

Mesh Selection in Contaminated Ventral Hernia Repair

—A Narrative Review of Comparative Evidence and Clinical Application

Junming Shi, Chuanchang Yin*

Department of Hernia Surgery, The First People's Hospital of Jingzhou Affiliated to Yangtze University, Jingzhou, China

Email: *yinchuanchang@yangtzeu.edu.cn

How to cite this paper: Shi, J.M. and Yin, C.C. (2026) Mesh Selection in Contaminated Ventral Hernia Repair. *Journal of Biosciences and Medicines*, 14, 38-53.
<https://doi.org/10.4236/jbm.2026.1411004>

Received: September 10, 2026

Accepted: October 27, 2026

Published: October 30, 2026

Copyright © 2026 by author(s) and Scientific Research Publishing Inc.
This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).

<http://creativecommons.org/licenses/by/4.0/>



Open Access

Abstract

Background: In a contaminated ventral hernia, the choice of mesh must account for both recurrence and complications of the wound. Biologic implants gained acceptance partly because they were thought less vulnerable to infection. Comparative clinical studies have since called that assumption into question. **Methods:** We reviewed randomized comparisons and their later follow-up reports, comparative cohorts, prospective studies of biosynthetic mesh, and clinical guidelines. Targeted searches of PubMed-indexed records, Europe PMC, and publisher websites were last updated on September 9, 2026. We considered each result in relation to the wound class, operative setting, mesh position, fascial closure, and length of follow-up. This was a selective narrative review without a formal assessment of bias or statistical pooling. **Findings:** In the randomized trials, polypropylene reduced recurrence compared with the biologic meshes tested. The clearest evidence concerns planned reconstruction in clean-contaminated or contaminated wounds, completed in one operation. Later follow-up continued to favor polypropylene for recurrence, with no detected excess of late infection or mesh excision. The safety estimates remain imprecise, and these trials provide little guidance for dirty wounds, uncontrolled sepsis, or bridging an open fascial defect. Biosynthetic mesh cohorts report promising results after the implant has resorbed, but comparisons differ considerably in their patients and methods. Emergency guidelines also favor permanent macroporous mesh when implantation is appropriate; their advice on timing and mesh position reflects the constraints of emergency surgery. **Conclusions:** For elective contaminated reconstruction, the best comparative evidence supports macroporous polypropylene for repairs with fascial closure and retromuscular reinforcement. Biologic or biosynthetic mesh may be considered for a stated clinical reason, but contamination by itself has

not been shown to confer an advantage on either material. Control of the infectious source and the feasibility of repair should guide the decision before a mesh is selected.

Keywords

Ventral Hernia, Incisional Hernia, Contamination, Polypropylene Mesh, Biologic Mesh, Biosynthetic Mesh

1. Introduction

The concern about placing permanent mesh in a contaminated wound is understandable: infection may persist around the implant. Yet loss of mechanical support can leave the abdominal wall vulnerable to recurrence. Biologic scaffolds were introduced into this difficult setting, and their use grew after the Ventral Hernia Working Group (VHWG) related patient and wound characteristics to choices in reconstruction [1]. At that stage, comparative trials had not established the clinical benefit attributed to biologic mesh [2].

The PRICE trial and a separate multicenter trial in clean-contaminated and contaminated repairs subsequently reported fewer recurrences with permanent synthetic mesh than with the biologic comparator [3] [4]. Follow-up of the latter trial, published in 2026, extended the observations on recurrence and late mesh complications [5]. These findings have a direct bearing on material choice for the operations studied. Their relevance to a different operation depends on its wound conditions and technique.

The term “contaminated hernia” alone gives too little information for that judgment. A surgeon planning reconstruction alongside controlled bowel surgery faces different conditions from one treating an emergency perforation. A previous wound infection adds another, distinct consideration. Physiological stability and the feasibility of repair are central to the 2026 European Hernia Society (EHS) emergency guidelines [6]. For absorbable implants, longer follow-up and recent comparative cohorts also allow a closer assessment of individual products than the broad label “biosynthetic mesh”.

We examine the choice among permanent synthetic mesh, principally polypropylene, biologic mesh, and absorbable biosynthetic mesh for adults with ventral or incisional hernias in Centers for Disease Control and Prevention (CDC) class II-IV fields. The main comparisons concern recurrence and infection or removal of the implant. We also consider wound complications, further surgery, patient-reported outcomes, and cost. For elective cases, the question is which material to use in planned single-stage reconstruction, particularly when the fascia can be closed and reinforced retromuscularly. Emergency evidence addresses a separate decision: whether mesh repair is appropriate after stabilization and source control, or whether definitive reconstruction should be postponed.

