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Surgical Treatment and Management of the Hernia Umbilical Riview and Update

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Abstract

Adult umbilical hernia repair has also undergone considerable sophistication over the last few years, shifting towards less traditional repair using the suture as the main repair material, in favor of mesh-based methods, which are more conducive to long-term biomechanical needs of the abdominal wall. This evidence-based review literature synthesises up-to-date evidence based on randomised controlled trials, systematic reviews, and recent clinical guidelines in order to compare surgical outcomes obtained using an open, minimally invasive, and robotic-assisted surgical technique. The results indicate that the mesh repair is always associated with the least recurrence rates in comparison to the suture-only closure, especially in cases when the mesh is placed in retromuscular, preperitoneal, or extraperitoneal positions; in these places, the tension-sharing support increases the durability and reduces the risk of seroma formation and adhesion. Less invasive extraperitoneal methods such as eTEP offer desirable rates of postoperative comfort and quicker recovery as compared to those offered by ENDOR with some extra advantages to hernias that come with diastasis recti by allowing the rebuilding of functional midline. Robotic repair enhances accuracy in performing more challenging dissections but depends on resource availability; the results of its repetition are similar to results with laparoscopy. The data shows that no one technique is always best, and effective repair is based on the ability to match the surgical strategy with the extent of defects, physiology, and capacity of the institution

Introduction

Surgical care of umbilical hernias has changed significantly over the last few years, as a practice that was largely influenced by the familiarity of the procedure became an informed endeavor that is influenced by the understanding of biomechanics, and evidence-based argumentation. Though these hernias are often treated like trifling flaws of the abdominal wall, their long-term behaviour presents a rather complicated picture than the size of these hernias does (Abood et al., 2024; Shams et al., 2025). Lapses continue to be a clinical problem, which makes further study of the response of the abdominal wall to intervention more significant. The realization that tension lines, fascial quality, and patient-specific factors could have a great impact on the outcomes has triggered a fresh urgency on the subject of the best reinforcement strategies. This has led to a growing use of the literature by surgeons, not only to provide procedural advice but to provide conceptual models to be used to select a technique to suit the anatomical and physiological realities of the abdominal wall (Almughamsi & Elhassan, 2025; Neri et al., 2024; Schwenderling et al., 2025).

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This change of view has increased the questioning of the established practice of surgical correction of small umbilical hernias using primary suture repair (Tigora et al., 2025; Nguyen et al., 2025; Ghosh & Naniwadekar, 2024). Initial experience tended to assume a small defect earned a correspondingly small intervention but modern experience disagrees with this and presents examples of how even small hernias are subject to erratic behaviour at the forces exerted by motion, respiration, and day-to-day activity. The studies that have described the mechanical implications of isolated suturing are that an approximation of weakened fascia can reduce the manifestation of the defect but does not consistently reinforce the structure (Tang et al., 2025; van den Berg et al., 2025). These results have generated a growing acceptance of mesh reinforcement as a more solid alternative. The shift to mesh is not merely an adaptation to recurrence rates but it represents a more general realization that the abdominal wall is a moving organ whose reconstruction requires more than merely restoring surface integrity. The idea behind this conceptual development forms the basis of present-day research on the topic of optimal mesh placement and the anatomical planes that provide the longest-lasting integrity.

In parallel with these advancements, the discipline has experienced a wave of innovation of minimally invasive surgical techniques. The optimization of intraperitoneal and extraperitoneal access has helped the surgeons to reclarify not only the reinforcement of repairs, but also the way the operative channel will be made. The increasing use of extraperitoneal techniques especially extended totally extraperitoneal (eTEP) repairs is an acknowledgment of the benefits of not using the peritoneal cavity. Surgeons gain reinforcement by placing mesh in a secure retramuscular space which conforms to the normal anatomy of the abdominal wall with the least amount of contact with the visceral organs. This modification is not simply a change in aesthetics in favor of less invasive instruments but also a sign of a more fundamental change of direction to less invasive procedures, less postoperative pain, and the long-term functionality of the abdominal wall. The growing popularity of eTEP and other such methods in the modern literature highlights the technical complexity of modern surgery, as well as its growing readiness to question some of its long-standing assumptions.

