

Mesh in hernia repair

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The term 'mesh' refers to prosthetic material, either a net or a flat sheet, that is used to strengthen a hernia repair. Mesh can be used to:

- bridge a defect: the mesh is simply fixed over the defect as a tension-free patch;
- plug a defect: a plug of mesh is pushed into the defect;
- augment a repair: the defect is closed with sutures and the mesh added for reinforcement.

Simple bridging of a hernia defect relies on a generous overlap of the mesh onto strong tissues around the defect in order to reduce the risk of recurrence. Mesh plug repairs have been used in small defects, especially where tissue overlap is hard to achieve, but have been largely abandoned because collagen deposition often produces a fibrous mass, a 'meshoma', that may cause chronic pain. Other complications include mesh migration, erosion into adjacent organs and fistula formation. Primary closure of the hernia defect with the addition of mesh for reinforcement placed in a tension-free manner is currently regarded as optimal. Suturing a mesh edge to edge into the defect (inlay), with no overlap, is not recommended. Mesh types

Gross structure

Net meshes are woven or knitted. Sheet meshes are not porous but may be perforated with multiple holes. Net meshes allow native tissue ingrowth between the strands so that the mesh becomes integrated into host tissues within a few months. Initial fixation of such mesh is by glue, sutures or tacks/staples, which may or may not be absorbable; in some cases, such as extraperitoneal repair of inguinal hernias, no mesh fixation may be required at all. 'Sheet' meshes do not allow host tissue ingrowth but eventually become encapsulated by host fibrous tissue. They always require strong, non-absorbable fixation to prevent mesh migration. Synthetic mesh

Most meshes used today are synthetic polymers of polypropylene, polyester or polytetrafluoroethylene (PTFE), but there may be other chemical additives and meshes may have a composite structure such as those with anti-adhesive barriers. Meshes for hernia repair are generally non-absorbable and designed to provoke tissue ingrowth that leads to the formation of a tissue barrier.

Polypropylene is an inert, hydrophobic, monofilament material so does not generate an immune response and tends to resist bacterial ingrowth. Polyester mesh is similar but hydrophilic, and is said to encourage microvascular ingrowth. PTFE meshes are flat sheets, quite inert and resistant to both tissue ingrowth and adhesion formation (Figure 64.6).

Weight and porosity

Synthetic meshes are very strong; early meshes were much stronger than a human abdominal wall, so they are considered to be 'over-engineered'. All meshes provoke a fibrous reaction. More dense or heavyweight meshes provoke a greater reaction, leading to collagen contraction and mesh stiffening, which is associated with impaired elasticity/mobility of the abdominal wall, foreign body sensation and pain. The term 'mesh shrinkage' is often used to describe this the mesh itself progressive decrease in mesh size over time, but does not shrink; instead, it is simply the natural progressive contraction of the fibrous tissue that has grown into the mesh. Thus 'mesh contracture' is a more accurate term. This process can lead to hernia recurrence if the mesh no longer covers the defect. Meshes can contract in area by more than 50%.

Meshes with thinner strands and larger spaces (pores) between them are preferred because they have better tissue integration, less contracture, less foreign body reaction, more flexibility and improved comfort.

(b) Figure 64.6 (a) Polypropylene mesh in totally extraperitoneal inguinal hernia repair. The blue lines are added purely to help the surgeon orientate the mesh. (b) Polyester mesh in an epigastric hernia repair.

