

Review Article

Mesh choice in inguinal hernia repair: key evidence and practical considerations

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ABSTRACT

Inguinal hernia repair is one of the most commonly performed procedures in general surgery, with prosthetic mesh reinforcement widely recognized as the standard of care due to its ability to significantly reduce recurrence rates. However, the increasing diversity of available mesh products has introduced important considerations regarding optimal prosthetic selection. Beyond structural reinforcement, mesh characteristics have been shown to influence postoperative pain, foreign body sensation, functional recovery, and overall patient quality of life. This focused review summarizes key evidence surrounding mesh selection in contemporary inguinal hernia repair, emphasizing practical considerations relevant to daily surgical practice. Core variables analyzed include mesh weight, pore size, density, anatomical placement, and fixation strategies. Lightweight meshes have demonstrated favorable outcomes in terms of reduced chronic postoperative pain and improved abdominal wall flexibility, while maintaining acceptable recurrence rates in most primary repairs. Similarly, large-pore and low-density meshes appear to enhance tissue integration and reduce fibrotic response compared with microporous prostheses. Mesh positioning within anterior or posterior planes, as well as the choice between penetrating and atraumatic fixation methods, further influences postoperative outcomes. Techniques such as glue fixation or non-fixation in selected laparoscopic repairs may reduce pain without compromising stability. Ultimately, no single mesh type is universally superior. Prosthetic selection should be individualized based on patient characteristics, hernia complexity, surgical approach, and surgeon expertise. Continued innovation in biomaterials and fixation technologies, alongside standardized outcome reporting, will be essential to refine evidence-based mesh selection and optimize long-term results in inguinal hernia surgery.

Keywords: Inguinal hernia repair, Prosthetic mesh, Mesh selection, Lightweight mesh, Chronic postoperative pain, Laparoscopic hernia repair

INTRODUCTION

Inguinal hernia repair is among the most frequently performed procedures in general surgery worldwide, with millions of operations conducted annually.¹ The introduction of prosthetic mesh has significantly reduced recurrence rates compared with tissue-based repairs, establishing mesh reinforcement as the current standard of care in most adult patients.² Both open anterior approaches, such as the Lichtenstein technique, and minimally invasive posterior repairs, including transabdominal preperitoneal (TAPP) and totally extraperitoneal (TEP) techniques, routinely incorporate mesh implantation to achieve durable outcomes.³

Despite its widespread adoption, mesh use has introduced new postoperative considerations. Chronic postoperative inguinal pain, foreign body sensation, stiffness, and mesh-related complications have emerged as clinically relevant issues influencing patient quality of life and long-term satisfaction.^{4,5} Consequently, attention has shifted from whether mesh should be used to how mesh characteristics may influence surgical and patient-reported outcomes.

Rationale

Multiple prosthetic mesh products are currently available, differing in material composition, weight, pore size, elasticity, and fixation requirements.⁶ Lightweight meshes have been associated with reduced inflammatory response and improved postoperative comfort, whereas heavyweight meshes may provide greater structural support in certain clinical scenarios.⁷ Similarly, large-pore meshes may enhance tissue integration while minimizing fibrosis and nerve entrapment, though concerns persist regarding long-term durability in larger defects.⁸

In addition to mesh structure, factors such as anatomical placement (anterior vs posterior plane) and fixation strategy (sutures, tacks, glue, or non-fixation) further complicate decision-making.⁹ Given this variability, mesh selection remains influenced by surgeon preference, institutional practice, and interpretation of heterogeneous evidence rather than universally standardized criteria.

Objective

This focused review aims to summarize key evidence and practical considerations surrounding mesh selection in inguinal hernia repair. Specifically, it examines how mesh weight, pore size, material properties, anatomical positioning, and fixation strategies may impact outcomes such as chronic pain, recurrence, postoperative complications, and patient quality of life.

By synthesizing current literature, this review seeks to provide a clinically oriented framework to support

individualized mesh selection in contemporary inguinal hernia surgery.

