In 1960, Ravitch and Hitzrot [1] wrote the following in the preface of their book, *The Operations for Inguinal Hernia and a Current Recommendation*:

This work arose from a discussion of the hernia repair during surgical house staff rounds at the Baltimore City Hospitals. It was apparent then, as it had often been during the past, and with other house staffs, that there was no uniformity of opinion as to the proper attribution of the various steps in any given repair of groin hernias. Frequently, there was a strong divergence of opinion as to what was meant by a “Halsted” or “Bassini” or “Ferguson” repair. The position taken by participants in the discussion was more likely to be influenced by chauvinistic attitudes, derived from the locus of their basic surgical training, than by precise historical and surgical information.

Although the repairs of today carry different eponyms (Lichtenstein, Kugel), the techniques have similar objectives. As more repairs have been added to the armamentarium, there has arisen a “strong divergence of opinion” on the approach (laparoscopic or open) and the type of mesh prosthesis (patch, patch and plug, Kugel). Who would have imagined that the treatment of inguinal hernia would continue to be such a controversial topic in the twenty-first century. For many surgeons in the middle to late part of the last century, inguinal hernia repair was a common procedure learned early in one’s training, and there was a clear gold standard for repair (at least within an institution). In the last decade or so of the twentieth century, surgeons began repairing even primary inguinal hernias with mesh,
something that was viewed before this time as sacrilege or, perhaps, a com-
mentary on one’s technical abilities, anatomic knowledge, or lack thereof.

Fortunately, the widespread adoption of mesh for the primary repair of an
inguinal hernia was mostly driven by data suggesting that the rates of re-
currence were high without it, and that if the mesh was correctly placed, the
rates of recurrence seemed significantly less. As mesh for primary hernia re-
pair became the standard, laparoscopic techniques for inguinal hernia repair
were developed and refined.

Within this article, many aspects of open inguinal hernia repair and the
data available to guide the surgeon’s choice of technique are reviewed. In-
guinal hernias are a common condition, especially in men; therefore, the ma-
jority of the literature available includes either mostly or all men. At the end
of this article, the topic of groin hernias in women is briefly addressed. This
review does not include the treatment of hernias in children. Additionally,
although sometimes there is confusion, this article addresses inguinal and
not femoral hernias. Femoral hernias are frequently treated in a similar
fashion, but because of their higher rates of incarceration and strangulation
and the fact that several major studies have excluded them, they are not in-
cluded in this review. From here on, the term hernia when used without
qualifiers refers to an inguinal hernia.

In recent years the literature has exploded with case reports (usually of
bad outcomes), case series (usually of excellent outcomes), and randomized
trials (with intermediate but probably more generalizable outcomes) on the
subject of inguinal hernia repair using many different outcome measures. To
the extent possible, this review uses available data from randomized multi-
center trials because these most likely represent the practice of inguinal her-
nia treatment as experienced by most patients.

To fix or not to fix

Surgical textbooks have long advocated that the presence of an inguinal
hernia is sufficient indication to repair it. Until recently, no randomized data
existed to either support or refute this practice; however, within the last 2
years, two randomized trials have been published comparing watchful
waiting with open mesh repair of inguinal hernias. One trial was a five-
site multicenter study in the United States and Canada [2]; the other was
a randomized trial conducted in England [3]. As elaborated below the results
of these two trials are similar, the conclusions drawn by the investigators are
quite different.

Combining the observation arms of both the North American and British
trials yields nearly 400 men with at least 1.5 years of observation of their
minimally symptomatic hernias. Clearly, the rate of incarceration is less
than 1%, and it appears there is no increase in complications associated
with waiting until symptoms worsen to repair the hernia. The data do not
refute that the presence of an inguinal hernia is an indication for repair;
rather, they give reassurance to patients and their surgeons that watchful waiting is an acceptable alternative for minimally symptomatic inguinal hernias in men.