and favours a pore size of at least 1 mm in all directions in order to promote collagen ingrowth that is not only strong but also elastic. Biological mesh So-called 'biological meshes' are sheets of sterilised, decellularised, connective tissue derived from a variety of sources, including human or animal dermis, bovine pericardium or porcine intestinal submucosa. They provide a 'scaffold' to encourage neovascular ingrowth, fibroblast infiltration and new collagen deposition. In theory host enzymes eventually break down the biological implant and replace it with normal host fibrous tissue. The rates of enzymatic degradation and collagen deposition vary between products and also depend on the local environment of the mesh. In the presence of infection, for example, some biological meshes break down more rapidly and weaken before remodelling can occur, leading to early hernia recurrence. Others are more resistant to breakdown, particularly those with chemical cross-linking between the fibrous strands. The choice of biological mesh depends on the clinical situation for which it is to be used. They are expensive, and their precise role in abdominal wall hernia repair has yet to be fully established. Absorbable meshes Synthetic absorbable meshes such as those made from polyglycolic acid, collagen or polyhydroxybutyrate may be used in temporary abdominal wall closure and for short-term buttressing suture lines but are not recommended in hernia repair as they are absorbed too quickly and induce only minimal collagen deposition. In recent years a number of synthetic, slowly absorbable meshes have been developed. These are designed to be gradually degraded by the body and replaced with strong native collagenous fibrosis in order to create a lasting repair. The long-term outcomes of repairs using these meshes are as yet unknown. Most standard meshes induce fibrosis and, if placed within the peritoneal cavity, promote unwanted adhesions. A number of meshes have been designed for intraperitoneal use. Most of these have two very different surfaces, one being sticky and one slippery. Good adherence and host-tissue ingrowth is required - on the parietal (fascia/muscle/peritoneum) side of the mesh, but the opposite (bowel) side needs to prevent adhesions to the abdominal contents. Usually, one side of the mesh is coated by material that prevents adhesions, such as polycellulose, collagen or PTFE. However, none of these materials is 100% effective at preventing adhesions and consequently intraperitoneal placement of mesh is associated with bowel obstruction, mesh erosion and fistulation (Figure 64.7). Surgeons now try to avoid intraperitoneal mesh placement whenever possible. Summary box 64.7 Mesh characteristics

Positioning the mesh The strength of a mesh repair depends on host-tissue ingrowth. Meshes should be laid in a tension-free manner on a firm, well-vascularised tissue bed with generous overlap of the hernia zone. The mesh can be placed:

- on top of the muscle/fascia in the subcutaneous space (onlay);
- within the defect (inlay);
- immediately deep to the muscle layers in the abdominal wall (sublay);
- extraperitoneally;
- intraperitoneally.

Each of these planes may be used with both open and laparoscopic techniques (Figure 64.8). Onlay meshes may become

Figure 64.7 Adhesions to intraperitoneal mesh causing bowel obstruction. Net (woven or knitted) or sheet Synthetic or biological - mainly synthetic Large pore, small pore - large pore causes less fibrosis and pain If for intraperitoneal use - non-adhesive surface on one side Non-absorbable or absorbable - mainly non-absorbable Anterior rectus sheath Subcutaneous space Linea alba Onlay space Rectus abdominis muscles Posterior Sublay spaces rectus sheath Retromuscular

Extraperitoneal space space Figure 64.8 Diagrammatic representation of the various layers into which meshes are placed in ventral hernia repair.

of skin flaps to allow wide overlap can lead to skin ischaemia and/or seroma formation. Inlay meshes are not recommended as they are effectively no more than a suture repair at each mesh-tissue interface. Meshes placed deep to the abdominal wall muscle layers have a mechanical advantage over onlay positioning as the abdominal pressure helps to keep the mesh in place; both sublay and extraperitoneal mesh placement techniques are generally preferred. Intraperitoneal mesh is associated with complications described earlier and many surgeons now try to avoid this. Limitations to the use of mesh The presence of infection limits the use of mesh. If a mesh becomes infected then it usually needs to be removed, although some infected situations can be salvaged using a combination of debridement, appropriate antibiotics and modern vacuum-assisted dressings. Meshes are expensive, especially biological, biodegradable or those for intraperitoneal use. Price or novelty is not always an indicator of quality or safety and a simple, non-absorbable, large-pore synthetic mesh is nowadays seen as the safest implant.

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