

Adult Umbilical Hernia Repair in the Era of Preperitoneal Mesh: Current Evidence, Controversies, and Surgical Advances

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Abstract

Mesh reduces recurrence after adult umbilical hernia repair, but the benefit is less certain for the smallest defects. This narrative review examines the choice of repair, with particular attention to preperitoneal mesh and minimally invasive extraperitoneal techniques. Defect width is classified according to the EHS/AHS framework as small (0 - 1 cm), medium (>1 - 4 cm), or large (>4 cm) [1]. Randomized trials support mesh over suture repair for defects measuring 1 - 4 cm. For hernias ≤ 2 cm, the early SUMMER report found no significant increase in surgical-site occurrences with a small onlay mesh; this finding addresses short-term safety rather than long-term recurrence. Open repair with a flat preperitoneal mesh is recommended for most symptomatic umbilical hernias, whereas a minimally invasive approach may be considered for large defects or increased wound risk. Ventral transabdominal preperitoneal repair (V-TAPP) and enhanced-view totally extraperitoneal repair (eTEP) avoid intraperitoneal mesh placement. Comparative studies report less early pain or shorter hospital stay in selected patients, often with longer operating time. Most include mixed ventral or incisional hernias, however, and provide indirect evidence for isolated primary umbilical hernia. The review also considers how rectus diastasis, obesity, cirrhosis with ascites, and emergency presentation affect repair selection. Current evidence supports tailoring the mesh plane and extent of dissection to the abdominal wall defect; it does not establish one extraperitoneal technique as preferable for every patient.

Keywords

Umbilical Hernia, Ventral Hernia, Mesh Repair, Preperitoneal Repair, V-TAPP, IPOM, eTEP, Recurrence

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1. Scope and Literature Approach

The literature search covered PubMed/MEDLINE and major journal databases through 31 August 2026. Search terms combined “umbilical hernia” with “mesh”, “suture”, “preperitoneal”, “V-TAPP”, “IPOM”, “eTEP”, “rectus diastasis”, “cirrhosis”, and “emergency repair”. We prioritized international guidelines, randomized trials, systematic reviews and meta-analyses, large registry studies, and recent comparative studies. Earlier reports were retained where they informed current treatment. This is a narrative review: studies were selected for their clinical relevance, without a formal systematic-review process or a new pooled analysis. Throughout the review, small, medium, and large refer to EHS/AHS defect widths of 0 - 1 cm, >1 - 4 cm, and >4 cm, respectively [1]. Different thresholds used by individual studies are stated separately. Findings from mixed primary ventral, incisional, or complex ventral-hernia cohorts are identified as indirect evidence for isolated primary umbilical hernia.

2. Introduction

Adult umbilical hernias are commonly encountered in surgical practice. Most are acquired, developing in association with midline fascial weakness and repeated or sustained increases in intra-abdominal pressure. Obesity, ascites, diabetes, and other comorbidities influence presentation and outcome [2]-[4]. Even when the defect is small and closure appears straightforward, recurrence, persistent discomfort, wound complications, and the risk of emergency presentation warrant consideration.

Mesh reinforcement has increasingly replaced primary suture repair over the past two decades. Attention has consequently turned to where the mesh is placed and how much dissection is required. Intraperitoneal onlay mesh (IPOM) permits minimally invasive repair but introduces concerns about bowel contact, fixation-related pain, and composite-mesh cost. Open preperitoneal repair, MILOS/eMILOS, V-TAPP, and eTEP offer different routes to extraperitoneal reinforcement. Their shared purpose is to support the abdominal wall while separating permanent synthetic mesh from the viscera [1].

The 2020 joint guideline from the European Hernia Society (EHS) and Americas Hernia Society (AHS) recommends mesh to reduce recurrence and suggests an open preperitoneal flat mesh for most symptomatic umbilical and epigastric hernias [1]. Laparoscopy may be considered for larger defects or increased wound risk. Many recommendations were weak because evidence specific to these hernias was limited. Subsequent studies of small defects and minimally invasive extraperitoneal repair therefore need to be assessed against both the guideline recommendations and the limitations of the original evidence.