**Perioperative preparation and care**

*Prophylactic antibiotics*

Prior to the routine use of mesh, prophylactic antibiotics were rarely used because the rate of infection was low and the consequences of infection seemingly lower. Placement of a permanent prosthesis (eg, a prosthetic joint or heart valve) is frequently an indication for antibiotic prophylaxis, especially when the consequences of a surgical site infection are significant. Other considerations in the decision making for prophylactic antibiotics include whether the procedure is classified as clean or not, with clean low complexity procedures demonstrating minimal benefit from prophylactic antibiotics. Although inguinal hernia repair is classified as a clean procedure, a surgical site infection, in particular one that complicates a mesh repair, frequently requires removal of the mesh. Although the frequency of surgical site infection after groin hernia repair is low, most surgeons believe the use of prophylactic antibiotics is warranted. Only a few trials have addressed this question. In a Cochrane Database Systematic Review published in 2004 [4], eight randomized trials addressing the question of prophylactic antibiotics were identified. Only three of the eight used prosthetic mesh for the repair; the other five trials did not. There was no statistical difference in infection rates among the total patient population or the subpopulation of patients undergoing mesh repair. More recently, in a meta-analysis of 2507 patients from six randomized trials designed to assess the benefits of antibiotic prophylaxis in mesh repair of inguinal hernia published in 2007, the surgical site infection rate was 1.38% in those receiving antibiotics versus 2.89% in those not receiving antibiotics [5]. This difference translated into an odds ratio of 0.48 with a 95% CI, of 0.27 to 0.85. With the currently available data, administration of prophylactic antibiotics is recommended for mesh repair of inguinal hernias.

*Perioperative patient instructions*

Postoperative patient instructions should include warning signs of a complication such as a hematoma or wound infection, as well as a discussion of what can be expected regarding normal postoperative pain and activity. A frequently measured outcome in clinical trials comparing techniques of inguinal hernia repair is the time necessary for the patient to be able to return to work or normal activities; however, this return may be limited by other factors such as physician instructions to the patient and work situations. In the VA trial [6,7], both open and laparoscopic patients were given identical preoperative education and postoperative instructions. Patients were
informed preoperatively that “most patients return to normal activities within 2 weeks.” Postoperative instructions included no lifting restrictions and no activity restrictions. In an interesting double-blind study of the economic impact of hernia repair, Butler and colleagues [8] randomized patients to transabdominal preperitoneal polypropylene (TAPP), total extraperitoneal (TEP), or Lichtenstein repairs. The postoperative care team and the patients were blinded to the repair by a large dressing that covered the abdomen until postoperative day 3. The average number of lost work days was 12 and did not differ among the three groups. In the VA trial [7], the median time to return to normal activities was 4 days in the laparoscopic group and 5 days in the open group, a significant difference statistically, but the difference between the VA groups was small overall, especially considering that most trials have recorded a longer time period (akin to the findings of Butler and colleagues) for return to work. These larger differences may be attributable, in part, to patient expectations, work conditions (eg, the availability of workman’s compensation or sick leave), and physician postoperative instructions.

The anatomy of a hernia

Thorough knowledge of inguinal anatomy is a key to performing an adequate repair. Surgeons must understand the anatomy from front to back and back to front, literally. Perhaps one of the most creative ways to teach and learn the complex three-dimensional groin anatomy is using the inguinal hernia origami developed a decade ago by Mann [9]. With proper folding of the preprinted double-sided paper, the student can “dissect” through the layers and better understand in three dimensions the relationships of the structures in the groin. Any student struggling with the anatomy is directed to this creative learning tool.

To mesh or not to mesh

In a Cochrane Database System Review in 2001 of open mesh versus open non-mesh repair [10], the researchers concluded, “There is evidence that the use of open mesh repair is associated with a reduction in the risk of recurrence of between 50% and 75%. Although the trials were heterogeneous there is also some evidence of quicker return to work and of lower rates of persisting pain following mesh repair.” There was no evidence that there was a difference in the frequency of other postoperative complications including numbness, and the data were too limited to detect differential effects in patients with bilateral, femoral, or recurrent hernias. At that point in time, they also found two studies comparing flat mesh with plug and mesh and did not find any significant differences between the two techniques.
Another argument for routine placement of mesh in primary inguinal hernia repair comes from the Cochrane review of open versus laparoscopic inguinal hernia repairs published in 2003 [11]. The review included data from 41 trials including 7161 patients published before 2003 and concluded, “The review showed that laparoscopic repair takes longer and has a more serious complication rate with respect to visceral (especially bladder) and vascular injuries, but recovery is quicker with less persisting pain and numbness. Reduced hernia recurrence of around 30-50% was related to the use of mesh rather than the method of mesh placement.”

