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Mesh Versus Suture Cruroplasty in Hiatal Hernia Repair: Recurrence, Safety, And Current Controversies in Patients Underwent Sleeve Gastrectomy

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Abstract

Hiatal hernia repair, particularly in large or recurrent cases, represents a major surgical challenge. Despite advances in minimally invasive surgery, the optimal technique for crural closure remains debated. The central controversy lies in whether mesh reinforcement offers superior long-term outcomes compared with suture-only cruroplasty. Suture cruroplasty is a surgical technique in which the diaphragmatic crura are approximated and closed using sutures alone, without the use of prosthetic material, thereby restoring the hiatal opening in a physiological manner. Mesh cruroplasty, in contrast, combines suturing of the crura with reinforcement using a mesh, which may be synthetic or biologic, to provide additional support and reduce the risk of recurrence, particularly in large or recurrent hiatal hernias. While mesh use may reduce short-term recurrence rates, concerns persist regarding mesh-related complications, durability, and patient safety. Synthetic non-absorbable meshes offer durable reinforcement and lower recurrence rates, especially in large defects, but carry risks such as erosion, stricture formation, and dysphagia. Conversely, absorbable and biologic meshes aim to provide temporary support during tissue remodeling, potentially reducing long-term complications, although long-term efficacy data remain limited. Current evidence suggests that mesh reinforcement may be advantageous in selected patients with large defects, recurrent hernias, or weak crural tissue. However, routine mesh use remains controversial because of the low quality of available evidence and the potential for serious delayed complications.

Keywords: Hiatal hernia; Mesh Cruroplasty; Suture Cruroplasty; Recurrence

Introduction

A hiatal hernia occurs when part or whole of the stomach protrudes into the thoracic cavity through the esophageal hiatus of the diaphragm. Sliding, rolling, and combined hernias are the three types of hiatus hernias, with sliding hernias accounting for more than 90% of cases.

In sliding hernias, the gastroesophageal junction lies above the esophageal hiatus. In rolling hernias, the gastroesophageal junction is in its normal position. Combined hiatus hernias have features of both sliding and rolling hernias. Large hiatus hernias may be complicated by gastric volvulus. Other complications include incarceration and obstruction (Roman & Kahrilas, 2014).

Advances in minimally invasive surgery have led to the widespread acceptance of laparoscopic hernia repair. Yet, a high recurrence rate remains despite this progress, particularly with large hernias repaired using primary sutures.

A laparoscopic hiatal hernia repair mainly consists of adhesions release, sac reduction, tension-free cruroplasty, and fundoplication. Despite laparoscopic hiatal hernia repair having demonstrated safety, long-term results showed higher recurrence rates than expected, with reports of up to 42% (Aili et al., 2023).

To address this issue, mesh has become common in surgical practice. Prosthetic reinforcement of the crural closure has been proposed to reduce recurrence by integrating into the tissue, increasing collagen deposition, and thereby allowing stability of the scar and durability of the repair.

These properties motivated surgeons in the middle 1990s to perform prosthetic reinforcement of the esophageal hiatus. Since then, multiple types of mesh have been used (Aiolfi et al., 2022).

However, early reports using mesh at the hiatus were associated with disastrous complications, with some requiring esophagogastric resections. These complications were thought to be caused by problems with the use of synthetic mesh materials.

Synthetic mesh was prone to erosion or infection that could lead to life-limiting dysphagia, chronic abdominal pain, and recurrent gastroesophageal reflux disease. As a result, bioprosthetic mesh was advocated by many as an alternative prosthetic material to create a tension-free crural repair (Rajkomar et al., 2023).

Principles of Laparoscopic Hiatal Hernia Repair

With modern advancements in minimally invasive surgery, including improved visualization, better instrumentation, and more experience, laparoscopy has become the standard of care in hiatal hernia repair.

The tenets of repair shared by most high-volume centers include complete mediastinal sac reduction, mobilization of 2–3 cm of intra-abdominal esophagus, and tension-free hiatal closure. All of these are associated with improved outcomes (Rajesh et al., 2022).

Reduction of Hernia Sac Contents

The hernia sac often extends well into the thoracic cavity and may include abdominal contents such as the stomach, small bowel, or colon. These should be reduced with atraumatic graspers and returned into the abdominal cavity.

In some cases, taking some of the short gastric vessels may be necessary to reduce the contents (Goethals et al., 2023).