3. Patient Selection: Symptoms, Anatomy, and Modifiable Risk

Elective repair is reasonable for most symptomatic adult umbilical hernias. A

small asymptomatic defect can instead be observed in selected patients. Watchful-waiting cohorts suggest that this is feasible, although some patients later undergo surgery [5]. These cohorts were not confined to isolated primary umbilical hernia, so their findings are indirect. Symptoms, enlargement of the defect, comorbidity, and the patient's preference should inform the decision, together with the potential consequences of an emergency operation.

Preoperative assessment should include more than defect diameter. Obesity, diabetes, smoking, ascites, previous abdominal surgery, and concomitant rectus diastasis are relevant because they influence wound morbidity, recurrence, or technical choice. In a long-term cohort of 332 patients, ascites, liver disease, diabetes, obesity, and primary suture repair were associated with recurrence [4]. Rectus diastasis deserves particular attention in patients being considered for suture-only repair. Köhler and colleagues found a substantially higher recurrence rate after sutured repair when rectus diastasis was present, supporting mesh reinforcement of the midline in this setting [6].

A clinically obvious, reducible primary umbilical hernia does not always require imaging. Ultrasound may help when a small defect is difficult to palpate or obesity limits examination. Computed tomography is more useful when the anatomy remains uncertain, when several midline defects or rectus diastasis are suspected, or when recurrent or complex disease is being assessed. For minimally invasive planning, defect width and the surrounding linea alba should be considered alongside the space available for extraperitoneal mesh placement.

4. Mesh versus Suture: The Debate Has Narrowed to the Smallest Defects

The most consistent finding across the umbilical hernia literature is that mesh reinforcement reduces recurrence. The classic randomized trial by Arroyo *et al.* reported recurrence in 11% of patients after suture repair compared with 1% after mesh repair [7]. More recently, a multicenter double-blind randomized trial of 300 adults with defects measuring 1 - 4 cm found fewer recurrences after mesh repair than after suture repair (approximately 4% versus 12% during the reported follow-up), without a major difference in serious wound complications [8].

In a 2020 meta-analysis of 14 studies involving 2361 patients, mesh was associated with a lower recurrence risk than suture repair (RR 0.48) [9]. Seroma was more frequent, but surgical-site infection, hematoma, and chronic pain did not increase significantly. These findings support the guideline preference for mesh in most symptomatic adult umbilical hernias [1]. For medium defects (>1 - 4 cm), suture-only repair requires a specific reason to forgo reinforcement, such as a contraindication to mesh.

Uncertainty persists for defects ≤ 1 cm and, in some practices, those up to 2 cm. In this setting, the dissection needed to place a mesh must be weighed against the expected recurrence benefit. SUMMER compared suture repair with a 4 × 4 cm lightweight onlay mesh in primary hernias ≤ 2 cm. Its early report included 290 randomized participants and found no significant increase in surgical-site oc-

currences with mesh [10]. The mesh procedure took longer, while clinically relevant early wound events were uncommon. These 30-day findings should be distinguished from the trial's 3-year recurrence endpoint, which is needed to assess the durability of the repair.

Suture repair can still be discussed for a very small defect in a low-risk patient without rectus diastasis, provided a nonabsorbable or slowly absorbable closure can be achieved without tension. Obesity, diabetes, diastasis, multiple defects, or previous recurrence favor considering mesh at a smaller defect size [4] [6]. The decision depends on whether the expected reduction in recurrence justifies the additional dissection and implanted material in that patient.

5. Mesh Plane Matters as Much as Mesh Use

Mesh may be placed onlay, preperitoneally, retromuscularly, or intraperitoneally. For most open repairs, the EHS/AHS guideline favors a flat preperitoneal mesh [1]. This position permits overlap beyond the defect without direct visceral contact and usually allows use of a prosthesis without an intraperitoneal anti-adhesive barrier. The plane chosen also determines the dissection required.