2. Scope and Literature Approach

For this narrative review, we combined search terms for ventral or incisional hernia with contamination, biologic, synthetic, biosynthetic, absorbable, polypropylene, and poly-4-hydroxybutyrate. PubMed-indexed records, Europe PMC, publisher pages, and reference lists of key papers were examined, with targeted searches for recent studies through September 9, 2026. Priority was given to randomized comparisons, subsequent reports from those trials, comparative cohorts, prospective studies of absorbable meshes, and guidelines relevant to contaminated repair. Foundational publications were retained to explain earlier practice.

For each key study, interpretation considered the enrolled population, contamination definition, mesh material and plane, fascial closure, outcome ascertainment, and duration and completeness of follow-up. Clean-wound studies were used only to identify limits of extrapolation. Primary inguinal and hiatal hernia studies, prophylactic mesh placement without an existing ventral defect, and pre-clinical studies without a direct clinical contribution were outside the review's scope. We did not attempt an exhaustive search, register a protocol, formally grade the risk of bias, or pool the results. When a trial produced several publications, we identified the later reports as follow-up or secondary analyses to avoid counting the trial more than once.

3. Defining the Clinical Setting

3.1. Wound Class and Patient Risk

Under the CDC classification, class II includes operations that enter a colonized viscus under controlled conditions, without unusual contamination. Gross gastrointestinal spillage or acute nonpurulent inflammation places a wound in class III; established infection or a perforated viscus places it in class IV [7]. These categories should be reported individually. Grouping them together conceals differences in bacterial burden, tissue condition, and the ability to obtain source control. The name of an accompanying procedure is also insufficient to assign a class: bowel resection, for example, can occur under controlled conditions or in the presence of spillage or perforation.

VHWG grade and CDC wound class describe related but different attributes. The original VHWG framework combines comorbidity, previous infection, and operative contamination [1]. Consequently, a VHWG grade 3 cohort should not automatically be interpreted as a cohort of CDC class III wounds. This is especially relevant to biosynthetic mesh studies, in which a previous wound infection may qualify a patient as potentially contaminated even when active contamination is absent at reconstruction.

The indications for reinforcing the abdominal wall also require context. The long-term randomized comparison of suture and mesh repair established a durability advantage for mesh in incisional hernia surgery, but it did not answer the separate question of what to implant during uncontrolled intra-abdominal infection [8]. Evidence supporting reinforcement should not be used to bypass a deci-

sion about the timing of definitive repair.

3.2. Elective Reconstruction and Emergency Repair

Before elective reconstruction, there is time to assess the defect alongside the patient's nutritional and functional status. The EHS guidelines for midline incisional hernia address modifiable risks and favor closing the fascia with retromuscular reinforcement in the population they cover. Their recommendations do not encompass every complex contaminated defect [9]. The principal randomized trial in contaminated reconstruction similarly tested a defined operation in specialist centers [4].

Emergency surgery has different constraints. Hemodynamic instability, bowel viability, a need for repeat exploration, or inability to close the fascia may determine the immediate operation before a durable mesh is selected. Older World Society of Emergency Surgery guidance already distinguished clean-contaminated surgery from contaminated or dirty wounds and acknowledged the limited evidence for reconstruction in the latter settings [10]. Current emergency recommendations should therefore be read within their own clinical scope, rather than replaced by an elective trial protocol.

4. Materials and the Reconstruction They Support

Permanent synthetic meshes vary in polymer, filament structure, pore size, and density. These characteristics are not interchangeable, and mesh weight alone is an incomplete description. Mechanical behavior also depends on the interaction between implant and abdominal wall, rather than tensile strength in isolation [11]. The strongest randomized evidence discussed below applies specifically to polypropylene and to the tested implantation technique. It does not establish equivalent performance for every permanent polymer or intraperitoneal composite.

Biologic meshes are tissue-derived extracellular matrix scaffolds. Processing, tissue source, and cross-linking alter their behavior. The prospect of tissue incorporation helped motivate their use. Whether that remodeling translates into fewer infections must be established clinically. Early critical appraisal found that recommendations favoring biologic mesh in contaminated fields relied predominantly on case reports and case series [2]. Their performance needs to be judged against a contemporary comparator and with adequate follow-up.

Biosynthetic absorbable meshes provide temporary reinforcement. The term covers different materials, including polyglycolic acid-trimethylene carbonate (PGA-TMC) and poly-4-hydroxybutyrate (P4HB), with different resorption profiles. PGA-TMC is generally absorbed within approximately 6 - 7 months, whereas P4HB resorption takes approximately 12 - 18 months [12] [13]. Neither the absence of a permanent polymer nor the duration of resorption establishes that a product will resist infection or prevent late recurrence better than polypropylene.