METHODS

Literature search

A focused literature search was conducted to identify relevant studies addressing mesh selection in inguinal hernia repair. Electronic databases including PubMed/MEDLINE, Google Scholar, and Scopus were searched for articles published from January 2000 to December 2025. Additional references were identified through manual screening of bibliographies from key review articles and international guidelines. Search terms included combinations of Medical Subject Headings (MeSH) and free-text keywords such as: “inguinal hernia,” “hernia repair,” “prosthetic mesh,” “mesh selection,” “lightweight mesh,” “heavyweight mesh,” “pore size,” “mesh fixation,” “chronic pain,” and “recurrence.” Boolean operators (AND, OR) were applied to refine the search and increase sensitivity. Priority was given to clinical guidelines, systematic reviews, meta-analyses, randomized controlled trials, and large comparative cohort studies. Relevant and widely cited older studies were included when necessary to provide historical or technical context.

Selection criteria

Studies were considered eligible if they evaluated prosthetic mesh use in adult patients undergoing inguinal hernia repair and reported outcomes related to mesh characteristics, including weight, pore size, material composition, anatomical placement, or fixation technique. Articles assessing clinical endpoints such as recurrence, chronic postoperative pain, surgical site complications, foreign body sensation, and patient-reported outcomes were prioritized. Exclusion criteria included studies focused exclusively on pediatric populations, femoral or non-inguinal hernias, biologic or biosynthetic meshes as the primary intervention, and experimental animal or laboratory research without direct clinical correlation. Case reports, small case series lacking comparative or generalizable data, and non-English publications were also excluded.

Given the narrative and focused nature of this review, no formal risk-of-bias assessment or quantitative meta-analysis was performed. Instead, evidence was synthesized descriptively to highlight key controversies and practical considerations relevant to contemporary surgical practice.

CENTRAL BODY

Lightweight vs heavyweight meshes

Mesh weight represents one of the most widely studied and debated variables in inguinal hernia repair.

Heavyweight meshes, typically composed of densely woven polypropylene with higher material mass, were historically favored for their tensile strength and durability.¹⁰ Their structural rigidity was believed to provide superior reinforcement of the posterior wall of the inguinal canal, theoretically reducing recurrence risk, particularly in large defects. However, clinical experience and comparative studies have demonstrated that heavyweight meshes may provoke a more intense foreign body inflammatory response, resulting in increased fibrosis, mesh stiffness, and nerve entrapment.¹¹ These biological reactions have been associated with higher rates of chronic postoperative inguinal pain and foreign body sensation, both of which significantly affect long-term patient quality of life.¹²

Lightweight meshes, developed to mitigate these complications, incorporate reduced material density and larger pore architecture. Evidence suggests they are associated with lower rates of chronic pain, improved abdominal wall flexibility, and enhanced patient comfort without consistently demonstrating increased recurrence in primary unilateral hernias.¹³ As a result, many contemporary surgeons favor lightweight meshes in elective settings, particularly among younger and physically active patients where postoperative comfort is a priority. Additional investigations have explored long-term functional outcomes associated with mesh weight.

Several cohort and registry-based studies suggest that while recurrence rates remain comparable between lightweight and heavyweight meshes in standard defects, patient-reported outcomes—particularly pain during physical activity and sensation of stiffness—tend to favor lightweight prostheses.¹⁴ These findings reinforce the concept that mechanical reinforcement alone should not be the sole determinant of mesh selection, especially in elective surgery focused on quality-of-life optimization.

Furthermore, the evolution of partially absorbable lightweight meshes has attempted to balance structural support with reduced long-term foreign material burden. Although early results are promising, long-term durability data remain limited, and their routine use continues to be evaluated in contemporary surgical practice.¹⁵

Pore size, mesh density, and tissue integration

Beyond overall weight, pore size plays a crucial role in mesh biocompatibility and tissue incorporation. Large-pore meshes allow for improved fibroblast ingrowth, neovascularization, and collagen deposition while reducing fibrotic bridging between filaments.¹⁶ This structural characteristic promotes more physiologic abdominal wall compliance and reduces mesh shrinkage over time.

