

## 2. Prosthetic Choice in Open Inguinal Hernia Repair

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While non-mesh repairs can be performed safely in experienced hands with standardized technique, such as the Shouldice (1), tension-free repairs with mesh placement have become the gold standard for the open repair of inguinal hernias (2). Traditionally, there has been concern about the placement of mesh in an acute/incarcerated hernia, but this appears to be safe (3), even in the context of bowel necrosis (4). Internet search of hernia mesh reveals countless brands and types of mesh for the repair of inguinal hernias. Mesh materials vary by source. There are absorbable and permanent synthetic meshes, allograft material, and xenograft material. In addition, mesh is sold in flat sheets, precut segments, and three-dimensional forms. Some mesh products include additional components to resist adhesions, to allow for fixation, or to prevent infection.

Webster's dictionary defines mesh as "that which entangles us" (5). This is not truer than in inguinal hernia repair. Millions of inguinal hernia repairs are performed in the world annually, predominantly open, with every variety of prosthetic, from polyester and polypropylene to mosquito netting in some parts of the world (6). In fact, a recent study demonstrates no significant difference in outcomes between sterile mosquito nets and standard commercial mesh, which cost 1,000 times more! (7)

### History

Initial management of inguinal hernias required external management with bandages, then trusses, first created by French surgeon Guy de Chauliac and then by Ambroise Pare, and subsequently a variety of plugs

to occlude the internal ring (8). Surgical intervention was first performed by Bassini, without any prosthetic, in 1884. The “Bassini repair” was documented with 2.6% mortality and 3.1% recurrence in 227 patients with 98% follow-up at 4.5 years (9). As experience with this procedure widened, a variety of types of wire and suture were utilized to reinforce the abdominal wall (10). Subsequently, early forms of mesh were created and implanted. These consisted of stainless steel, which was too stiff; nylon, which disintegrated too rapidly; and then polypropylene (11–13). At this point, mesh was simply used to buttress or reinforce suture repairs.

### *Mesh Utilized in Tension-Free Repairs*

Usher was the first to introduce significant changes in the conceptual repair of hernias, utilizing mesh to bridge the hernia gap, instead of just buttress a repair performed under tension. Thus, the first description of a tension-free hernia repair was presented: “If mesh is used to bridge the defect instead of reinforcement for tissues approximated under stress, this factor of tension is eliminated, and recurrence becomes less likely” (14). The next mission was to identify the ideal location to place the mesh. Irving Lichtenstein performed and presented an updated tension-free hernia repair with mesh placed anterior to the transversalis fascia in 1980, and this “Lichtenstein repair” has become accepted as a standard hernia repair which is simple to perform, can be safely conducted under local anesthesia, and has acceptable rates of complication and time for recovery (15–17).

### *Preperitoneal Mesh*

The main concern of these repairs remained the forces of abdominal pressure on that location of mesh placement. There was a concern that these forces increase the risk of recurrence for mesh placed anterior to the fascia, instead of the preperitoneal location. Thus, a line of repairs was proposed for mesh placed in the preperitoneal location, either via laparoscopic placement or through open repair (18–20).

A subset of these repairs also includes a prosthetic inserted into the internal ring, either alone or with a hernia patch, to help prevent recurrence (21, 22) (Fig. 2.1). Plugs can be visualized via laparoscopy or CT scan. Radiographically, it appears as a smooth round or oval hypodense mass close to the inferior epigastric artery, confirming the importance of radiologist’s knowledge of past surgical history when reviewing scans (23). There are multiple reports of mesh migration from the intended