The work required of a mesh depends on whether it reinforces a fascial closure or spans a defect that remains open. A multicenter comparison and meta-analysis

by Holihan and colleagues associated primary fascial closure with fewer recurrences than bridging, while acknowledging substantial heterogeneity and limitations in the underlying studies [14]. Comparisons between mesh products therefore need to record whether the fascia was closed.

5. Comparative Evidence for Permanent Synthetic Mesh

5.1. Randomized Trials and Extended Follow-Up

In PRICE, 165 patients with clean or contaminated ventral hernias were randomly assigned to porcine biologic mesh or polypropylene. At two years, recurrence affected 39.7% of the biologic group and 21.9% of the synthetic group. A larger difference was reported in the contaminated subgroup, although its size and the trial's broader eligibility criteria limit the precision of that estimate [3]. The trial favors polypropylene overall, while leaving uncertainty about the size of the benefit within individual contamination categories.

The trial by Rosen and colleagues enrolled 253 patients with CDC class II-III wounds. All underwent fascial closure with retromuscular placement of either medium-weight polypropylene or non-cross-linked porcine dermis. Recurrence at two years affected 5.6% of the polypropylene group and 20.5% of the porcine dermis group, a difference of 14.9 percentage points. The groups did not differ significantly in surgical site occurrences requiring a procedure (odds ratio 1.22, 95% confidence interval 0.60 - 2.44) [4]. Because both the operation and materials were specified, this trial is particularly relevant to planned single-stage contaminated reconstruction. Its safety estimate is less decisive: the confidence interval still includes differences that could matter clinically.

Remulla and colleagues later assessed 203 members of the same randomized cohort (80.2%), with a median follow-up of 5.4 years. Midline recurrence over the longer follow-up period was reported in 11.8% of patients assigned synthetic mesh and 23.6% assigned biologic mesh. Neither group had a newly recorded mesh infection or mesh excision after year 2. Most of the cumulative difference in recurrence arose during the first two years; the curves were not shown to keep separating thereafter [5]. The earlier benefit therefore persisted during extended observation. Incomplete follow-up and the small number of late complications still limit what can be concluded about safety. These are later observations from one trial, rather than results from an additional randomized comparison.

A smaller pilot trial of 87 complex repairs found no benefit from biologic mesh at one year; its primary composite outcome numerically favored synthetic mesh but was imprecisely estimated [15]. A participant-level analysis combining this pilot trial with PRICE included 252 randomized patients. At 24 - 36 months, the primary composite of major complications did not differ significantly between materials [16]. That pooled analysis should be distinguished from the Rosen trial and should not be cited as independently confirming its recurrence effect.

Four randomized trials, with 758 patients in total, were combined in a meta-analysis that favored synthetic mesh for both recurrence and major complications

[17]. Its pooled population included different wound classes and operative contexts. It supports the overall direction of the trial evidence, but the pooled estimate does not resolve uncertainty in poorly represented subgroups. Selected studies and their principal applicability limits are summarized in **Table 1**.

Table 1. Selected studies informing mesh choice in contaminated ventral hernia repair.

Study and design	Population and repair	Main reported outcome	Applicability limit
PRICE 2021 Randomized trial [3]	165 patients; clean and contaminated wounds; porcine biologic mesh versus polypropylene	Two-year recurrence: 39.7% biologic versus 21.9% synthetic	Contaminated subgroup results come from a broader trial population
Rosen 2022 Randomized trial [4]	253 class II-III repairs; retromuscular mesh with fascial closure	Two-year recurrence: 20.5% biologic versus 5.6% synthetic	Two specific materials and specialist reconstruction centers
Remulla 2026 Extended randomized cohort [5]	Follow-up in 203 of the original 253 patients; median 5.4 years	Midline recurrence: 23.6% biologic versus 11.8% synthetic; no new infections or excisions beyond year 2	Same cohort as Rosen 2022; incomplete long-term follow-up
RICH 2012 Prospective single-arm study [23]	80 repairs using porcine dermis; 39 class II, 39 class III, 2 class IV; 16 bridged	Two-year recurrence: 28%; wound events: 66%; no complete matrix excision	No comparator; bridging and very few class IV cases
COBRA 2017 Prospective single-arm study [12]	104 class II-III repairs using PGA-TMC; fascial closure; 84% followed at 2 years	Two-year Kaplan-Meier overall recurrence: 17%	No comparator; overall outcome includes midline and parastomal recurrence
Van den Dop 2023 Prospective cohort follow-up [13]	84 elective VHWG grade 3 repairs using P4HB; 61 assessed at 5 years	Five-year estimated recurrence: 15.9%; four new recurrences after year 2	VHWG grade 3 does not equal CDC class III; attrition
Huang 2024 Retrospective cohort [25]	207 PGA-TMC repairs across all wound classes; median follow-up 55.4 months	Recurrence: 28.8% contaminated versus 10.4% clean	Different wound groups and observation times; no alternative-mesh control