Mobilization of the Hernia Sac

After reducing the hernia contents, the sac should be mobilized away from mediastinal structures. Because the sac forms an avascular plane, it should be bluntly dissected away from intrathoracic structures with minimal bleeding.

A critical step in this portion of the operation is to identify and preserve the vagal nerves that run along the esophagus. If there is a concern of encountering a replaced left hepatic artery while dissecting the sac, the vessel should be clamped and the liver observed (Hakobyan et al., 2025).

Mobilization of the Esophagus

Because the hernia contents invariably travel along the esophagus, it is common for the esophagus to be partially displaced into the thoracic cavity.

To avoid recurrence, the esophagus should be mobilized and its distal end restored to its intra-abdominal location. Generally, at least 3 centimeters of the esophagus should sit comfortably below the diaphragm.

If this is not possible, an esophageal lengthening procedure, such as Collis gastroplasty, should be performed (Petrov et al., 2019) (Figure 1).

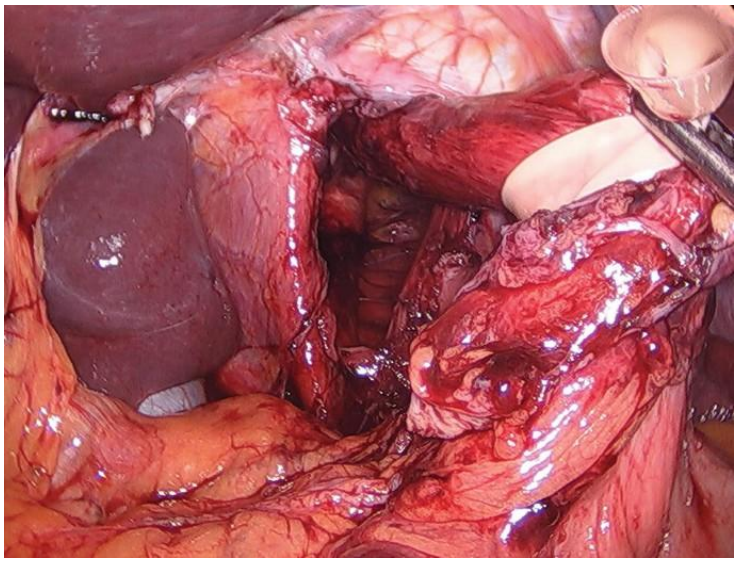

Figure 1. Mobilization of the esophagus. Because the hernia contents invariably travel along the esophagus, it is common for the esophagus to be partially displaced into the thoracic cavity. To avoid recurrence, the esophagus should be mobilized and its distal end restored to its intra-abdominal location (Ibrahim & Telem, 2019).

Closure of the Crura

After the esophagus has been mobilized, the hernia defect around the crura should be closed. This should be a tension-free repair with horizontal interrupted sutures placed posterior to the esophagus.

For larger defects, relaxing incisions along the lateral diaphragm can be made to facilitate approximating the crura (Westcott & Ward, 2020) (Figure 2).

