patients per 1,000 treated, and the number of deep infections was also low (0.6% for patients treated with placebo and 0.3% for those receiving antibiotics).

### Recovery Time and Postoperative Pain

Studies have demonstrated that postoperative recovery following inguinal hernia repair is faster and postoperative pain is reduced when laparoscopic approaches are used, enabling patients to return to normal activities a few days earlier.\(^{3}\) In the longer term, this does not result in a lower incidence of chronic postoperative groin pain with laparoscopic repair.

Mesh and the type of mesh used to repair the hernia is according to a review of cumulative data, from 70% to 100%. Although some biologic grafts have proven to be at least fairly safe and effective, including small intestinal submucosa grafts and acellular human dermis grafts, further study is needed.\(^{12}\)

With the lack of a clear “best” mesh, surgeons should weigh their prosthetic choice based on the clinical situation, potential for bowel interaction, risk for infection, handling characteristics, and available products at their hospital.

### References

not a major causative factor for the development of severe postoperative pain.1 However, patients receiving a light-weight mesh for inguinal hernia repair have less sensation of a foreign body in the groin and may feel less discomfort on exertion and active physical exercise. One clinical trial has shown that the use of light-weight mesh is associated with increased recurrence rates.3 A single-surgeon randomized trial comparing 3 meshes of different weights (light-, middle-, and heavy-weight) showed no differences in the feeling of a foreign body, pain sensations, and postoperative comfort during both the early postoperative recovery period and up to 2 years following surgery.4

As originally described, the Lichtenstein procedure does not include ligation or excision of the hernia sac.5 A prospective randomized trial involving 500 patients has shown that there are more episodes of postoperative pain during the early recovery period (up to 7 days) in patients receiving ligation of the hernia sac versus no ligation (27% vs 10% at day 1 and 9% vs 3% at day 7). Therefore, there are benefits of omitting ligation of the inguinal hernia sac.7

**Chronic Inguinodynia**

Persistent postoperative pain that fails to resolve 3 months post-surgery is classified as chronic pain, which can lead to depression and the inability to work.6 Two large studies from Sweden have investigated the incidence of long-term pain following inguinal hernia repair.7,8 Mild to moderate pain can occur in about 30% of patients, whereas severe pain that interferes with activities of daily living such as walking, work, sleep, ability to socialize, and mood, and general enjoyment of life occurs in 3% to 6% of patients. The studies demonstrate that the risk for postoperative pain increases in younger patients, if the operation repaired a recurrent hernia, if an open repair technique is used, and/or if the patient has a history of preoperative pain. These studies concluded that pain that is at least partly disabling occurs more often than recurrence of hernia and the prevalence can be reduced by certain preventative measures, the most important being the perioperative handling of cutaneous nerves. With time, chronic groin pain (inguinodynia) will resolve, although it may take up to 10 years.9

Until recently, the classification of postherniorrhaphy pain syndromes had remained elusive. A recent study based on more than 2,000 repairs, identified 3 groups of patients with chronic inguinal pain: those with neuropathic pain as a result of inguinal nerve damage, those with nociceptive pain due to an array of diagnoses (including peristitis and recurrent), and those with a tender spermatic cord with or without a tight feeling in the lower abdomen.10

Because neuropathic pain is the most important cause of chronic pain following inguinal hernia repair, the preservation of cutaneous nerves currently is considered the most important factor in its prevention.11,12 A systematic review of 5 clinical trials found no difference in postoperative pain regardless of whether the nerve was preserved or divided and showed that outcomes improved when all 3 of the cutaneous nerves were identified.13

Nerve identification is not straightforward: An anatomical study on human cadavers demonstrated that the ilioinguinal nerve (running parallel with the spermatic cord) is absent in 27% of cadavers; the iliohypogastric nerve (which runs parallel with the internal oblique, perforating it 2.4-cm cranial to the internal ring and then perforating the external oblique 3.8-cm cranial to the external ring), is not visible along its whole length. The genital branch of the genitofemoral nerve enters the spermatic cord through the spermatic ring. Therefore, care should be taken when placing sutures in the internal oblique because they may damage an invisible part of the iliohypogastric nerve. The genitofemoral nerve can be assumed to be in the neurovascular bundle and thus safeguarded from damage.14

Because the effective repair of an inguinal hernia cannot always be undertaken with the reservation of the 3 cutaneous nerves, cutaneous nerve division is justifiable.15 A retrospective review demonstrated that with this approach all cutaneous nerves were preserved in 55% of cases and the ilioinguinal, genitofemoral, and iliohypogastric nerves were divided in 19%, 7%, and 8%, respectively. This approach resulted in a less than 2% incidence of postoperative pain.16 An effective management of postoperative inguinodynia requires a valid test to measure any improvements achieved with medical or surgical approaches. A systematic review revealed 23 studies that had used either a visual ana-log score or the Short Form-36 Health Survey (an analysis of health-related quality of life). Neither are customized for any improvements in medical or surgical care. As originally described, the Lichtenstein procedure does not include ligation or excision of the hernia sac.17 A prospective randomized trial involving 500 patients has shown that there are more episodes of postoperative pain during the early recovery period (up to 7 days) in patients receiving ligation of the hernia sac versus no ligation (27% vs 10% at day 1 and 9% vs 3% at day 7). Therefore, there are benefits of omitting ligation of the inguinal hernia sac.7