Rates are reproduced as reported by the studies, using their own outcome definitions and follow-up denominators. They are not directly comparable across rows. The Remulla report extends the Rosen randomized trial and must not be counted as an independent trial. CDC, Centers for Disease Control and Prevention; PGA-TMC, polyglycolic acid-trimethylene carbonate; P4HB, poly-4-hydroxybutyrate; VHWG, Ventral Hernia Working Group.

5.2. Observational Studies and External Validity

Earlier observational data explain why randomized comparison became necessary. Carbonell and colleagues reported 100 retrorectus polypropylene repairs in class II-III wounds. Wound class was associated with different surgical site infection rates: 7.1% for clean-contaminated repairs and 19.0% for contaminated repairs. Four implants required removal, with anastomotic leakage or other enteric complications among the circumstances reported [18]. The series showed that polypropylene could be used in these fields, while the removals illustrated the difficulty posed by continuing contamination.

In a multicenter cohort of 126 contaminated or clean-contaminated repairs,

Majumder and colleagues found significantly fewer wound events and recurrences with synthetic than biologic mesh [19]. A separate series of 541 contaminated repairs also favored permanent synthetic material, with most meshes placed extra-peritoneally [20]. These findings are compatible with the randomized evidence, but surgeon selection of material and differences in case complexity can influence their apparent effect sizes.

Registry data include patients treated outside the original trial settings. An analysis from the Abdominal Core Health Quality Collaborative (ACHQC) covered 2,484 elective repairs in class II-III fields. After propensity matching, several wound outcomes at 30 days did not differ significantly across groups, whereas reported recurrence at one year was lower with permanent mesh than with absorbable synthetic or biologic implants [21]. Matching cannot resolve unrecorded differences in patient selection, and the way recurrence is identified during follow-up also affects these comparisons.

Another ACHQC analysis included 7,219 repairs using polypropylene and compared contaminated with clean wounds. For infection at the surgical site within 30 days, contamination carried an adjusted odds ratio of 2.60 (95% confidence interval 1.96 - 3.46). Only 20.8% of patients had follow-up at one year, making recurrence estimates difficult to interpret [22]. Thus, the use of polypropylene does not remove the wound morbidity associated with contamination. Since every repair used polypropylene, this analysis offers no direct comparison of mesh categories.

6. The Remaining Role of Biologic Mesh

The RICH study established that single-stage reconstruction using non-cross-linked porcine dermis was feasible in selected contaminated cases. Among 80 patients, 28% developed recurrence and 66% experienced at least one wound event by two years, although no matrix required complete excision. Sixteen defects were bridged, and only two patients had CDC class IV wounds [23]. These details matter: graft retention is a different outcome from durable repair, and the cohort provides little direct evidence for heavily infected class IV defects.

The randomized comparisons carry more weight in routine material selection than this uncontrolled experience. Contamination alone is not a supported indication for choosing the biologic products evaluated in those trials [3] [4]. Conversely, unfavorable findings for a particular porcine dermal matrix cannot prove that every biologic product behaves identically. Current comparisons have not identified a benefit that would justify routine use. When a biologic implant is considered for an exceptional case, including salvage, the reason should be explicit and weighed against recurrence risk and cost.

7. Biosynthetic Absorbable Mesh

7.1. Prospective Cohorts and Follow-Up beyond Resorption

The prospective multicenter COBRA study evaluated PGA-TMC mesh in 104 class II-III repairs with fascial closure. The two-year Kaplan-Meier estimate of

overall recurrence was 17%, with 84% completing follow-up. Intraperitoneal placement was associated with more recurrence than retrorectus placement, but only ten patients received intraperitoneal mesh [12]. With nonrandom allocation of mesh position and so few intraperitoneal repairs, the observed association has limited relevance to other meshes or techniques.

For P4HB, Christopher and colleagues described 60 patients with CDC class II-IV wounds operated on by a single surgeon. They reported surgical site infection in 16.7% and recurrence in 8.3%, with a median observation period of 24.2 months [24]. These percentages describe the experience of that cohort. Differences in the patients assessed at follow-up, together with the lack of a comparator, make them unsuitable for direct comparison with the randomized polypropylene results.