Onlay repair avoids deep dissection and is accessible for small defects and day-case surgery. Subcutaneous dissection can, however, cause seroma and wound complications. In SUMMER, a small onlay mesh for defects ≤ 2 cm did not significantly increase early surgical-site occurrences [10]. A randomized double-blind comparison of onlay and preperitoneal placement found both approaches feasible, with a shorter operation in the preperitoneal group [11]. The small sample limits conclusions about recurrence.

Preperitoneal and retromuscular placement allow reinforcement with standard macroporous synthetic mesh, but require development of a suitable tissue plane. An extensive retromuscular dissection may be disproportionate for an isolated 1-cm defect. The same exposure may be useful when a larger defect, recurrence, or rectus diastasis requires reinforcement across a wider area of the midline. The extent of dissection should reflect that anatomical need.

Technical details should be reported alongside the name of the operation. For open preperitoneal repair, the EHS/AHS guideline suggests at least 2 cm of overlap for defects smaller than 1 cm, at least 3 cm for defects measuring 1 - 4 cm, and at least 5 cm for defects larger than 4 cm [1]. For V-TAPP and retromuscular repair, the operative aim is tension-free fascial closure when feasible, broad and flat extraperitoneal coverage, and only enough fixation to prevent displacement or folding; overlap should increase with defect size rather than follow a fixed rule [12]. Randomized evidence that defect closure reduces seroma and recurrence comes from laparoscopic umbilical IPOM, so applying that result to V-TAPP or retromuscular repair remains an extrapolation [13].

6. Open versus Minimally Invasive Repair

Open repair is suitable for many small and medium primary umbilical hernias. A

short infraumbilical incision provides access to the defect and preperitoneal plane, and selected patients can undergo the procedure under local or regional anesthesia. For a small symptomatic hernia in a non-obese patient at low wound risk, an open preperitoneal mesh offers a relatively simple, low-cost repair consistent with the EHS/AHS guideline [1].

The potential advantages of laparoscopy are greater when wound risk is high or several defects need assessment. It avoids a larger incision through thick subcutaneous tissue and permits inspection of the anterior abdominal wall. A 2024 meta-analysis of randomized trials reported lower recurrence, local infection, wound dehiscence, and seroma after laparoscopic primary ventral hernia repair [14]. The trials varied in technique and size, and the population was not limited to isolated primary umbilical hernia. This is therefore indirect evidence. It supports considering minimally invasive repair for obesity, larger or multiple defects, and increased wound risk, but does not justify laparoscopy for every small umbilical defect [1] [14].

Comparisons of open and minimally invasive surgery should specify the mesh plane. Laparoscopic access can be used for intraperitoneal, preperitoneal, or retro-muscular placement, and these repairs differ in both tissue dissection and mesh exposure to the viscera.

7. From IPOM to Extraperitoneal Minimally Invasive Repair

7.1. IPOM and IPOM-Plus

Laparoscopic IPOM provides intra-abdominal visualization and mesh overlap through small incisions. Closing the defect before mesh insertion, termed IPOM-plus, reduced seroma and recurrence compared with bridging in an umbilical-specific randomized trial [13]. The mesh remains intraperitoneal and usually requires fixation. Concerns about adhesions, bowel contact, persistent pain, and the long-term presence of a prosthesis within the cavity remain relevant even with composite meshes. Composite prostheses and fixation devices also add cost. Extraperitoneal approaches were developed in part to avoid these limitations.

IPOM remains an option when a safe preperitoneal plane cannot be developed or an extraperitoneal repair would be unduly difficult. Surgeons may also be more familiar with it, and operating time can be shorter. These advantages need to be weighed against intraperitoneal mesh placement when an extraperitoneal repair is otherwise feasible.

7.2. V-TAPP

Ventral transabdominal preperitoneal repair (V-TAPP) applies a familiar inguinal-hernia principle to the anterior abdominal wall: the peritoneum is opened, a preperitoneal pocket is created, the defect is closed when appropriate, a conventional synthetic mesh is placed outside the peritoneal cavity, and the peritoneum is closed over the prosthesis. The technique preserves laparoscopic visualization while avoiding direct mesh-viscera contact.