These inventions have also simultaneously expanded the range of indications of more specialized procedures (Khera et al., 2024; Wentzensen et al., 2024; In patients who present with co-existent diastasis recti or complex midline deformities, the traditional repair methods might not be sufficient in the management of the structural integrity as well as the aesthetic concerns of the abdominal wall. The introduction of ENDOR is an opportunity to consider the example of a surgical paradigm that takes into consideration anatomically integrative repairs, the purpose of which is not only to seal the defect but also to restore continuity in the entire linea alba (Arias-Espinosa et al., 2024; Grosu-Bularda, et al., 2024). Even though these kinds of repairs might provoke the short-term sequelae, including seroma formation, the available literature shows that these incidences are usually temporary and should be viewed in a further treatment context. Similarly, the integration of robotic aid into extraperitoneal hernia-repair indicates a willingness of the field to use technology not only to bring new things, but also to improve ergonomics and accurate dissection that is needed in complicated reconstructions (Lomanto et al., 2024). The above developments can be seen as a landscape where innovation is directly responsive to the structural demands of the abdominal wall.

With the increased diversification of surgical methods, the need to understand clinical, anatomic, and institutional variables is even further aggravated (Sharma et al., 2025; Asghar et al., 2024; Dejenie et al., 2024). This literature shows that it is not possible to separate the choice of technique form patient-specific factors including obesity, metabolic disease, ascites, and the existence of concomitant rectus diastasis. All of these conditions alter the mechanical milieu by which repairs need to act upon. Similarly, the expediency of specific strategies depends on the institutional capability, such as access to sophisticated platforms, surgical education and perioperative assistance frameworks. These facts highlight the fact that the effectiveness of a

technique is not determined by its design only but by the parameters of context in which it is used. Modern surgeons have to, thus, strike a balance between idealised conditions as outlined in the controlled studies and the realities of the real world clinical environment. It is important to have a literature review that incorporates these dimensions to make thoughtful and context-based decision-making.

In the light of such changing paradigms, an extensive analysis of up-to-date evidence is justified and needed (dos Santos et al., 2024; Kumar et al., 2024; Talenti, 2025). The rise in the recent publications which refer to umbilical hernia repair is a result of increased clinical interest as well as the multiplication of techniques which deserve to be evaluated in an intensive manner. A systematic synthesis allows the determination of the recurrent patterns, clarification of convergent evidence and identification of unresolved questions that remains in the course of clinical enquiry. In addition, it provides a chance to follow the development of the field beyond binary comparisons between open and laparoscopic techniques, to a more holistic view on the reinforcement strategies, mesh positioning, and patient-centered outcomes. This kind of synthesis does not only present a summary of available knowledge but also puts a conceptual transformation that reinvented abdominal wall surgery in the modern world.

This paper is hence designed to explore these modern trends by examining the most notable discoveries of the current literature on umbilical hernia repair (Arrey et al., 2024; Guo et al., 2024; Wang et al., 2025). With a critical review of mesh versus suture repair, the increasing popularity of less invasive extraperitoneal methods, the contextual importance of specialized repair, including ENDOR, and the growing role of robotic platforms, this review attempts to represent a field in its transition. Thus, it will explain the principles currently informing the effective repair strategies, emphasize the factors, which define the choice of a procedure, and shed light on the conceptual and practical issues that still remain. It is not just the listing of the technique options, but a congruent interpretive framework, which harmonizes evidence, anatomy and patient-centered rationale, therefore, provides an understanding of the current development of umbilical hernia surgery both in practice and theoretical foundations.

Methods

The current study used extensive literature review to explain the dynamic situation of surgical procedure and management of adult umbilical hernia. The type of review was chosen due to the fact that the sphere is highly innovative, as new operational techniques and clinical guidelines are introduced rather quickly. By doing so, the researchers involved tried to put together an articulate representation of the existing body of evidence so that alternative methods of surgery can be evaluated comparatively without losing the fine clinical arguments that underlie the decision-making process in everyday practice. As a result, the literature review was selected as the most suitable way of fulfilling the purpose of the study since they enabled them to combine various types of evidence without losing the contextual complexity of surgical knowledge.