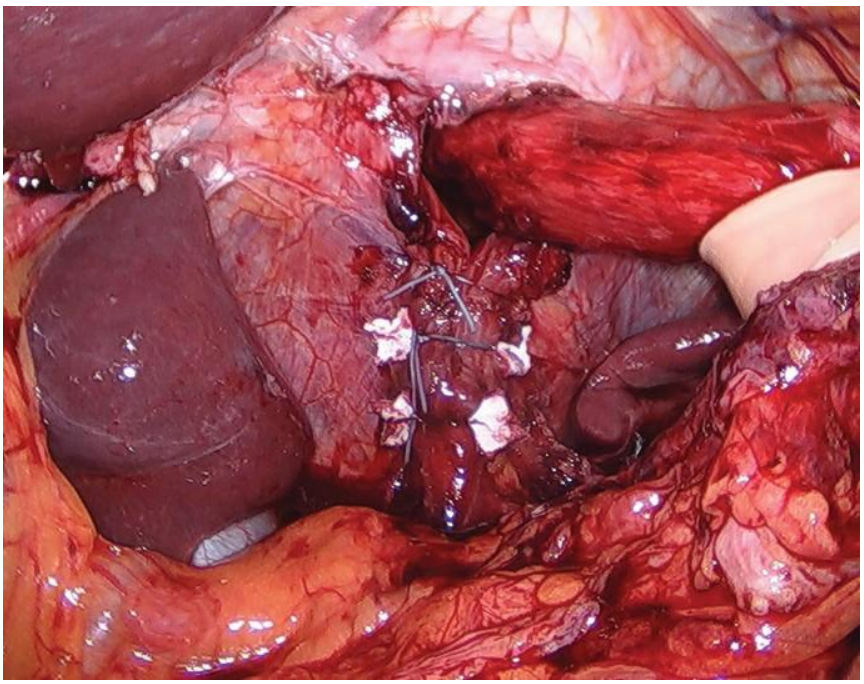

Figure 2. Closure of the crura. After the esophagus has been mobilized, the hernia defect around the crura should be closed. This should be a tension-free repair with horizontal interrupted sutures placed posterior to the esophagus (Ibrahim & Telem, 2019).

Suture Cruroplasty

Suture cruroplasty is a surgical technique in which the diaphragmatic crura are approximated and closed using sutures alone, without the use of prosthetic material, thereby restoring the hiatal opening in a physiological manner.

Suture-only repair avoids the risks associated with foreign materials, including erosion, infection, fibrosis, and stricture formation. It is generally considered adequate in small primary hiatal defects where the crura can be approximated without excessive tension.

The main limitation of suture cruroplasty is the risk of recurrence, particularly in large defects, recurrent hernias, or patients with weak and attenuated crural tissue.

High tension on the repair, poor tissue quality, increased intra-abdominal pressure, and inadequate intra-abdominal esophageal length may contribute to disruption of the sutures and recurrence of the hernia.

Mesh Cruroplasty

Mesh cruroplasty combines suturing of the crura with reinforcement using a mesh, which may be synthetic or biologic, to provide additional support and reduce the risk of recurrence, particularly in large or recurrent hiatal hernias (Latorre-Rodríguez et al., 2024).

The surgical repair of hiatal hernia using mesh cruroplasty typically involves a laparoscopic approach. The procedure begins with the reduction of the herniated abdominal contents back into the abdominal cavity.

Subsequently, the posterior crura of the diaphragm are approximated and closed with interrupted sutures to restore the normal anatomy of the esophageal hiatus (Elfeky et al., 2023).

Following primary crural closure, reinforcement is achieved by placing a U-shaped or circular non-absorbable mesh over the repaired crura, covering the posterior defect and encircling the esophagus.

The mesh serves to strengthen the repair site, reducing tension on the suture line and minimizing the risk of hernia recurrence.

Mesh fixation is performed carefully with sutures to secure the implant, avoiding injury to the diaphragm's central tendon and adjacent vital structures such as the heart and esophagus (Ukegjini et al., 2023) (Figure 3).

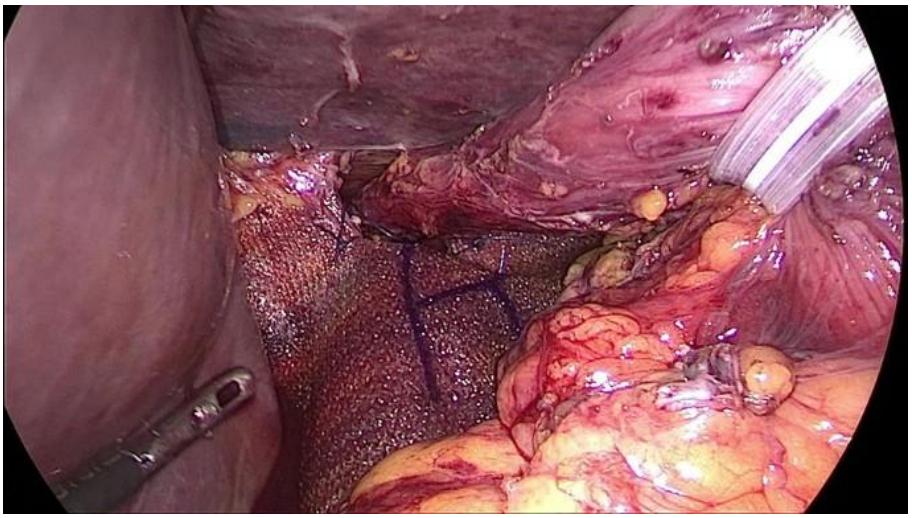

Figure 3 . Mesh cruroplasty is primarily indicated for patients presenting with large hiatal defects, weak or attenuated crura, or recurrent hernias where simple suture repair is insufficient to ensure durability. The mesh provides a scaffold that facilitates tissue ingrowth, thus enhancing long-term repair strength (Najm et al., 2023).