Megas *et al.* compared V-TAPP with laparoscopic IPOM in propensity-matched patients with small and mid-sized ventral hernias [15]. V-TAPP was associated with lower opioid use, shorter hospital stay, and lower material cost; neither matched group had a recurrence during the reported follow-up. A 2023 systematic review also found favorable short-term outcomes with V-TAPP, but noted heterogeneity and limited study quality [16]. Both sources included hernias other than isolated primary umbilical hernia and thus provide indirect evidence for this population.

The 2025 V-TAPP versus IPOM meta-analysis included eight cohort studies and 952 patients [17]. Seven studies were retrospective, and most enrolled mixed ventral-hernia populations. Selection bias and the inclusion of different hernia types limit conclusions for primary umbilical repair. Two subsequent studies focused on umbilical hernias. Chang *et al.* compared V-TAPP using biologic mesh with IPOM-plus using composite mesh in 55 patients [18]. Because the groups differed in both mesh plane and material, differences in pain or foreign-body sensation cannot be assigned to the operative approach alone. This comparison is hypothesis-generating. In a retrospective series of 70 primary umbilical hernias, Prassas *et al.* reported less pain at 24 hours and a shorter stay after V-TAPP than after IPOM, but a longer operation [19]. These short-term findings do not establish a long-term recurrence advantage.

V-TAPP separates the prosthesis from the viscera by closing the peritoneum over the mesh. Its technical demands include creating an adequate pocket and repairing peritoneal tears; operating time may be longer during the learning phase. The reported early recovery benefits are encouraging, but whether they lead to better long-term quality of life or fewer recurrences remains unresolved.

7.3. Enhanced-View Totally Extraperitoneal Repair, Retromuscular Endoscopic Repair, and MILOS Concepts

Enhanced-view totally extraperitoneal repair (eTEP) creates an expanded extraperitoneal working space for mesh placement, usually retromuscularly. This permits reinforcement across a wider midline area when rectus diastasis or more extensive fascial weakness is present, without planned entry into the peritoneal cavity. A 2025 meta-analysis comparing eTEP with IPOM reported less pain on post-operative day 7 and a shorter hospital stay, but substantially longer operating time [20]. Recurrence and overall complication rates did not differ significantly. Because ventral and incisional hernias were combined, these results cannot be treated as direct evidence for isolated primary umbilical hernia.

MILOS and eMILOS combine a small access incision with extraperitoneal sublay reinforcement. Reinbold *et al.* reported favorable 1-year outcomes in a large registry-based series of primary umbilical and epigastric hernias [21]. A limited skin incision can therefore be used to obtain broad mesh overlap. This may be useful when rectus diastasis or multiple linea alba defects make a local repair insufficient to address the surrounding midline weakness.

Robotic articulation can assist preperitoneal dissection and suturing, although access to the platform and cost may limit its use. A 2025 meta-analysis of robotic V-TAPP and robotic IPOM found broadly similar short-term outcomes, with a possible reduction in surgical-site infection after V-TAPP [22]. The included populations had mixed ventral hernias, so the evidence is indirect for primary umbilical hernia. Platform choice should be considered separately from the indication for repair and the choice of mesh plane.

8. Special Clinical Situations

8.1. Obesity and Rectus Diastasis

Obesity is associated with recurrence and wound morbidity. A thick subcutaneous layer can make a larger open incision less attractive, particularly when minimally invasive access is feasible. Weight reduction should be encouraged where achievable. In a symptomatic patient, however, the expected benefit of delaying surgery for weight optimization needs to be balanced against symptom burden and the likelihood of achieving that reduction. Body mass index alone does not resolve this decision.

With rectus diastasis, weakness extends along the linea alba beyond the umbilical defect. Closing the defect alone leaves that wider area untreated. Köhler *et al.* observed more recurrences after suture repair in patients with diastasis, supporting consideration of mesh and, in selected cases, broader midline reconstruction [6].