Two authors were involved in the systematic literature search to guarantee the maximum rigor of the methodology and minimize the possibility of bias. Four major medical databases that have always remained the primary repositories of high-quality scientific literature (PubMed, Scopus, NCBI, and Cochrane CENTRAL) were used as the starting point of the search. The published materials that were considered only include those that have been published in the year 2024 or later up to July 2025. This period was specifically selected due to the fact that these were the years when there was significant increase of extraperitoneal and robotic methods of hernia repair and that there was also revision of the clinical guidelines offered by international hernia societies. With the time limit being the latest literature, the study aimed to capture the actual situation in scientific knowledge instead of having results that no longer correspond to the modern clinical practices.

The search strategy was based on the combination of key terms that cover the scope of modern hernia surgery such as: umbilical hernia, mesh repair, open and minimally invasive, extraperitoneal access, eTEP, IPOM, and robot-assisted repair. The final pool contained a large number of publications, but only the ones that reported specific data regarding the techniques used in the operations, complication rates or a long-term outcome or evidence-based recommendations were further developed to undergo in-depth analysis. This narrowing down or filtering guaranteed that the review did not get diluted in lack of analytical clarity by studies with no clinical significance.

In order to achieve consistency and credibility, explicit inclusion criteria were used during the review. The studies that were eligible had to talk about umbilical hernia repair in adults and give sufficient details on how it is done as well as the outcome after the surgery. The review considered and accepted comparative studies, clinical trials, systematic reviews, meta-analyses, and updated consensus statements and rejected case reports and non-peer-reviewed publications because of their insufficient methodological rigour to support evidence-based conclusions. Through these requirements, the review sought to develop a sound base based on which general interpretations might be made.

The chosen research was then reviewed individually. The researchers factored in the nature of the surgical procedure used, the location of the mesh, the nature of the surgical procedure, be it an open or laparoscopic surgery, extraperitoneal surgery, or robot-assisted surgery and the post-surgical complications and outcome. The analysis was formatted in a story format as this was considered necessary since it enabled findings using different methodologies to be connected using a logical interpretive strand. In such a way, the review provided clarity of the connections between the techniques, explained the strengths and weaknesses of each one, and highlighted the clinical reasoning that nowadays guides the preferred practices, thus taking care of the subtleties of the surgical decision-making that could be missed in purely quantitative summary.

These methodological procedures were aimed to give a more profound and incorporated interpretation of the modern umbilical hernia repair. The critical analysis of evidence in the context of sound intellectual argumentation facilitated the study to make not only a summary of data available, but also a valuable and informed addition to the current scholarly debate in hernia surgery. What it produces is an integrated body that clinicians can refer to when it is necessary to bring their practice in line with the latest developments in technique, technology and evidence based guidelines.

Results and Discussion

There were 27 studies that met the inclusion criteria and were included in the final review; they included randomized controlled trials, systematic reviews, meta-analyses, and updated clinical guidelines published in 2024 -2025. Data were gathered in the qualitative manner and cross-compared in the framework of the surgical methods in terms of recurrence rates, mesh positioning, postoperative events, minimal invasive activity, and factors of clinical decision-making. Among the four major patterns identified in the synthesis, mesh reinforcement offers better durability efficiency as compared to suture-only repair, mesh anatomical placement is critical to recurrence and complication rate, minimal-invasiveness extraperitoneal techniques are promising, and technique choice is still contingent on patient factors and contextual factors.

Outcome of Suture Versus Mesh-Based Repair

Recurrence rates were further found to be lower in literature studies that were reviewed that utilized mesh repair as compared to primary suture closure. Primary suture repair had recurrence rates of 1020 per cent in a span of two to five years especially in defects of more than 1.52 cm. Mesh repair on the other hand, had recurrence values mainly below 8□□ GB,

depending on where it was placed and improvements in the technique. Retromuscular and preperitoneal repairs were mentioned to be the most enduring modalities and recurrence rate was often reported to be between 1-4%. These observations confirm the existing international best practices that suggest that umbilical hernias in adults should be implanted with mesh to reduce the recurrence.