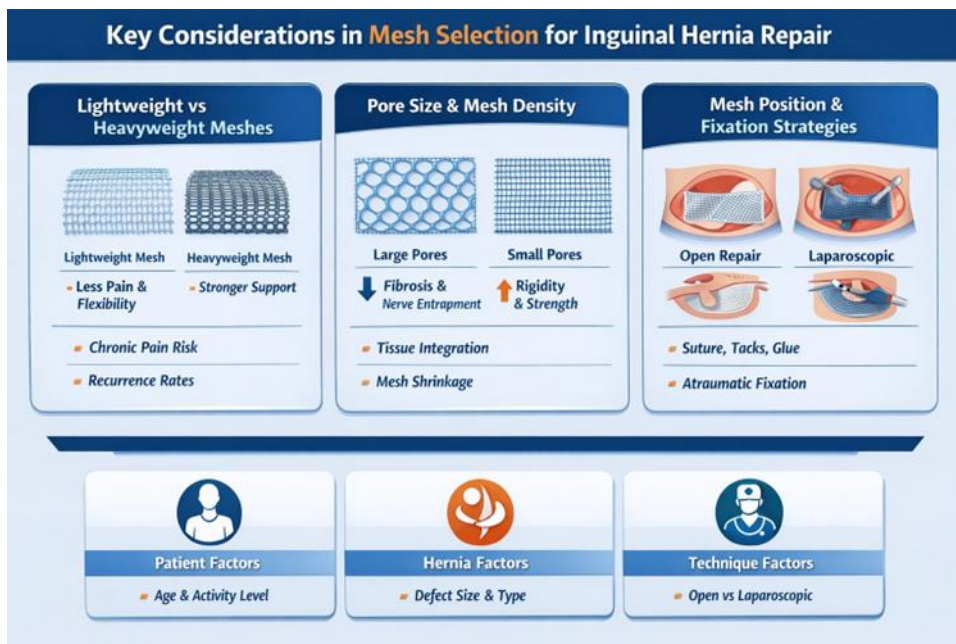


Figure 1: Key considerations in mesh selection for inguinal hernia repair.

Conversely, small-pore or microporous meshes tend to induce denser scar plate formation, which may increase stiffness and the likelihood of nerve compression.¹⁷ These factors have been implicated in postoperative discomfort and chronic pain syndromes. Nevertheless, smaller pore structures may offer theoretical advantages in mechanical strength and resistance to deformation, which can be relevant in larger or recurrent hernia defects. Current

evidence supports the use of large-pore, low-density meshes in most standard inguinal hernia repairs, balancing adequate reinforcement with improved postoperative comfort profiles.¹⁸ From an immunobiological standpoint, pore size also influences macrophage response and bacterial clearance. Larger pores facilitate immune cell migration and may theoretically reduce susceptibility to chronic mesh

infection by allowing better antibiotic penetration and host defense activity.¹⁹ Although infection rates in elective inguinal hernia repair are generally low, these structural characteristics may become relevant in contaminated or high-risk surgical fields. In addition, mesh elasticity and filament structure interact with pore size to determine the prosthesis' overall biomechanical behavior. Meshes that better mimic native abdominal wall compliance may reduce tension at the repair site, thereby contributing to improved functional recovery and patient satisfaction in the postoperative period, see Figure 1.²⁰

This infographic summarizes the principal factors influencing mesh selection in contemporary inguinal hernia repair. The upper panel compares lightweight and heavyweight meshes, highlighting differences in structural support, postoperative pain risk, and abdominal wall flexibility. The central section illustrates the impact of pore size and mesh density on tissue integration, fibrosis, nerve entrapment, and mesh shrinkage. The right panel outlines the relevance of mesh position and fixation strategies across open and laparoscopic approaches, including suture, tack, glue, and atraumatic fixation methods. The lower section integrates patient-related, hernia-related, and technique-related factors that should guide individualized prosthetic selection to optimize surgical outcomes and patient quality of life.