8.2. Cirrhosis and Ascites

Cirrhosis with ascites complicates both the development and repair of an umbilical hernia. Ascites, malnutrition, portal hypertension, and impaired healing increase perioperative risk and may compromise the repair. Deferral until a complication occurs is also hazardous, given the worse outcomes associated with emergency surgery.

The underpowered CRUCIAL randomized trial found elective repair feasible in selected patients with cirrhosis and ascites [23]. In a systematic review of more than 3000 patients, mortality was higher in patients with cirrhosis than in those without it; among those with cirrhosis, emergency repair carried higher mortality than elective repair [24]. A 2023 nationwide cohort also found worse outcomes with emergency presentation [25]. When possible, ascites should be controlled before planned repair. Medical treatment, drainage, or a transjugular intrahepatic portosystemic shunt (TIPS) may be considered in selected patients, and the timing of hernia surgery should take transplant candidacy into account.

Elective mesh repair may reduce recurrence, but contamination, ascites control, and hepatic reserve remain central to the decision. In uncontrolled ascites or severe decompensation, medical optimization and the timing of surgery take priority over selecting a repair technique.

8.3. Emergency Presentation and Contaminated Fields

In an incarcerated or strangulated hernia, resuscitation, bowel assessment, and control of contamination determine the immediate operative priorities. Evidence on mesh in this setting requires careful interpretation. A multicenter randomized trial of clean-contaminated and contaminated ventral hernia repairs found lower 2-year recurrence with retromuscular synthetic mesh than with biologic mesh, with similar safety and much lower prosthesis cost [26]. The trial involved complex ventral hernias. It therefore supplies indirect evidence, rather than a material-selection rule, for an isolated emergency primary umbilical hernia.

Permanent mesh is not appropriate in every strangulated hernia. Gross enteric spillage, physiological instability, or compromised soft tissue may favor a staged or simplified repair, and bowel resection adds to the assessment of contamination. The choice should reflect tissue quality and the ability to achieve source control as well as recurrence risk. Biologic mesh should not be assumed to be safer solely because of its material category.

9. Practical Decision Points

Table 1 summarizes the evidence most likely to affect routine decisions and the main limits of that evidence.

Table 1. Practical decision points in adult umbilical hernia repair.

Clinical question	What the evidence supports	What remains uncertain	Practical interpretation
Mesh for medium (>1 to 4 cm) primary defects	Randomized trials and meta-analysis show lower recurrence with mesh [7]-[9].	Best plane and prosthesis dimensions near the lower end of this range.	Mesh should be discussed routinely; suture-only repair is selective.
Mesh for defects of 2 cm or less	Early SUMMER data support the short-term safety of a small onlay mesh [10].	Three-year recurrence and chronic pain.	Risk factors and rectus diastasis should influence the choice.
Open or minimally invasive access	Open preperitoneal mesh has disease-specific guideline support; laparoscopic repair may reduce wound morbidity [1] [14].	The laparoscopic evidence is not limited to isolated umbilical hernia.	Choose access according to wound risk, anatomy, and expertise.
IPOM or V-TAPP	Comparative studies report less early pain or shorter stay after V-TAPP [15]-[17] [19].	Most evidence is retrospective or derived from mixed ventral-hernia cohorts.	V-TAPP is reasonable when a safe flap and adequate coverage can be achieved; IPOM remains useful in selected cases.
eTEP or retromuscular MIS	Mixed ventral/incisional data suggest less early pain and a shorter stay than IPOM, with longer operating time [20].	Umbilical-specific randomized evidence.	Most relevant when broad midline reinforcement is needed.
Cirrhosis with ascites	Emergency repair has worse outcomes; elective repair after optimization is favored [23]-[25].	Selection thresholds and mesh strategy in severe decompensation.	Control ascites and plan repair when feasible.
Biologic or synthetic mesh in contamination	A randomized complex ventral-hernia trial favored synthetic mesh for recurrence and cost [26].	Direct applicability to emergency primary umbilical hernia.	Avoid reflexive material choices; account for contamination and tissue quality.