Mesh and Its Influence on Recurrence Patterns

Suture-only repair has a significantly greater recovery-rate in virtually all studies. The recurrence rates were found to be 10-20 percentage points over a period between two to five years, particularly when the defect was abnormal by a margin of more than 1.5-2cm. The onset of mesh reinforcement led to a significant change in the results; the recurrence rates tended to be less than 8 per cent, and the rates were lower in general when the mesh was strengthened in deeper and tension sharing planes. Retromuscular and preperitoneal techniques were the most common and the recurrence rates of these methods tend to be 1-4 percent, which supports the latest guidelines according to which the use of mesh is preferred in the majority of adult cases. This was a slow trend, it was a linear pattern based on several independent research works.

Table 1. Comparison of Surgical Techniques and Recurrence Rates

Surgical Technique	Recurrence Range Reported	Evidence Summary
Primary Suture Repair	10–20% within 2–5 years	Higher recurrence; suited for very small defects
Mesh Repair (general)	1–8%	More favorable long-term results
Onlay Mesh	7–12%	Seroma risk due to superficial plane
Inlay Mesh	>15%	Rarely recommended
Retromuscular/Sublay	1–3%	Most stable and durable
Preperitoneal Mesh	2–4%	Comparable with sublay
Intraperitoneal IPOM	4–8%	Reliable yet risk of visceral contact
IPOM-Plus	3–6%	Improved variation of IPOM
eTEP / Extraperitoneal MIS	~2–4%	Low recurrence with faster recovery
ENDOR	<5% (short-mid term)	Strong option for diastasis
Robotic Repair	~2–4%	Outcome similar to laparoscopy

The information above in the table above highlights a conspicuous difference between the use of suture only repair and mesh-based methods. The recurrence rates are reduced drastically on incorporation of mesh especially when placed in supportive planes of the body. Minimally invasive methods, which are retromuscular, preperitoneal, and extraperitoneal, are always the safest ones.

Mesh Positioning and Complications

Mesh placement location not only affects durability but it also affects postoperative comfort. Mesh that is under strain or surface precipitates more seroma and wound complications. Onlay methods, despite being technically simple, often record seroma rates in the range of twenty and thirty percent. Due to their more secure protection of the anatomy, retromuscular and extraperitoneal methods are more likely to describe fewer early complications. IPOM intraperitoneally gives repeatable performance which is acceptable; nonetheless, adhesions and long-term pain remain a possibility by continuing mesh-visceral interactions.

Table 2. Complication Profiles Associated with Different Mesh Placement Approaches

Complication	Higher Risk in	Lower Risk in	Clinical Note

Seroma	Onlay, ENDOR	Retromuscular & Extraperitoneal MIS	Onlay reports up to 20–30%
Infection	Open/Onlay	MIS extraperitoneal	Small incisions reduce exposure
Chronic Pain	IPOM (tacks)	Sublay & eTEP	Often related to visceral interaction
Adhesions	IPOM	Extraperitoneal repairs	Avoided when peritoneum spared
Recurrence	Suture, Inlay	Sublay & Preperitoneal	Mesh remains key to durability

The profiles of complications indicate that the greater the integration of the meshes into the abdominal wall, the more desirable is the recovery. The mesh can be incorporated into the tissue structure instead of being a patch with a retromuscular and extraperitoneal repair.

Strength of Techniques and Their Appropriate Use

The advantages of each operative approach are specific, which depends upon the clinical circumstances. Suture repair provides speed and convenience but proves to be constrained in the long-run. However, technically more challenging, sublay mesh repair is the best option in terms of long-term stability. eTEP and TAPP are the way to minimum postoperative pain, faster recovery, and fewer adhesions in the hands of skilled surgeons. ENDOR can be used in the restoration of function of abdominal wall in patients presenting with rectus diastasis despite the expected early seroma. The repair of robots provides no better recurrence rates as compared to laparoscopy, but it enhances the ergonomics of the complex dissections that need high levels of precision.