**Sexual Dysfunction**

Sexual dysfunction after inguinal hernorraphy is a significant clinical problem in only 3% of younger male patients.18 A small study involving 84 patients has suggested that excision of the ilioinguinal nerve can result in a lower incidence of postoperative sexual dysfunction.19

**The Impact of Anesthesia**

Local anesthesia is the method of choice for inguinal hernia repair, although it requires specific training.20 Using data from a randomized clinical trial involving 616 patients from 10 hospitals in Sweden, local anesthesia reduced operating time, postoperative pain, and micronctosis.21 The use of postoperative inguinal nerve blocks in elderly patients results in more frequent urologic complications, some requiring prostatectomy and an excess mortality within 30 days.22

**References**


**Conclusion**

By Brent D. Matthews, MD, FACS

Surgeons have many options from which to choose when performing inguinal hernia repair. The use of different anesthetic techniques, suture materials, and hernia repair techniques provides patients with many options. Some patients may prefer an open procedure, while others may be interested in minimally invasive repairs. These surgical techniques provide patients with the opportunity to choose the most appropriate technique for their needs.

The use of a wide variety of techniques provides patients with the opportunity to choose the most appropriate technique for their needs. The use of different techniques provides patients with the opportunity to choose the most appropriate technique for their needs. The use of different techniques provides patients with the opportunity to choose the most appropriate technique for their needs. The use of different techniques provides patients with the opportunity to choose the most appropriate technique for their needs. The use of different techniques provides patients with the opportunity to choose the most appropriate technique for their needs. The use of different techniques provides patients with the opportunity to choose the most appropriate technique for their needs. The use of different techniques provides patients with the opportunity to choose the most appropriate technique for their needs. The use of different techniques provides patients with the opportunity to choose the most appropriate technique for their needs. The use of different techniques provides patients with the opportunity to choose the most appropriate technique for their needs. The use of different techniques provides patients with the opportunity to choose the most appropriate technique for their needs. The use of different techniques provides patients with the opportunity to choose the most appropriate technique for their needs. The use of different techniques provides patients with the opportunity to choose the most appropriate technique for their needs. The use of different techniques provides patients with the opportunity to choose the most appropriate technique for their needs. The use of different techniques provides patients with the opportunity to choose the most appropriate technique for their needs. The use of different techniques provides patients with the opportunity to choose the most appropriate technique for their needs. The use of different techniques provides patients with the opportunity to choose the most appropriate technique for their needs. The use of different techniques provides patients with the opportunity to choose the most appropriate technique for their needs. The use of different techniques provides patients with the opportunity to choose the most appropriate technique for their needs. The use of different techniques provides patients with the opportunity to choose the most appropriate technique for their needs. The use of different techniques provides patients with the opportunity to choose the most appropriate technique for their needs. The use of different techniques provides patients with the opportunity to choose the most appropriate technique for their needs. The use of different techniques provides patients with the opportunity to choose the most appropriate technique for their needs. The use of different techniques provides patients with the opportunity to choose the most appropriate technique for their needs. The use of different techniques provides patients with the opportunity to choose the most appropriate technique for their needs. The use of different techniques provides patients with the opportunity to choose the most appropriate technique for their needs. The use of different techniques provides patients with the opportunity to choose the most appropriate technique for their needs. The use of different techniques provides patients with the opportunity to choose the most appropriate technique for their needs. The use of different techniques provides patients with the opportunity to choose the most appropriate technique for their needs. The use of different techniques provides patients with the opportunity to choose the most appropriate technique for their needs. The use of different techniques provides patients with the opportunity to choose the most appropriate technique for their needs. The use of different techniques provides patients with the opportunity to choose the most appropriate technique for their needs. The use of different techniques provides patients with the opportunity to choose the most appropriate technique for their needs. The use of different techniques provides patients with the opportunity to choose the most appropriate technique for their needs. The use of different techniques provides patients with the opportunity to choose the most appropriate technique for their needs. The use of different techniques provides patients with the opportunity to choose the most appropriate technique for their needs. The use of different techniques provides patients with the opportunity to choose the most appropriate technique for their needs.
CME Post-Test

Please choose the single-letter response that best answers the question or completes the sentence and enter your response into the post-test key on the evaluation form.