These two large systematic reviews provide ample evidence for the use of mesh in all adult male inguinal hernia repairs. The next question is what configuration of the mesh to use and by which approach.

**Techniques: open non-mesh and open mesh repairs**

When comparing techniques of hernia repair (tissue versus mesh, laparoscopic versus open), surgeons rely first on “surgeon-centered” outcomes such as recurrence, complications, and death (Table 1). For each of the surgeon-centered outcomes, the rates depend heavily on how closely and for how long the patients are followed, on how meticulously complications are searched for and documented, and on how hernia recurrences are determined. There are also “patient-centered” outcomes which, when all else is equal, may sway a surgeon (or a patient) toward or away from a particular technique. The argument to mesh or not to mesh in open repair has been addressed previously. Postoperative pain (in particular pain lasting beyond 3 months) has been recognized in the last 10 years as a significant side effect of hernia repair. Although the incidence appears to be lower with mesh repair than with non-mesh repair [10], it is still common enough that patients should be informed of this potential complication when consent for the procedure is obtained in the clinic. In most studies with long-term follow-up, the incidence of chronic pain is approximately 6% to 13%. The recognition of this problem has led to several studies evaluating techniques to manage the ilioinguinal and genitofemoral nerves at the time of repair. Several of these studies are reviewed in the following sections, followed by a discussion of the techniques for open non-mesh repairs and several of the mesh options that have been developed over the last few decades.

**Management of the nerves**

When studies about the incidence of chronic pain after inguinal hernia pegged the rate at a substantial 6% to 13%, surgeons began to evaluate management of the sensory nerves during hernia repair. Several studies have compared in a randomized fashion the outcomes of pain and numbness with routine sectioning of the ilioinguinal nerves versus leaving the nerves intact. Although one study found that a prophylactic ilioinguinal
<table>
<thead>
<tr>
<th>Repair</th>
<th>Type</th>
<th>Recurrence rate for primary repairs</th>
<th>Postoperative pain</th>
<th>Reported advantages/disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tissue repairs</td>
<td></td>
<td>May be as high as 17% at 10 years [14]</td>
<td>Many reports of pain higher than with mesh repairs</td>
<td>Need to understand groin anatomy for tissue repairs</td>
</tr>
<tr>
<td>Bassini</td>
<td>Conjoined tendon to inguinal ligament</td>
<td>5%-15%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>McVay</td>
<td>Conjoined tendon to Cooper’s ligament</td>
<td>5%-15%</td>
<td></td>
<td>Repairs sufficient for inguinal and femoral hernias</td>
</tr>
<tr>
<td>Shouldice [12–15]</td>
<td>Triple layer tissue repair</td>
<td>&lt;1%-7%</td>
<td>Chronic pain reported by as many as 20% of patients at 3 years</td>
<td>All mesh repairs are tension free</td>
</tr>
<tr>
<td>Mesh repairs [16]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lichtenstein [7,16,17]</td>
<td>Onlay patch</td>
<td>&lt;1%-5%</td>
<td></td>
<td>Easy technique to learn, long-term experience in most institutions</td>
</tr>
<tr>
<td>Kugel [17,18]</td>
<td>Preperitoneal patch with spring</td>
<td>4%</td>
<td></td>
<td>Reported low operative times (around 35 min in some reports)</td>
</tr>
<tr>
<td>PerFix plug [19,20]</td>
<td>Plug and patch</td>
<td>4%</td>
<td></td>
<td>Fast/mesh plug migration</td>
</tr>
<tr>
<td>Prolene Hernia System [21–26]</td>
<td>Preperitoneal and onlay</td>
<td>&lt;1%-3%</td>
<td></td>
<td>Fast (around 35 min in experienced hands) [21,24]</td>
</tr>
<tr>
<td>Stoppa [27]</td>
<td>Large preperitoneal mesh</td>
<td>&lt;1%</td>
<td></td>
<td>Supplies laparoscopic view, mesh placed behind abdominal wall</td>
</tr>
</tbody>
</table>
neurectomy was associated with less chronic groin pain and a similar frequency of numbness [28], another found the opposite and suggested that preservation of the nerves reduced chronic pain [29]. The most recent meta-analysis suggests that the nerves should probably be identified during open hernia repair. Division of and preservation of the ilioinguinal nerve show similar results [30]. Although it seems intuitive that a suture tied down on a nerve would cause pain, this has not been studied in any scientific manner (and probably never will be). Sometimes a clue to the etiology of pain is to evaluate effective methods of pain control. For postherniorrhaphy chronic groin pain, there is not yet a treatment of choice, although case series of triple neurectomy seem to demonstrate success with this technique [31].