The prospective P4HB cohort provides observations five years after repair, well beyond the expected period of resorption. Of the original 84 patients, 61 underwent follow-up assessment. Estimated recurrence was 15.9%, including four recurrences first detected between years 2 and 5. During that interval, no complications attributed to the mesh and no further operations for chronic pain were reported [13]. Patients entered the study on the basis of VHWG grade 3. Among those followed, a history of wound infection was far more common than gastrointestinal contamination or a stoma. This distinction limits the use of these long-term results for patients with CDC class III-IV wounds.

Later recurrence is also relevant to PGA-TMC. Huang and colleagues followed 207 repairs involving all wound classes for a median of 55.4 months. Recurrence affected 28.8% of contaminated repairs, compared with 10.4% of clean repairs [25]. Differences in case mix and observation time limit a causal comparison, but the findings show why an early low recurrence rate is insufficient to judge an absorbable scaffold.

7.2. Comparative Evidence and Unresolved Questions

Newer comparative studies remain sensitive to their clinical setting. A 2025 matched study found no significant three-year recurrence difference between P4HB and polypropylene after retrorectus repair, but it included clean wounds only [26]. It should not be cited as evidence of equivalent performance in contamination. In a separate matched comparison of class II-IV repairs, the biosynthetic implant was placed as an onlay and the biologic implant as an underlay [27]. Because both material and placement changed together, the outcomes cannot isolate a material effect.

The 2026 meta-analysis brought together 35 descriptive studies and 17 comparative studies of biosynthetic meshes designed to provide support over a prolonged resorption period. In comparisons with permanent synthetic mesh, recurrence did not differ significantly and the odds of explantation were lower [28]. The authors nevertheless identified marked heterogeneity, a predominance of retrospective studies, and limited follow-up. The explantation finding merits further investigation in a defined contaminated population using a specified device; it is insuf-

ficient to establish that device's superiority over polypropylene.

For a patient who wishes to avoid a permanent implant, a biosynthetic device can be considered if definitive reinforcement is otherwise appropriate. That discussion should identify the product, where it will be placed, and how long it is expected to provide support. More severe contamination, by itself, is not evidence that a resorbing implant will perform better. Direct randomized comparisons in contaminated wounds, with follow-up well beyond absorption and consistent definitions of recurrence and explantation, remain a priority.

8. Credibility of the Evidence

The preference for polypropylene in elective reconstruction rests mainly on the randomized comparisons with the biologic products tested [3] [4]. The completeness of follow-up needs careful reading. Rosen and colleagues reported two-year follow-up for 233 of 241 surviving participants (97%). The later report assessed 203 of the original 253 randomized patients (80.2%) [4] [5]. One percentage uses survivors as its denominator and the other uses everyone randomized, so the figures cannot be compared directly as retention rates. Missing outcomes may change the estimated recurrence rate and matter particularly when few late infections occur. Confidence is consequently greater in the recurrence benefit within this elective setting than in estimates of rare late harms.

In observational studies, surgeons choose the material with knowledge of the contamination, previous failures, and planned operation. Those same factors, along with surgeon expertise, may affect the result. Propensity matching can balance measured characteristics but leaves unmeasured selection factors unresolved [19]-[22]. Cohorts without a comparator show what was achievable with a biologic or biosynthetic implant in selected patients. Attrition and differences in the device or fascial closure further restrict comparisons across these studies [12] [13] [23] [24] [28]. They support consideration of alternatives in selected cases, while leaving comparative superiority or equivalence to polypropylene unproven. Emergency recommendations are conditional because their supporting evidence has low or very low certainty [6]. This appraisal is qualitative; we did not conduct a formal risk-of-bias assessment or apply GRADE.

9. Applying the Evidence in Practice

Here, adequate source control means treating the anatomical focus that sustains infection. Depending on the findings, this may require draining a collection, debriding infected nonviable tissue, or stopping an enteric leak. Giving antibiotics alone does not establish that the source has been controlled. This operational interpretation follows sepsis guidance and the EHS requirement for source control before emergency mesh repair [6] [29].

Uncontrolled sepsis is used here to describe unresolved infection accompanied by persistent or worsening organ dysfunction or hemodynamic instability despite initial treatment. It is a clinical boundary for applying elective reconstruction ev-

idence, not a separate diagnostic category or a single laboratory cutoff. Resuscitation and infection management take priority in these patients, particularly in septic shock [6] [10] [29].

Feasible fascial closure means that the native fascial edges can be approximated without bridging, excessive tension, or physiological compromise [6] [10]. The emergency EHS pathway requires direct closure without a myofascial release [6]. In elective specialist reconstruction, a planned release can still produce the fascial closure used in the randomized trial [4]. Preoperative CT helps anticipate the need for advanced closure techniques, but does not provide a universal threshold for safe closure [9].