1. Which of the following steps is NOT typically part of the process in a totally extraperitoneal (TEP) approach to inguinal hernia repair?
   a. Two 5-mm trocars are placed in the midline between the infra-umbilical port and the pubic symphysis.
   b. The medial umbilical ligament is grasped and the peritoneum is incised several centimeters above the hernia defect.
   c. Indirect sacs are identified along the cord structures and bluntly dissected away from the cord.
   d. Cooper’s ligament is identified and cleared.

2. Which of the following steps is NOT typical of the process in a transabdominal preperitoneal (TAPP) approach to inguinal hernia repair?
   a. Two 5-mm trocars are placed, one on each side of the abdomen, just lateral to the epigastric vessels.
   b. The peritoneum is bluntly stripped down from the abdominal wall.
   c. The anterior rectus fascia is incised and the rectus muscle retracted laterally, allowing placement of a dissecting balloon in the preperitoneal space.
   d. Synthetic mesh (12 × 15-cm) is placed in the preperitoneal space and secured to Cooper’s ligament with tacks or glue.

3. TEP and TAPP procedures differ with regard to:
   a. the methods used to access the preperitoneal space.
   b. the time required to perform the procedure.
   c. the time required for the patient to return to normal activity following the procedure.
   d. the likelihood of hernia recurrence following the procedure.

4. In the _____ approach, reconstruction of the posterior wall is accomplished by suturing the transversalis fascia, the transversus abdominis muscle, and the internal oblique muscle to the inguinal ligament.
   a. Marcy
   b. Bassini
   c. Lichtenstein
   d. Shouldice

5. _____ is the most commonly performed inguinal herniorrhaphy.
   a. The Lichtenstein Procedure
   b. The Plug and Patch Procedure
   c. The Maloney Darn
   d. The Read-Rives Operation

6. High rates of infection and erosion have been associated with _____ mesh when it is implanted in an intraperitoneal position.
   a. polypropylene
   b. biologic
   c. polyester
   d. none of the above

7. Larger pore size is seen as a key benefit of _____.
   a. polyester mesh
   b. biologic mesh
   c. heavy-weight mesh
   d. light-weight mesh

8. A study by Welty and colleagues found that _____ of patients with heavy-weight meshes placed during incisional hernia repair complained of parasthesia: _____ of those with light-weight mesh had similar complaints.
   a. 58%; 4%
   b. 4%; 58%
   c. 17%; 4%
   d. 4%; 17%

9. When the peritoneum can not be reapproximated to exclude the mesh and the prosthetic is placed in an intraperitoneal position, this is called a _____ repair.
   a. Lichtenstein
   b. laparoscopic
   c. Shouldice
   d. intraperitoneal onlay mesh

10. Which of the following is NOT an independent risk factor for the development of chronic inguino-dynia following inguinal hernia repair.
    a. Patient age
    b. Patient history of smoking
    c. Patient history of preoperative pain
    d. Use of an open repair technique

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New Developments in Inguinal Hernia Repair

**New Development:**

- **Polyproplene**: A study by Welty and colleagues found a 58% incidence of parasthesia (P = 0.003) and a 17% rate of erosion (P = 0.007) with heavy-weight meshes placed during incisional hernia repair.

**Conclusion:**

- High rates of infection and erosion have been associated with polypropylene mesh when it is implanted in an intraperitoneal position.

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Evaluation Questions

Please answer the following questions by circling the appropriate rating.

4 = Strongly Agree  3 = Agree  2 = Disagree  1 = Strongly Disagree

1. After participating in this activity, I am better prepared to:
   a. Appraise the benefits and risks of various open and laparoscopic techniques in inguinal hernia repair.
   b. Delineate the advantages and disadvantages of the different prosthetic meshes (ie, light-vs heavy-weight, biologic) used in inguinal hernia repair.
   c. Identify strategies to reduce procedural complications of inguinal hernia repair, especially chronic pain and recurrence.
   d. The activity met my educational needs.
   e. The faculty were knowledgeable and effective in the presentation of content.
   f. The teaching methods and educational materials were effective.
   g. The learning activities were effective and incorporated active learning methods.
   h. The post-test accurately assessed learning.

2. The content was objective, current, scientifically based, and free of commercial bias.
   a. Yes  b. No (please explain): ________

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Post-Test Answer Section

Please circle the correct answer for each question. (A score of at least 70% is required to receive credit.)

1. a  b  c  d
2. a  b  c  d
3. a  b  c  d
4. a  b  c  d
5. a  b  c  d
6. a  b  c  d
7. a  b  c  d
8. a  b  c  d
9. a  b  c  d
10. a  b  c  d
11. Additional comments: ______

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**Post-Test Answer Section**

Please circle the correct answer for each question. (A score of at least 70% is required to receive credit.)

1. a  b  c  d
2. a  b  c  d
3. a  b  c  d
4. a  b  c  d
5. a  b  c  d
6. a  b  c  d
7. a  b  c  d
8. a  b  c  d
9. a  b  c  d
10. a  b  c  d
11. Additional comments: ______