Indications for Mesh Cruroplasty

Mesh cruroplasty is primarily indicated for patients presenting with:

- Large hiatal defects.
- Weak or attenuated crura.
- Recurrent hiatal hernias.
- Repairs performed under excessive tension.
- Cases in which simple suture repair is considered insufficient to ensure durability.

The mesh provides a scaffold that facilitates tissue ingrowth, thus enhancing long-term repair strength (Najm et al., 2023).

Patient-specific factors strongly influence outcomes. In large hiatal hernias, recurrent hernias, or patients with fragile crural tissue, mesh reinforcement may confer significant benefit.

Conversely, in small primary defects, suture-only cruroplasty is generally considered adequate, avoiding the risks associated with foreign materials (Memon et al., 2019).

Types of Mesh

Various mesh materials are utilized in hiatal hernia repair, including synthetic non-absorbable meshes, synthetic absorbable meshes, and biologic meshes.

Synthetic Non-absorbable Mesh

Synthetic non-absorbable meshes include polypropylene and polytetrafluoroethylene.

These meshes offer durable reinforcement and lower recurrence rates, especially in large defects. However, they carry risks such as:

- Mesh erosion.
- Esophageal stricture.
- Dense fibrosis.
- Chronic dysphagia.
- Mesh infection.
- Injury to adjacent organs.

Synthetic Absorbable Mesh

Synthetic absorbable meshes include polyglactin and polyglycolic acid.

These materials provide temporary reinforcement during the early healing period and are gradually absorbed. Their purpose is to support the crural repair during tissue remodeling while reducing the risk of permanent foreign-body complications.

Biologic Mesh

Biologic meshes are derived from biological materials such as porcine dermal collagen or bovine pericardium.

Absorbable and biologic meshes aim to provide temporary support during tissue remodeling, potentially reducing long-term complications. However, long-term efficacy data remain limited (Najm et al., 2023).

Mesh Configuration and Placement

The mesh configurations used for hiatal hernias are varied. Simple shapes such as rectangular or triangular meshes were initially used to cover the primary closure.

Over time, this approach evolved to include meshes designed with a central opening to facilitate the passage of the esophagus, such as U-shaped, keyhole, and A-shaped designs (R. Li et al., 2023).

There is no universal consensus regarding the ideal mesh material, size, configuration, or fixation method.

Permanent synthetic meshes offer durability but carry higher complication risks, while absorbable and biologic meshes may be safer but potentially less effective over the long term.

Technical aspects such as mesh placement and avoidance of direct contact with the esophagus remain critical in reducing complications (FitzGerald & Kumar, 2014).

Emerging evidence indicates that recurrent hernias frequently occur at the anterior hiatus, suggesting that anterior mesh reinforcement in addition to posterior coverage may be necessary to optimize outcomes.

The surgical technique may also be augmented by relaxing incisions in the diaphragm to relieve excessive tension on crural closure, especially in cases where primary repair is under high strain.

This adjunct procedure, however, warrants cautious application due to the risk of future herniation through the relaxing incision (Schneider et al., 2025).

Comparison Between Mesh and Suture Cruroplasty

Memon et al. reported that mesh repair seems to be superior to suture cruroplasty for large hiatal hernia repair. Therefore, the routine use of mesh may be advantageous in selected cases.

For the reoperation variable, the odds ratio was significantly 3.26 times higher for the suture group.

For recurrence of hiatal hernia, the odds ratio for the suture group was nonsignificantly 1.65 times higher compared with the mesh group. Comparable effects were noted for all other variables (Memon et al., 2019).

Salehi et al. found that using biosynthetic mesh for medium and large hiatal or paraesophageal hernia repair significantly reduces the likelihood of both anatomical and symptomatic recurrence compared with using only suture cruroplasty.

Short-term anatomical hernia recurrence rates were 11.8% and 15.6% for the mesh and suture groups, respectively.

Longer-term anatomical recurrence rates were 24.7% for the mesh group and 44.9% for the suture group.

The rates of symptomatic hernia recurrence were 8.8% and 14.6% in the short-term and 17.2% and 42.2% in longer-term follow-ups for the mesh and suture groups, respectively (Salehi et al., 2024).