10. Comparison of Common Repair Strategies

Table 2 compares the anatomical plane, practical strengths, and limitations of the main repair options.

Table 2. Comparison of common repair strategies.

Approach	Mesh plane	Main advantages	Main limitations	Most suitable setting
Open preperitoneal	Preperitoneal	Simple, reproducible, inexpensive; disease-specific guideline support	Local wound morbidity; dissection may be awkward in obesity	Most small and medium symptomatic primary hernias
Open onlay	Onlay	Straightforward mesh placement; limited deep dissection	Subcutaneous dissection; seroma and wound concerns	Selected small defects, including limited-mesh strategies
IPOM/IPOM-plus	Intraperitoneal	Familiar, relatively fast, broad intra-abdominal visualization	Intraperitoneal mesh, fixation-related pain, composite-mesh cost	When extraperitoneal dissection is unsafe or impractical
V-TAPP	Preperitoneal	No direct mesh-viscera contact; standard synthetic mesh; laparoscopic visualization	Flap creation and closure; learning curve; longer operating time	Selected small and medium primary ventral hernias in experienced hands
eTEP/retromuscular MIS	Retromuscular	Broad sublay space; no intraperitoneal mesh; useful with diastasis	Technical complexity; longer operating time; learning curve	Wider midline weakness, multiple defects, or rectus diastasis
MILOS/eMILOS	Retromuscular/sublay	Small access with broad extraperitoneal reinforcement	Technique-specific training and instrumentation	Patients needing sublay repair without a large open incision

11. Unresolved Questions and Future Directions

For the smallest defects, long-term randomized comparisons remain a priority. The early SUMMER report addresses wound safety, whereas the 3-year recurrence endpoint is needed to judge whether a limited onlay mesh provides a durable advantage over suture repair [10]. Chronic pain, reoperation, and patient-reported body image should also be followed.

V-TAPP and other extraperitoneal techniques need randomized comparisons in clearly defined hernia populations. Much of the V-TAPP literature is observational and combines primary and incisional defects [16] [17]. Reports should specify defect width, rectus diastasis, mesh dimensions, overlap, closure, fixation, and surgeon experience. These details are needed to distinguish the effects of the operation from patient selection and the learning curve. The two 2026 umbilical-specific comparisons improve population relevance but remain nonrandomized; one also changes mesh material along with mesh plane [18] [19].

Recurrence alone does not capture recovery after an elective, usually short-stay operation. Early pain, return to work, foreign-body sensation, cosmetic satisfaction, and cost are also relevant. Longer operating time may be acceptable if pa-

tients recover more comfortably or the repair costs less, but technical complexity by itself is not evidence of benefit.

Treatment comparisons should account for the abdominal wall surrounding the defect. Diastasis, additional midline defects, previous repair, tissue quality, obesity, and contamination can alter the suitability of a given approach even when defect widths are similar. Studies that describe these features would be more useful for selecting an operation for an individual patient.

12. Conclusion

Mesh lowers recurrence compared with suture repair for adult umbilical defects measuring 1 - 4 cm [7]-[9]. For the smallest hernias, the recurrence benefit must still be weighed against added dissection and implanted material; the early SUMMER findings support short-term safety of a limited onlay mesh, not yet its long-term superiority [10]. Open preperitoneal flat-mesh repair remains supported by disease-specific guidance for most symptomatic cases [1]. V-TAPP and eTEP offer extraperitoneal alternatives when wound risk or the extent of midline weakness favors minimally invasive repair. Their comparative evidence is less certain because many studies are retrospective or include mixed ventral-hernia populations [15]-[17] [20]. The 2026 umbilical-specific studies add short-term observations, but neither is randomized and one compares different mesh materials as well as different planes [18] [19]. Repair selection should account for these limitations and for the patient's anatomy, recurrence risk, wound risk, and the surgeon's experience.

Conflicts of Interest

The authors declare no conflicts of interest.

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