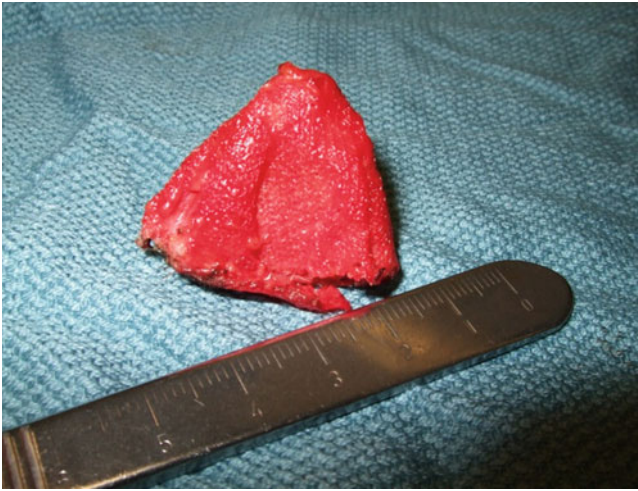


Fig. 2.1. Plug, removed for chronic pain.

location, including a case report of intraperitoneal migration of a mesh plug with a small intestinal perforation (24).

To address this risk, in 1998, Gilbert and Graham introduced a double-layered device, which sits in the inguinal defect, combining a small plug with both a subaponeurotic component and preperitoneal patch, all formed of polypropylene. This mesh is called the Prolene Hernia System (PHS). The PHS incorporates the goal of decreased suture placement with mesh placed in the preperitoneal location. The material is polypropylene and placed via open technique (25). Results have been evaluated and demonstrate 1% recurrence and 2% chronic pain with a mean follow-up of 49 months (26). Longitudinal follow-up has demonstrated 2.3% recurrence and 1.8% chronic pain at 5.5 year follow-up. (27) Comparison of flat polypropylene mesh and PHS at 1 year demonstrates that the PHS surgery takes 15 min longer, on average, and there was no difference in pain, return to activity, complication, or recurrence. (28)

Nonabsorbing synthetic mesh is available in ePTFE (Gortex®), which is seldom used in the groin, and porous sheets such as polypropylene, polyester, and Ultrapro. Porous mesh is further divided into light-, medium-, and heavyweight mesh, based upon the density of the mesh fibers.

Lightweight mesh has been compared with heavyweight, and the recent data has demonstrated some benefit in lightweight mesh. Lightweight mesh has been shown to result in reduced chronic groin pain at the operation site, although there was no associated increase in quality of life in one study (29). In a separate study, reduced postoperative pain

and recurrence in the short term was found but there was no statistical difference in recurrence rate at longer-term follow-up (30). Mesh can also be combined with absorbable elements to create ultralightweight mesh, such as Ultrapro®. A literature search was performed using Medline, Embase, and Cochrane databases to identify relevant randomized controlled trials, and comparative studies looked at long-term complications of prosthetic meshes, specifically comparing partially or completely absorbable meshes with conventional nonabsorbable mesh. The primary outcomes reviewed included hospital stay, time taken to return to work, seroma, hematoma, wound infection, groin pain, chronic pain, foreign body sensation, recurrence, and testicular atrophy. It was concluded that absorbable and nonabsorbable mesh repairs of inguinal hernias do not afford significant benefit, but lightweight mesh was associated with a significant reduction in prolonged pain and foreign body sensation. (31) An additional meta-analysis reviewed Vypro II (large pore) and standard polypropylene mesh for inguinal hernia repair, looking at recurrence, pain, urinary tract infection, seroma, foreign body sensation, and testicular atrophy. This analysis found a difference only in the sensation of a foreign body, which was reduced in the large-pore mesh (32).

### *Self-Fixation Mesh*

A more recent addition has been mechanisms of self-fixation to avoid the placement of sutures, which have been implicated in increased pain (Fig. 2.2). A randomized study of self-fixing mesh demonstrates decreased operative time, decreased pain postoperative day 1 by visual analog pain score, and decreased cumulative dose of postoperative pain medicine over standard mesh secured with sutures. (33) Another similar study that assessed pain after the use of a self-adhesive, light mesh with reduced sutures demonstrates reduced early postoperative pain compared with conventional prosthesis (34) and a rat model with similar mesh demonstrates no harmful influence on the ductus deferens in the rat model (35).