The elective use best supported by direct comparison is retromuscular reinforcement with macroporous polypropylene in a class II-III field, once the infectious source is controlled and fascial closure is feasible [4]. Technical planning should establish how the defect will be closed and how the mesh will be separated from the viscera. A different closure or mesh position changes how closely the repair resembles the trial operation and therefore how confidently its results can guide the decision.

For emergency repair, the 2026 EHS recommendation is conditional: mesh may be used in a patient who is stable, has adequate source control, and has a wound of CDC class II or higher that permits direct closure. For mesh repair, the guidelines favor permanent macroporous synthetic mesh. However, they suggest onlay placement for open emergency repair and defer definitive reconstruction when direct closure is not feasible; certainty is low or very low for these recommendations [6]. This differs from specialist elective reconstruction in both patient selection and technical priorities. The guideline could not provide separate estimates for class II-III versus class IV wounds, so its broad recommendation does not eliminate uncertainty in dirty cases.

Class IV wounds should therefore prompt a decision about source control and reconstructive timing, rather than an automatic switch to a biologic or biosynthetic implant. In a prospective nonrandomized study, Birolini and colleagues reported feasible single-stage onlay polypropylene repair in 40 selected dirty-infected cases compared with 40 clean controls [30]. That experience suggests that infection is not an absolute barrier in every carefully selected reconstruction, but it does not justify definitive mesh repair during uncontrolled sepsis.

Management after removal of an infected mesh is another distinct problem. A 2025 two-center series used P4HB after explantation in 29 patients and reported substantial early morbidity, a short mean follow-up of 17 months, and one subsequent mesh explantation [31]. This experience is relevant to specialist salvage decisions, although it cannot determine which replacement material is best across such cases. Temporary closure or staged reconstruction remains relevant when patient physiology, tissue viability, or ongoing contamination prevents a durable immediate repair. **Table 2** summarizes the questions that should be resolved before choosing an implant; it is a clinical synthesis, not a validated decision rule.

Table 2. Clinical questions that determine the relevance of mesh evidence.

Clinical situation	Question before mesh selection	Evidence-informed approach
Planned class II-III reconstruction	Can contamination be controlled and the fascia closed with retromuscular reinforcement?	Polypropylene has direct randomized support when the proposed repair resembles the tested operation [4] [5]
Emergency hernia with direct closure feasible	Is the patient stable and has adequate source control been achieved?	Use the emergency guideline context, including its conditional material and plane recommendations [6]
Emergency defect not amenable to direct closure	Would definitive reconstruction add excessive operative burden or compromise immediate care?	Consider deferred reconstruction and an appropriate temporary closure strategy [6]
Dirty wound or infected-mesh replacement	Is infection controlled, is tissue viable, and is immediate durable repair realistic?	Individualize timing and material in specialist care; available selected cohorts do not establish a universally preferred implant [30] [31]
Explicit preference to avoid a permanent implant	Does the patient understand recurrence uncertainty and the possible need for further surgery?	Discuss a specified biosynthetic device as an alternative, acknowledging the absence of established superiority in contaminated wounds [13] [28] [34]

This table is an interpretive clinical synthesis, not a validated treatment algorithm. Wound class, physiological stability, defect closure, operative plane, and the specific device all affect applicability. Elective trial results should not be transferred uncritically to emergency surgery.

Enteric fistula, anastomotic leak, planned stoma surgery, and active mesh infection should not be treated as interchangeable forms of contamination. The elective class II-III trial included selected fistula repairs and stoma creation or reversal; their presence alone does not exclude applicability, although these small subgroups cannot establish separate material effects [4]. A persistent fistula or anastomotic leak with ongoing contamination requires source control before the elective evidence can guide reconstruction [18] [29]. Planned stoma surgery should be classified by the actual operative contamination, rather than assumed to be a dirty wound [7]. Active mesh infection differs from a history of infection and requires a separate assessment of explantation, residual contamination, and timing; salvage series do not establish the best replacement material [31].

10. Patient Outcomes and Economic Considerations

A repair may remain intact while leaving a patient with pain, impaired abdominal wall function, or the burden of further procedures. These outcomes deserve attention alongside recurrence and mesh removal. The quality-of-life analysis of PRICE found no significant between-group differences using mixed models, including in analyses by contamination. Some analyses of change in the Short Form 36 favored synthetic mesh, and overall costs were higher with biologic mesh [32]. Across these measures, patients did not report a consistent advantage from the biologic material.