Open non-mesh techniques

Although open mesh techniques are superior to non-mesh techniques, the non-mesh repairs are described in this section as they might be used in instances when mesh placement is contraindicated, such as with contamination. The choice of a non-mesh repair is dependant on the surgeon’s experience with a given technique as well as the quality of tissues available for the repair. When a pure tissue repair is not possible because of tension on the repair, a biologic graft such as acellular dermal matrix can also be considered.

Bassini repair

The Bassini repair [1] was developed in the late nineteenth century and was revolutionary at the time for low recurrence rates when compared with the previous standard of care procedures; however, recent studies comparing the Bassini repair and the closely related Shouldice repair show that the Shouldice repair is superior where recurrence rates are concerned. The Bassini repair involves exposing the preperitoneal fat by opening the transversalis fascia from the internal inguinal ring to the pubic tubercle, followed by reconstruction of the abdominal wall. This reconstruction is performed by suturing Bassini’s triple layer (includes the internal oblique, the transversus abdominus muscle, and the transversalis fascia) to the iliopubic tract/inguinal ligament with interrupted permanent sutures.

McVay’s repair

Hernia treatment via the McVay repair [1] is similar to the Bassini repair with the exception that the triple layer superiorly is approximated to Cooper’s ligament, not the inguinal ligament. This repair is composed of interrupted stitches that begin at the pubic tubercle and follow posteriorly along Cooper’s ligament, narrowing the femoral ring and obliterating the “empty” space between the inguinal ligament and Cooper’s ligament. A “transition” stitch is then placed to transition back up to the inguinal ligament at the level where the iliac vein crosses Cooper’s ligament to finish the repair.
A relaxing incision in the anterior rectus fascia is usually included as part of this repair. Although in past decades this repair was chosen by many surgeons as their gold standard, currently, the primary use of this repair technique is for femoral hernias in contaminated fields.

**Shouldice repair**

The Shouldice repair originated when E.E. Shouldice sought more efficiency in preventing World War II recruits from being rejected from the Army due to inguinal hernias [1]. Through this effort and that of his surgical hospital following the war, recurrence rates with this technique were reduced from 20% to below 2% between 1945 and 1953.

Dissection involves exposing the crura of the external ring following exploration to the level of the external oblique, followed by incision of the external oblique in the direction of its fibers and with care not to damage the ilioinguinal nerve which is found just beneath the external oblique. The spermatic cord is then mobilized followed by ligation of the cremasteric muscle for necessary exposure and visualization of the incisional area on the transversalis fascia. The spermatic cord is reflected laterally, and the transversalis fascia is split from the internal inguinal ring as far down as necessary. The transversalis can be trimmed at this point, followed by freeing this fascia from preperitoneal fat to expose the edge of the posterior internal oblique and transversalis fascia.

Repair of the defect by the Shouldice method involves use of continuous nonabsorbable suture allowing for even distribution of tension and preventing interruption sites which could result in recurrence. The first suture line begins at the pubic tubercle, tracking laterally and approximating the iliopubic tract and the medial flap (transversalis fascia, internal oblique muscle, transversus abdominus muscle). This line continues as far as and including the stump of the cremaster muscle and then is reversed without interruption to begin the second suture line which tracks medially and approximates the internal oblique and transversalis muscles to the inguinal ligament. The third suture line is begun with a new suture and starts close to the internal ring. This line approximates the external oblique aponeurosis to the medial flap and ends at the pubic crest. The last suture line is begun by reversing the third suture line and as a more superficial reinforcing line over the top of the third line (Fig. 1).

**Mesh repairs**

The mesh used for uncomplicated (that is noncontaminated) inguinal hernia repairs should be a permanent material generally made out of polypropylene or mersilene. In general, polytetrafluoroethylene prostheses have not been used routinely in open repairs. An important aspect of mesh hernia repair is to understand the characteristics of the mesh. When studied in animals and humans, most of the permanent meshes used for inguinal hernia repair undergo shrinkage of between 30% and 50% over time [32,33]. This
property makes it imperative to have mesh overlapping good fascia by at least 2 cm. In many laparoscopic hernia repair trials, using too small a piece of mesh has been associated with an increased risk of recurrence. The current size of mesh recommended for the Lichtenstein open repair is 3 by 6 in (7.5 by 15 cm).