Mesh position and fixation strategies

Mesh placement within different anatomical planes represents another important consideration. In open anterior repairs, such as the Lichtenstein technique, the mesh is positioned over the posterior wall of the inguinal canal, placing it in closer proximity to inguinal nerves.²¹ This anatomical relationship may partially explain the higher incidence of chronic neuropathic pain reported in some open repairs. In contrast, laparoscopic approaches—including TAPP and TEP—position the mesh within the preperitoneal posterior space, allowing broader myopectineal orifice coverage while minimizing direct nerve contact.²² This posterior placement may contribute to improved pain outcomes and faster functional recovery in selected patients.

Fixation technique further influences postoperative results. Traditional suture or tack fixation provides secure mesh anchoring but has been associated with nerve irritation and pain.²³ Atraumatic fixation methods, including fibrin glue and self-gripping meshes, have gained popularity due to their potential to reduce early and chronic postoperative pain without compromising recurrence rates in appropriately selected cases.²⁴ In small defects repaired laparoscopically, non-fixation strategies have also demonstrated acceptable outcomes.

Recent comparative analyses have suggested that atraumatic fixation may be particularly advantageous in minimally invasive repairs, where wide mesh overlap

provides inherent stability. Avoiding penetrating fixation devices may reduce the risk of vascular or neural injury within the preperitoneal space.²⁵ However, in large medial defects or recurrent hernias, selective fixation remains advisable to prevent mesh migration. Cost considerations also influence fixation choice. While fibrin sealants and advanced self-gripping mesh may reduce postoperative pain, their higher material cost may limit widespread adoption, particularly in resource-constrained healthcare systems.²⁶

Limitations and future directions

This review has several limitations. Its focused, narrative design lacks the methodological rigor of systematic reviews, including formal risk-of-bias assessment and quantitative data synthesis. Selection bias may be present, as literature inclusion was based on clinical relevance and interpretative appraisal rather than predefined systematic criteria. Additionally, heterogeneity across studies in surgical technique, mesh type, fixation method, and outcome reporting limits direct comparison of findings.

Another limitation relates to the variability in chronic pain definitions and measurement tools across studies. Differences in follow-up duration, assessment scales, and reporting thresholds complicate interpretation of patient-reported outcomes and may influence perceived advantages between mesh types.²⁷ Similarly, surgeon experience and procedural volume represent confounding variables rarely standardized in comparative analyses.

Future research should prioritize high-quality randomized controlled trials directly comparing modern lightweight and large-pore mesh technologies across both open and minimally invasive platforms. Standardization of chronic pain definitions, patient-reported outcome measures, and long-term recurrence reporting will be essential to refine evidence-based mesh selection. Emerging biomaterials, resorbable prosthetics, and bioengineered meshes may further expand the field, warranting ongoing investigation into their safety, durability, and cost-effectiveness in inguinal hernia repair. In parallel, integration of patient-centered outcomes, cost-utility analyses, and real-world registry data will be critical to guide pragmatic mesh selection in diverse healthcare settings.

CONCLUSION

Mesh reinforcement remains the cornerstone of modern inguinal hernia repair, having significantly reduced recurrence rates and improved long-term surgical durability. However, as prosthetic technology has evolved, attention has shifted toward optimizing patient-centered outcomes, particularly chronic postoperative pain, foreign body sensation, and functional recovery. Current evidence suggests that mesh characteristics—including weight, pore size, density, anatomical positioning, and fixation strategy—play a meaningful

role in shaping both clinical and patient-reported outcomes.

Lightweight and large-pore meshes have demonstrated favorable comfort profiles in many elective settings, while atraumatic fixation techniques may further reduce postoperative pain without compromising repair integrity in appropriately selected cases. Importantly, no single mesh type is universally ideal. Optimal prosthetic selection should be individualized, integrating patient factors, hernia characteristics, surgical approach, and surgeon expertise. As innovation in biomaterials and fixation technologies continues, future high-quality comparative studies and standardized outcome reporting will be essential to refine evidence-based mesh selection. In contemporary practice, thoughtful prosthetic choice—rather than routine or preference-based selection—represents a key opportunity to enhance both surgical durability and patient quality of life following inguinal hernia repair.

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