An ACHQC study examined patient-reported outcomes after elective contaminated reconstruction. After propensity matching, changes in pain and quality-of-

life scores did not differ significantly among nonabsorbable mesh, absorbable synthetic mesh, and biologic mesh at the follow-up intervals reported [33]. The matched groups were small and longer-term observation was incomplete, so modest differences may remain uncertain. Taken with the recurrence findings from randomized trials, these results offer no established patient-reported benefit that would routinely favor biologic mesh.

Patients should be asked which outcomes matter to them and how they view a permanent implant. A 2025 study using a video decision aid and probability trade-off questions in 100 patients found that most prioritized recurrence risk over mesh category [34]. Because the study included hernias beyond contaminated cases, its findings should guide the discussion rather than determine an individual choice. Recurrence and further surgery can be discussed in concrete terms alongside the permanence or eventual absorption of the implant.

In the principal randomized trial, the median prosthetic cost was US\$105 for synthetic mesh and US\$21,539 for biologic mesh. Direct hospital expenditure over 30 days was also lower in the synthetic arm [4]. These are study-specific US costs, not current prices applicable to every hospital. A separate cost-utility model favored synthetic mesh for elective retromuscular repair, while showing that different assumptions about late complications could change the preferred strategy [35]. An earlier analysis confined to clean-contaminated repair reached a similar economic conclusion [36]. The value of these models depends on the clinical estimates entered into them, which makes observed long-term outcomes essential. A more costly scaffold needs to offer additional patient benefit if it is to replace polypropylene in routine practice.

11. Evidence Limitations and Research Priorities

Much of the uncertainty arises when results from a narrowly selected population are applied to the wider range of cases described as contaminated hernias. Elective specialist reconstruction, emergency bowel surgery, previously infected wounds, and active mesh infection should not be pooled conceptually as a single indication. Technical differences further complicate interpretation, particularly when bridging, fascial closure, or mesh plane varies between treatment groups.

How and when recurrence is sought affects the result. Examination, imaging, patient reports, and records of reoperation will not identify exactly the same recurrences. Attrition can obscure both late recurrence and uncommon infection, especially in registries. Future comparative studies should report denominators at each interval and distinguish asymptomatic imaging findings from symptomatic recurrence and repeat repair. Reports from the same trial should remain identifiable to avoid counting the same participants repeatedly.

A useful next comparison would test a specified biosynthetic device against contemporary polypropylene in patients with a clearly defined degree of contamination, using a consistent technique and follow-up that continues after resorption. Dirty wounds and infected-mesh replacement require separate evaluation.

Patient-reported outcomes and the total burden of subsequent procedures should accompany recurrence and mesh retention. Our own review selected studies narratively and did not formally grade their risk of bias. The resulting clinical interpretation retains those limitations.

12. Conclusion

For elective single-stage reconstruction of class II-III ventral hernias, permanent macroporous polypropylene is the best-supported choice when the fascia can be closed and reinforced in the retromuscular plane. Its recurrence advantage over the biologic comparator persisted at longer follow-up, without a detected increase in late mesh infection or excision. Absorbable biosynthetic devices remain an option, but a consistent benefit over polypropylene in contaminated wounds has yet to be demonstrated. Emergency presentations and active infection require their own assessment of source control, closure, and timing. Material selection should follow that assessment and remain within the limits of the populations and operations studied.

Funding

This work received no specific funding.

Author Contributions

The first author drafted the manuscript. The corresponding author conceived the review.

Review Registration

This narrative review was not prospectively registered.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

- [1] Breuing, K., Butler, C.E., Ferzoco, S., Franz, M., Hultman, C.S., Kilbridge, J.F., *et al* (2010) Incisional Ventral Hernias: Review of the Literature and Recommendations Regarding the Grading and Technique of Repair. *Surgery*, **148**, 544-558. <https://doi.org/10.1016/j.surg.2010.01.008>
- [2] Primus, F.E. and Harris, H.W. (2013) A Critical Review of Biologic Mesh Use in Ventral Hernia Repairs under Contaminated Conditions. *Hernia*, **17**, 21-30. <https://doi.org/10.1007/s10029-012-1037-8>
- [3] Harris, H.W., Primus, F., Young, C., Carter, J.T., Lin, M., Mukhtar, R.A., *et al* (2021) Preventing Recurrence in Clean and Contaminated Hernias Using Biologic versus Synthetic Mesh in Ventral Hernia Repair. *Annals of Surgery*, **273**, 648-655. <https://doi.org/10.1097/sla.0000000000004336>
- [4] Rosen, M.J., Krpata, D.M., Petro, C.C., Carbonell, A., Warren, J., Poulouse, B.K., *et al* (2022) Biologic vs Synthetic Mesh for Single-Stage Repair of Contaminated Ventral