As noted previously, in the situation of a contaminated field (eg, with strangulated bowel), if a primary tissue repair cannot be accomplished, a temporary mesh may be used (synthetic such as Vicryl or allogeneic such as Alloderm or Dermamatrix) with the assumption that there is a high likelihood of recurrence of the hernia as the temporary mesh is reabsorbed; however, by this time, the wound should have healed, and the case should once again be clean.

**Lichtenstein**

The Lichtenstein technique [34] of onlay mesh hernia repair was first popularized by Lichtenstein in 1984. The routine use of mesh, coined the “tension-free repair,” took some time (about 10 years) to be universally adopted for primary hernia repair. The technique has undergone modifications over the years and is relatively easy to describe and teach. For both the VA laparoscopic versus open trial and the American Watchful Waiting trial, the Lichtenstein technique as described in a video made in 1997 was used.
When local anesthetic was used in the trial, the authors recommended using the anesthetic technique of Lichtenstein as well. This practice results in a more uniformly anesthetized operative field independent of the operator when compared with other techniques including ilioinguinal nerve blocks. Both techniques are briefly described in the following section.

**Anesthetic technique.** After usual preparation and draping of the groin, 3 to 5 mL of local anesthetic (the authors used a 1:1 mixture of 1% lidocaine and 0.5% bupivacaine for the hernia trial) is infiltrated in the subcutaneous tissue along the planned incision site. Without withdrawing the needle from the skin, another 2 to 3 mL is used in the dermis to create a skin wheal along the planned incision. Starting just lateral to the lateral edge of the incision and at 2 cm intervals along the incision for a total of five injections, 2 mL of the mixture is injected below the external oblique fascia by directing the needle perpendicular to the skin and inserting until the “pop” of piercing the external oblique fascia is felt. The procedure then commences. Once the external oblique fascia is identified, another 8 to 10 mL of the mixture is injected laterally just beneath this fascia. A few milliliters may be infiltrated at the pubic tubercle, around the neck, and inside the indirect hernia sac.

**Repair method.** A 5-cm skin incision is made starting at the pubic tubercle and extending laterally along Langer’s lines. The external oblique aponeurosis is opened including the external ring. If an indirect hernia is found, after dissecting it from the other cord structures to at least the level of the internal ring, the sac is either inverted without division when possible or divided leaving the distal portion in situ and closing the proximal sac. If a direct hernia is identified, the sac is simply inverted using an absorbable purse-string suture.

A prosthesis measuring approximately $8 \times 16$ cm is used. The lower edge of the prosthesis is fixed using a continuous suture to Poupart’s ligament beginning medially and overlapping 2 cm onto the pubic tubercle and proceeding laterally along the ligament beyond the internal ring using three to four bites of 2.0 Prolene, ending just lateral to the internal ring. If a femoral defect is suspected, the inferior edge of the prosthesis is sutured to Cooper’s ligament, beginning near the area of the pubic tubercle and continuing laterally along Cooper’s ligament. A transition stitch is then accomplished between the prosthesis, Cooper’s ligament, the femoral sheath, and Poupart’s ligament, and the repair is then continued laterally along Poupart’s ligament to just lateral to the internal ring. The superior medial border of the prosthesis is secured to the rectus sheath with an interrupted 2.0 Prolene suture, creating a wrinkle in the mesh. The superior border of the mesh is tacked to the internal oblique with an interrupted 2.0 Prolene suture. A slit is made transversely in the mesh from the lateral aspect to the location of the internal ring. The slit should be made such that the lower portion is one-third the width of the mesh. The upper and lower portions of the mesh are brought
around the cord. The lower border of the upper portion and the lower border of the lower portion are then tacked to the inguinal ligament just lateral to the internal ring with an interrupted 2.0 Prolene suture, recreating the shutter mechanism of the internal ring. The tails of the mesh are placed laterally under the external oblique. Management of the cremasteric muscles (split versus divided) is at the discretion of the surgeon and frequently depends on the characteristics of the hernia and the condition of the muscle. Additional analgesia (30 mL of dilute Marcaine [10 mL of 0.5% Marcaine mixed with 20 mL of saline]) may be instilled into the operative site. The external oblique fascia is then closed, and the skin is closed with a running subcuticular suture.