Table 3. Comparative Strengths and Limitations of Techniques

Technique	Strengths	Limitations	Best Applied In
Primary Suture	Simple, low resource	Higher recurrence	Very small hernias
Onlay	Easy access	Higher seroma	Limited-access planes
Sublay/Retromuscular	Excellent stability	Skill-dependent	Defects >2 cm
Preperitoneal	Low recurrence	Learning curve	MIS conversion cases
IPOM	Straightforward access	Possible chronic pain	When extraperitoneal not feasible
IPOM-Plus	Better than IPOM	Still intraperitoneal	Moderate-sized hernias
eTEP/TAPP	Low pain, quicker recovery	Requires expertise	Elective MIS repairs
ENDOR	Addresses diastasis	Seroma expected	Functional reconstruction
Robotic	High precision	Costly	Complex centers

This analogy highlights the fact that there is no one technique that can be deemed superior in all. An ideal technique will only come up when it is wisely matched with the anatomy in question as well as the expertise of the practor.

Influence of Patient and Facility Context

The evidence also makes us remember that even the most efficient method will not work when used in a wrong context. The conditions that always play a role are patient physiology, comorbid conditions, integrity of the abdominal wall and the capabilities of the institution. Obese patients had reduced wound complications when operated using minimally invasive extraperitoneal access. Where contamination is involved, great care is necessary in selecting of mesh or in stage repair. The open mesh or intraperitoneal onlay mesh (IPOM) methods are also effective and feasible in resource-limited settings. Centers that utilize eTEP or robotic-assisted dissection are more likely to report high-quality outcomes that are highly specialized because of high volume and special training.

Table 4. Clinical Factors Influencing Technique Selection

Clinical Context	Suitable Approach	Key Consideration
Defect >2 cm	Mesh repair	Suture alone often insufficient
Obesity	MIS extraperitoneal	Reduces wound burden
Diastasis Recti	ENDOR	Structural correction
Contaminated Area	Selective mesh/staged	Risk-aware planning
Emergency	Situation dependent	Mesh safe in clean-contaminated
Low Resource	Open mesh/IPOM	Accessible and pragmatic
High Skill Center	eTEP/Robotic	Excellent long-term performance

In these situations, the best results happen through repair that does not violate the biomechanics of the abdominal wall, and takes into consideration the operative environment, within which the operation is undertaken.

The current review confirms that there is a significant change in the modern umbilical hernia management. However, during the last five years, clinical reasoning has shifted out of the traditional assumption that little adult hernias can be well treated using simple suture closure. Rather, the investigators are progressively describing the abdominal wall as affected by the constant mechanical stress which requires reinforcement that can sustain the long-term functional load. This change can be well seen in the new recommendations by Maia et al. (2025) as well as in recent statements by the European Hernia Society and the American Hernia Society, which state that mesh use has become the norm, not a supplementary tool.

Published in 2025, the SUMMER randomized trial offers strong clinical evidence, which supports such a transition. The trial proves that mesh repair of small umbilical hernias lowers the recurrence rate and does not increase the early postoperative adverse events. These results contradict the belief that minimal intervention surgery itself is less risky, but, rather, the results indicate that insufficient reinforcement can lead to late failure. The evidence, which is synthesized in the given review, does not contradict this view, but on the contrary, supports the usefulness of mesh reinforcement, even in case of tiny defects.

The next focus is set on mesh placement. According to Holihan et al. (2024), mesh in the deeper anatomical planes, including the retromuscular or preperitoneal space, has a better force distribution and results in a more durable repair. This fact is also supported by Wang, Chen, and Chu (2025), who reported increased patient satisfaction and better long-term quality of life in case of extraperitoneal sublay repair compared to intraperitoneal IPOM repair. As a whole, these results suggest that mesh positioning is also one of the most important factors in determining the durability, and not the presence/absence of mesh.

This trend is more evident in comparison at the network-level. A meta-analysis by Buunen et al (2025) included retromuscular and preperitoneal procedures in the top list of procedures that could reduce recurrence and complications, and inlay and suture-only repairs always fell short. The synthesis of the studies in this review proves this direction and shows that more profound mesh integration provides more positive results.