Tam et al. reported that the odds of recurrence, but not the need for reoperation, were less after mesh cruroplasty. However, the quality of evidence supporting the routine use of mesh cruroplasty is low (Tam et al., 2016).

Elfeky et al. reported that laparoscopic mesh hiatal cruroplasty results in improvement of symptoms and quality of life and a decrease in hernia recurrence, but evidence supporting the routine use of mesh cruroplasty is low (Elfeky et al., 2023).

Recurrence and Durability

Recurrence following hiatal hernia repair remains an important clinical problem. The risk is particularly high in patients with large hernias, poor crural tissue, increased intra-abdominal pressure, or repairs performed under tension.

Early randomized controlled trials suggested that mesh reinforcement decreases anatomical recurrence in large hiatal hernias.

However, subsequent studies with extended follow-up have reported inconsistent results, indicating that the initial benefit may diminish over time.

Thus, recurrence prevention remains an unresolved issue, and the long-term durability of mesh reinforcement compared with suture-only repair continues to be questioned (Antoniou et al., 2012).

The presence of anatomical recurrence does not always correlate with recurrent symptoms or the need for reoperation. Some patients may develop a small radiological recurrence while remaining clinically asymptomatic.

Therefore, anatomical recurrence, symptomatic recurrence, quality of life, and the need for revisional surgery should all be considered when evaluating the success of hiatal hernia repair.

Mesh-Related Complications

Early reports using mesh at the hiatus were associated with serious complications, with some patients requiring esophagogastric resections.

Synthetic mesh was prone to erosion or infection that could lead to life-limiting dysphagia, chronic abdominal pain, and recurrent GERD.

Mesh-related complications may be costly and can appear years after hernia repair. Long-term follow-up requires registries such as Herniamed. Such a registry can be extended for research purposes following patients for years.

Patient-reported outcomes should be included. Patients' wishes and expectations matter and should be considered for good outcomes (Köckerling et al., 2021).

Dysphagia

Dysphagia is one of the most commonly reported symptoms of mesh-related complications. It may result from:

- Excessively tight crural closure.
- Dense fibrosis around the esophagus.
- Mesh contraction.
- Esophageal stenosis.
- Direct mesh erosion into the esophageal lumen.

Mesh Erosion

Mesh erosion is a rare but serious delayed complication. It occurs more frequently with permanent synthetic mesh and may involve the esophagus or stomach.

Patients may present with dysphagia, chest pain, epigastric pain, weight loss, bleeding, or recurrent reflux symptoms.

Fibrosis and Stenosis

Excessive fibrotic reaction surrounding the mesh may lead to narrowing of the esophageal hiatus and esophageal stenosis.

Severe cases may require endoscopic intervention, mesh removal, esophageal resection, or partial or total gastrectomy.

Infection

Mesh infection may cause chronic pain, fever, abscess formation, and failure of the hiatal repair. Permanent synthetic mesh may be difficult to remove because of tissue incorporation and proximity to the esophagus, stomach, heart, and major vessels.

Evidence Regarding Mesh Complications

Stadlhuber et al. reported that mesh-related complications were commonly manifested as dysphagia, heartburn, chest or epigastric pain, weight loss, and, in some cases, fever.

Reoperations revealed intraluminal mesh erosion, esophageal stenosis, and dense fibrosis.

Some patients required esophagectomy or partial to total gastrectomy, whereas others were managed without major surgery, including instances of endoscopic mesh removal.

No immediate postoperative mortality was reported. However, some patients developed severe delayed complications such as gastroparesis or long-term dependence on tube feeding.

Importantly, the study found no evident association between the type or configuration of mesh used and the occurrence of complications (Stadlhuber et al., 2009).

Spiro et al. reported that mesh-related complications are rare, with dysphagia being a common presenting feature.

Mesh erosion is associated with synthetic mesh more frequently. The incidence of mesh-related erosion was reported to be 0.035%.

Polytetrafluoroethylene, expanded polytetrafluoroethylene, composite, and other synthetic meshes were frequently associated with mesh erosion requiring intervention (Spiro et al., 2020).

Robinson et al. reported that adverse events of surgical mesh for hernia repair included:

- Infection.
- Mechanical failure.
- Pain.
- Foreign-body reaction.
- Intestinal complications.
- Adhesions.
- Seroma.
- Erosion.