Other mesh repairs

Kugel repair

The Kugel repair is considered a simple and minimally invasive repair, but its success is dependant on the experience and training of the surgeon. The Kugel repair was detailed in a recent issue of *Surgical Clinics of North America* [36]. The Kugel repair combines the ease of an anterior approach with mesh placed in the preperitoneal position. The mesh is designed to expand into its full dimensions after being rolled or folded and placed in the preperitoneal space through a relatively small opening. A 2- to 3-cm incision is located halfway between the superior iliac spine and the pubic tubercle delving through the external oblique, internal oblique, and transversalis fascia. Any indirect sac is ligated or inverted. The inferior epigastric vessels are identified and should remain attached to the transversalis fascia while the peritoneum is freed from the posterior aspect of the transversalis fascia, creating a preperitoneal pocket in which to place the Kugel patch. The Kugel patch, typically a standard size of 8 × 12 cm, is inserted into the preperitoneal space and allowed to expand. The patch is secured with a single stitch and allowed to cover the defect. The suture holds it in place along with the pressure from the peritoneum as the patient stands and proceeds with normal activities.

Plug and patch

The plug and patch or PerFix repair [37] uses a cone-shaped plug made of two layers of polypropylene mesh that is inserted into the inguinal canal in an indirect hernia, followed by the placement of a mesh patch which is sewn around the spermatic cord and laid on top of the posterior wall. Repair of a direct hernia is accomplished with this method by likewise placing the plug into the defect, followed by placement of patch around the spermatic cord in the same fashion. This repair can be used in large or small defects by employing larger or smaller sizes of premanufactured plugs, or by the construction of the required size of plug in the operating room. The utility of this patch is based on its versatility for repairing various sizes of defects and its lesser dependence on user experience and training. This technique was
fully elucidated in a previous issue of *Surgical Clinics of North America* [37]. The reader is directed there for further details on the technique and its outcomes.

Migration or erosion of the plug has been infrequently reported. The plug has been associated with small bowel volvulus and diverticulitis in case reports. A review of the available reports of migration or erosion showed this complication to be rare and associated with technical error at the time of operation.

**Prolene Hernia System**

The Prolene Hernia System (PHS) was developed as an option inguinal hernia repair that combined the benefits of anterior and posterior mesh components. It was introduced in 1998 and since then has been studied in retrospective chart reviews [21] and randomized trials [22–26]; however, none of these studies provide long-term data (beyond 1.5 years) for recurrence.

In the procedure for using this system [21], the inguinal canal is approached anteriorly as described for the Lichtenstein repair. If present, the indirect sac is dissected and inverted, and a preperitoneal pocket is created through the internal ring using a Raytec sponge. The posterior portion of the PHS is then deployed in the preperitoneal space. The anterior portion is positioned and sutured much like the onlay patch in the Lichtenstein repair. A lateral slit is made in the PHS mesh to accommodate the cord and relocate the internal ring, usually a bit laterally. The lateral anterior portion of the PHS is then deployed under the external oblique aponeurosis laterally (Fig. 2).

The advertised advantages of the PHS in comparison with an onlay mesh or mesh plug include reduced pain and reduced recurrence rates. Only one study found a reduction in immediate postoperative pain [26]. PHS was associated with a shortened operative time by 4 to 5 minutes in two of the randomized trials [25,26] but not in the third [24]. The studies have not

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**Fig. 2.** (A) Prolene hernia system anterior view. (B) Prolene hernia system posterior view. (Courtesy of Ethicon, Inc., Somerville, NJ; with permission).
shown a difference in long-term pain. The lack of evidence supporting the advertised claims may be responsible for the low use of this system.