Other recent literature also points to the increased importance of minimally invasive extraperitoneal methods. Bohm et al. (2025) also found that eTEP has similar recurrence rates as IPOM, but with less postoperative pain and adhesion-related complications. Similar outcomes were reported by Wang et al. (2025) and Kapoor et al. (2024), who showed that it could be reproducible in advanced centers. These results indicate that MIS extraperitoneal repair is not a technological novelty but a more anatomic technique, which allows easier tissue recovery without direct contact of visceral organs.

The formation of ENDOR demonstrates the fact that the choice of technique is more and more oriented not only to the correction of defects, but also to the abdominal wall activity. As Kockerling, Schug Pass and Bittner (2025) show, ENDOR is effective among patients with concomitant diastasis recti. In spite of the fact that seroma is most commonly described in the early healing, Brucchi et al. (2025) observe that these complications do not tend to influence the final outcome. These works represent a wider movement towards repairs that are aimed at renovating the midline as a productive and aesthetic entity and not as a way of covering a hole.

Literature is not always unanimous. According to Ferrara et al. (2024), long-term follow-up outcomes, reporting of chronic pain, and functional recovery are incongruent. The gaps were also observed in the current review and reflect the necessity of standardized assessment tools that allow drawing more reliable conclusions about comparative results. Cases of liver cirrhosis and ascites still present the issue of clinical complexity. Even though Coelho et al. (2016) falls out of the main review period, it is still relevant and is often referred to by Maia et al. (2025) who suggests that the use of meshes could be deemed as under-optimized perioperative control and does not have to be avoided completely.

Institutional capacity comes out to be a significant factor with regard to variation of outcomes. According to Abdulmageed (2025), MIS programs require surgeon education, selection of cases, and systematic progress to be successfully implemented. According to the JPTCP study (2024), the most effective way to achieve shorter hospital stays is to offer perioperative systems to facilitate fast recovery, not focusing on technique only. Robotic platforms also have a role to play as they help in enhancing the precision of suturing when doing complicated dissections, but the existing literature lacks recurrence cases that are better than laparoscopic procedures.

The general trend of evidence paints a picture of a profession that is perfecting rather than substituting the underlining strategies. Mesh reinforcement has taken center stage in long-term repairs and retromuscular and preperitoneal placements and increasingly accepted as measures consistent with abdominal biomechanics. Minimally invasive procedures have other advantages in form of lesser pain and better recovery experiences. Further developments will probably rely on the enhancement of the reporting standards, the increased availability of advanced methods beyond the centers of high skills, and the creation of follow-up models that could fully reflect the long-term outcomes of functional performance.

Conclusion

This review outlines a clear change in the treatment of adult umbilical hernia where primary suture repair is gradually replaced by mesh reinforcement as the intervention of preference. Literature synthesies show that mesh yields significantly reduced rates of recurrence and good long-term structural stability particularly when the defect is continuously stressed under mechanical forces. As a result, mesh has changed its role as an optional adjunct to an essential part of durable repair that the choices made by surgeons are guided by a biomechanically aware understanding of abdominal-wall biomechanics.

The effectiveness of mesh-based repair heavily relies on the location in the supportive anatomic planes. Retromuscular, preperitoneal, and extraperitoneal designs are always the very best with minimal complication rates as compared to more superficial or intraperitoneal methods.

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Minimally invasive extraperitoneal surgeries, including eTEP, additionally increase the comfort and functional recovery after surgery and apply to the patients with diastasis recti, extending the range of therapeutic opportunities. In spite of the fact that robotic platforms provide a higher level of technical accuracy, all the benefits will always depend on the institutional resources and level of skills of the operator, which means that the technological advancement will be most useful in partnership with adequate skills and experience.

The available evidence confirms that there is no universal technique that is better than the others; the best results are achieved with the repair plans being customized to the morphology of the defects, the patient features, and the intraoperative environment. Mesh is still the foundation of modern repair, although clinical judgment still dominates the choice of the most suitable modality in every instance. The gaps in the current literature about chronic pain, functional recovery, and patient quality of life need to be filled with future research, and therefore the surgical practice is evolving not only through innovation but also through evidence-based support that will anchor the decision-making process to patient-centred outcomes.

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