### *Absorbable Mesh*

Synthetic mesh is available as an absorbable prosthetic for use in highly contaminated situations. Vicryl® and Dexon are examples of this type of mesh. These products remain intact for just a few weeks and, therefore, are associated with high recurrence rates and are, therefore, generally reserved for grossly contaminated cases.

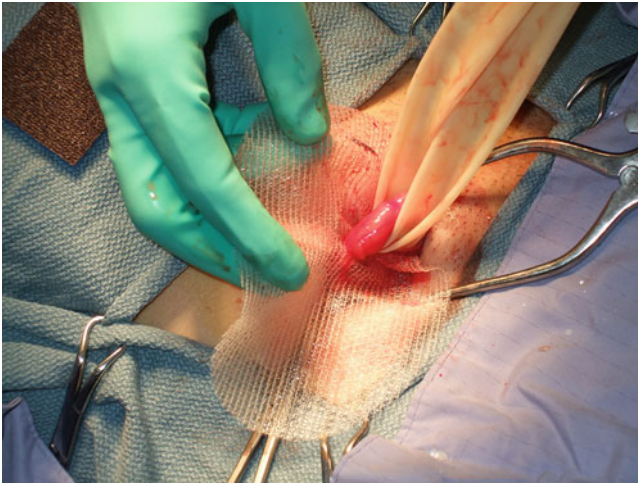


Fig. 2.2. Self fixation mesh.

### *Biologic Mesh*

Biologic mesh is available for patients who are at high risk of infection. Allografts, including Alloderm®, have limited experience and use in the groin. Xenografts are biologics derived from nonhuman dermis, often bovine or porcine. They are harvested cells, essentially an acellular collagen, supported by chemical processes for stabilization. Permacol mesh and Surgisis mesh are examples of xenografts. Additional biologics have been studied (36), but there is little human data and no long-term human outcomes available. As in all prosthetics, allergies and religious and cultural beliefs need to be taken into consideration in the surgical placement of biologic products.

Data on outcomes of hernia repair relative to type of mesh are available in terms of ease of use, durability/recurrence, and long-term chronic pain. See Table 2.1 for a summary of advantages/disadvantages of each mesh type.

In final summary, there are innumerable types, shapes, and components of mesh. Each carries a unique profile of benefits and risks. There is short-term data suggesting better surgeon ease of placement and reduced pain with both lightweight and self-fixation meshes. Long-term results remain unchanged, and biologic grafts remain relatively unstudied. It would seem that surgeons should select a mesh which they feel comfortable

Table 2.1. Advantages/disadvantages of each mesh type.

| <b>Mesh</b>       | <b>Advantages</b>  | <b>Disadvantages</b>  |
|-------------------|--|---|
| Lichtenstein-type | Heavyweight porous<br><br>Lightweight porous<br><br>Porous plus absorbable component<br>Porous with self-fixation component<br>Plug and patch  | More acute pain<br>Likely more chronic pain<br>None<br><br>Increased cost<br><br>Increased cost<br>Less long-term data<br>Learning curve<br>Potential increase in chronic pain          |
| Preperitoneal     | Collagen scaffold<br><br>Mesh with a memory ring<br><br>Plug<br><br>Prolene Hernia System  | Increased cost<br>Little long-term data<br>Possible migration<br>Increased cost<br><br>Learning curve<br>Plug migration<br>Potential increase in chronic pain<br>Learning curve<br>Cost |
|                   | Safe, well studied<br><br>Less acute pain<br>Likely less chronic pain<br>No difference with addition of absorbable material<br>Less acute pain<br>Possible less chronic pain<br>Helps overcome the force of abdominal pressure<br><br>Ability to place in patients high risk for infection<br>Cross-linked have better durability<br>Ease of placement<br>Location helps overcome the force of abdominal pressure<br><br>Less acute pain<br>Easy to place with experience<br>Some data suggest it decreases recurrence<br><br>Low recurrence<br>Well studied |   |

placing, place these meshes consistently to improve their comfort with the devices, and follow these patients prospectively for outcomes. It is likely that in this complex field, there is not one right mesh for each patient.

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