**Stoppa**

The Stoppa repair involves reinforcement of the visceral sac by a preperitoneal bilateral mesh prosthesis [27]. The technique, recommended for large, complex, or bilateral hernias, is performed using one of two standard incisions—a vertical midline subumbilical or a low horizontal skin incision. The midline fascial layers are divided, providing access to the preperitoneal space. This space is further opened with blunt dissection, much like that used for a laparoscopic approach. The hernia sacs are reduced using gentle traction. Indirect sacs should be opened and explored with the finger to simplify their dissection from the other cord structures and to ensure evacuation of their contents. Large sacs can be transected and closed proximally. A large piece of mesh (Stoppa recommended Dacron) is then prepared in a chevron shape with a dimension of 24 × 18 cm. Using clamps, the mesh is then placed into the preperitoneal space being sure to pull the cephalad lateral clamp as far as possible laterally and posteriorly, and the lower lateral clamp as far as possible behind the corresponding obturator wall. No attempt is made to secure the mesh with clips or sutures. Several variations on this repair have been reported and are outlined in available textbooks. This repair is similar in many ways to the laparoscopic repair, and familiarity with the anatomy from the “inside” is helpful when approaching hernias laparoscopically.

**Teaching and learning the repair**

The VA hernia trial provided a large database with which to examine some questions about the impact of resident participation in hernia repair and, to a lesser extent, the impact of surgeon experience on outcomes. To address the latter, the authors examined the impact of resident training level on outcomes such as recurrence and complications [38]. The results differed based on technique. Although there did not appear to be a significant impact of resident level of training on the outcomes of laparoscopic repair, there was a significant impact of resident level on recurrence in open repair (Fig. 3). There were no differences in complication rates, but as might be expected, operative times were significantly shorter for senior (postgraduate year [PGY] 4+) residents when compared with junior (PGY 1-2) residents (76.3 minutes and 71.6 minutes, respectively).

Although it has never been adequately studied, it appears that surgeons receive adequate training during residency in hernia repair which translates into continued reasonable results as far as recurrence rates beyond training. In the VA trial, the authors could find no relationship of volume and outcome for the attending surgeons in the open repair [39], but that finding was likely because all of the participating surgeons had passed the volume threshold for open hernia repair during their residencies. In the Watchful
Waiting trial, the recurrence rate in the open repair group was lower than in the VA trial. This finding could have been due to many factors, including patient and hernia characteristics, but could also be accounted for, in part, by site or surgeon selection. In the Watchful Waiting trial, sites and surgeons with proven interest and expertise in hernia repair participated. In the VA trial, there was a less subspecialized group of surgeons participating because the structure of the VA at the time was such that nearly all general surgeons at each site qualified (by having previously performed >25 open mesh repairs) for performing repairs in the open group.

**Inguinal hernias in women**

In 2005, Koch and colleagues [40] published the largest series of groin hernia repairs in women. They used data from the prospectively collected Swedish Hernia Register between 1992 and 2003 to provide excellent information about the outcomes of hernia repair in women. Important points from this landmark study are as follows:

- Women undergo a higher proportion of emergency hernia repair than men (16.9% versus 5.0%).
- Women who are originally diagnosed with an indirect or direct hernia at primary repair are likely to have a femoral hernia found at reoperation for a recurrence (41.6% versus a corresponding 4.6% of men).
- Nearly 40% of women did not undergo a standard (Shouldice, Lichtenstein, plug/mesh, TAPP/TEP) repair.
Women had a higher risk for reoperation for recurrence (relative risk, 2.61 [95% CI, 1.89–3.61] for women versus 1.92 [95% CI, 1.74–2.12] for men).

Techniques associated with the lowest risk for reoperation in men were associated with the highest risk in women.

Using the reoperation rates after the Lichtenstein repair as reference, women had the lowest risk of reoperation after laparoscopic repairs, whereas Lichtenstein repair provided the lowest risk of reoperation in men. Given the high proportion of femoral hernias found in women at reoperation for recurrence, primary repair laparoscopically may benefit the patient in avoiding a missed femoral hernia.

**Recommendations**

Groin hernia continues to be a common diagnosis. In men who need repair of their hernia because of symptoms, open repair with mesh continues to be an excellent option for a first time hernia repair in adults. If a non-mesh repair is offered, it should be the Shouldice repair because, at least in experienced hands, it has been shown to have outcomes similar to open mesh repairs. For most surgeons, a Lichtenstein onlay repair is easy to learn and easily applied in most settings. It has been studied more than the other open mesh repairs in randomized trials across multiple institutions such that the results from these large studies can be generalized to both the general population and the typical general surgeon. The uniform adoption of other open mesh techniques should require further study and long-term follow-up to show that they are at a minimum equivalent to the well-studied Lichtenstein repair in terms of recurrence and long-term chronic pain, the two most significant adverse outcomes for patients.

**References**


OPEN REPAIR OF INGUINAL HERNIA