Compared with other mesh types, Sepra/polypropylene mesh had more mechanical failures, biomaterial mesh had more reactions, PTFE/polypropylene mesh had more intestinal complications, and PTFE mesh tended to have more infections (Robinson et al., 2005).

Current Controversies

Hiatal hernia repair, particularly in large or recurrent cases, represents a major surgical challenge. Despite advances in minimally invasive surgery, the optimal technique for crural closure remains debated.

The central controversy lies in whether mesh reinforcement offers superior long-term outcomes compared with suture-only cruroplasty.

While mesh use may reduce short-term recurrence rates, concerns persist regarding mesh-related complications, durability, and patient safety.

These unresolved issues have fueled ongoing research, expert debates, and evolving clinical guidelines.

Routine Versus Selective Mesh Use

The potential reduction in recurrence supports the use of mesh, particularly in large defects. However, the risk of severe mesh-related complications argues against routine implantation in all patients.

The decision should therefore depend on:

- Hernia size.

- Crural tissue quality.
- Degree of tension after primary closure.
- History of previous repair.
- Patient comorbidities.
- Surgeon experience.
- Type of mesh available.

Long-Term Efficacy

The long-term benefit of mesh reinforcement remains uncertain. Some studies demonstrate lower recurrence rates, whereas others show that the difference between mesh and suture repair decreases with extended follow-up.

Further multicenter studies with larger sample sizes and longer follow-up periods are required to determine the durability and safety of mesh-reinforced repair.

Selection of Mesh Material

There is no universal consensus regarding the ideal mesh material.

Permanent synthetic meshes may provide the strongest reinforcement but are associated with erosion and fibrosis.

Biologic and absorbable meshes may have a lower risk of long-term complications but may not provide permanent protection against recurrence.

Current Guidelines

Current recommendations do not support the routine use of mesh in every hiatal hernia repair.

The Society of American Gastrointestinal and Endoscopic Surgeons reported that routine mesh use is not recommended.

Mesh reinforcement should be considered selectively in large or recurrent hiatal hernias.

Patient counseling and informed consent are emphasized, highlighting the balance between potential benefits and risks.

Patients should be informed about:

- The possibility of recurrent hernia after suture-only repair.
- The potential reduction in recurrence with mesh reinforcement.
- The uncertainty regarding long-term mesh durability.
- The possibility of dysphagia, fibrosis, erosion, infection, and revisional surgery.
- The lack of consensus regarding the optimal mesh type.

Future Directions

Further multicenter studies with larger sample sizes and longer follow-up periods are recommended to confirm the long-term safety and efficacy of laparoscopic hiatal hernia repair with mesh cruroplasty.

Comparative studies evaluating mesh-reinforced versus non-mesh cruroplasty are needed to determine the optimal surgical approach for preventing hernia recurrence.

Future research should include:

- Objective radiological evaluation of recurrence.
- Upper gastrointestinal endoscopy.
- Esophageal pH monitoring.
- High-resolution manometry.

- Standardized symptom assessment.
- Quality-of-life assessment.
- Long-term evaluation of mesh-related complications.
- Comparison of synthetic, absorbable, and biologic meshes.

Standardized definitions of anatomical recurrence, symptomatic recurrence, and treatment failure are required to allow reliable comparison between studies.

Conclusion

Suture cruroplasty restores the hiatal opening without introducing prosthetic material and remains an appropriate technique for small primary defects that can be closed without excessive tension. Mesh cruroplasty provides additional reinforcement and may decrease anatomical and symptomatic recurrence, particularly in patients with large defects, recurrent hernias, weak crural tissue, or tension at the site of primary closure. However, mesh implantation may be associated with serious delayed complications, including dysphagia, dense fibrosis, esophageal stenosis, infection, and erosion into the esophagus or stomach. Permanent synthetic meshes offer durable reinforcement but carry higher complication risks. Absorbable and biologic meshes may reduce permanent foreign-body complications, although their long-term efficacy remains uncertain. Mesh cruroplasty remains a valuable technique for reinforcing hiatal hernia repair in selected patients, balancing the benefits of reduced recurrence against potential mesh-related complications. Routine mesh use is not recommended. Mesh reinforcement should be individualized according to hernia size, tissue quality, repair tension, previous recurrence, patient characteristics, and surgeon experience. Further long-term comparative studies are required to determine the ideal mesh material, configuration, fixation technique, and patient selection criteria.

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