- Hernias: A Randomized Clinical Trial. *JAMA Surgery*, **157**, 293-301. <https://doi.org/10.1001/jamasurg.2021.6902>
- [5] Remulla, D., Carvalho, A., Birrell, A.M., Fafaj, A., Maskal, S.M., Woo, K.P., *et al.* (2026) Mesh-Related Outcomes of Biologic versus Synthetic Mesh for Single-Stage Repair of Contaminated Ventral Hernias: A 5 to 10-Year Analysis of a Randomized Controlled Trial. *Annals of Surgery*, **283**, 390-397. <https://doi.org/10.1097/sla.0000000000006906>
 - [6] Stabilini, C., Theodorou, A., Pawlak, M., Antoniou, S., Berrevoet, F., Bougard, H., *et al.* (2026) EHS Guidelines on the Management of Primary Ventral and Incisional Hernias under Emergency Conditions. *Journal of Abdominal Wall Surgery*, **5**, Article No. 16228. <https://doi.org/10.3389/jaws.2026.16228>
 - [7] Mangram, A.J., Horan, T.C., Pearson, M.L., Silver, L.C. and Jarvis, W.R. (1999) Guideline for Prevention of Surgical Site Infection, 1999. *American Journal of Infection Control*, **27**, 97-134. [https://doi.org/10.1016/s0196-6553\(99\)70088-x](https://doi.org/10.1016/s0196-6553(99)70088-x)
 - [8] Burger, J.W.A., Luijendijk, R.W., Hop, W.C.J., Halm, J.A., Verdaasdonk, E.G.G. and Jeekel, J. (2004) Long-Term Follow-Up of a Randomized Controlled Trial of Suture versus Mesh Repair of Incisional Hernia. *Annals of Surgery*, **240**, 578-585. <https://doi.org/10.1097/01.sla.0000141193.08524.e7>
 - [9] Sanders, D.L., Pawlak, M.M., Simons, M.P., Aufenacker, T., Balla, A., Berger, C., *et al.* (2023) Midline Incisional Hernia Guidelines: The European Hernia Society. *British Journal of Surgery*, **110**, 1732-1768. <https://doi.org/10.1093/bjs/znad284>
 - [10] Birindelli, A., Sartelli, M., Di Saverio, S., Coccolini, F., Ansaloni, L., van Ramshorst, G.H., *et al.* (2017) 2017 Update of the WSES Guidelines for Emergency Repair of Complicated Abdominal Wall Hernias. *World Journal of Emergency Surgery*, **12**, Article No. 37. <https://doi.org/10.1186/s13017-017-0149-y>
 - [11] Deeken, C.R. and Lake, S.P. (2017) Mechanical Properties of the Abdominal Wall and Biomaterials Utilized for Hernia Repair. *Journal of the Mechanical Behavior of Biomedical Materials*, **74**, 411-427. <https://doi.org/10.1016/j.jmbbm.2017.05.008>
 - [12] Rosen, M.J., Bauer, J.J., Harmaty, M., Carbonell, A.M., Cobb, W.S., Matthews, B., *et al.* (2017) Multicenter, Prospective, Longitudinal Study of the Recurrence, Surgical Site Infection, and Quality of Life after Contaminated Ventral Hernia Repair Using Biosynthetic Absorbable Mesh: The COBRA Study. *Annals of Surgery*, **265**, 205-211. <https://doi.org/10.1097/sla.0000000000001601>
 - [13] Van den Dop, L.M., Van Rooijen, M.M.J., Tollens, T., Jørgensen, L.N., De Vries-Reilingh, T.S., Piessen, G., *et al.* (2023) Five-Year Follow-Up of a Slowly Resorbable Biosynthetic P4HB Mesh (Phasix) in VHWG Grade 3 Incisional Hernia Repair. *Annals of Surgery Open*, **4**, e366. <https://doi.org/10.1097/as9.0000000000000366>
 - [14] Holihan, J.L., Askenasy, E.P., Greenberg, J.A., Keith, J.N., Martindale, R.G., Roth, J.S., *et al.* (2016) Component Separation Vs. Bridged Repair for Large Ventral Hernias: A Multi-Institutional Risk-Adjusted Comparison, Systematic Review, and Meta-Analysis. *Surgical Infections*, **17**, 17-26. <https://doi.org/10.1089/sur.2015.124>
 - [15] Olavarria, O.A., Bernardi, K., Dhanani, N.H., Lyons, N.B., Harvin, J.A., Millas, S.G., *et al.* (2021) Synthetic versus Biologic Mesh for Complex Open Ventral Hernia Repair: A Pilot Randomized Controlled Trial. *Surgical Infections*, **22**, 496-503. <https://doi.org/10.1089/sur.2020.166>
 - [16] Dhanani, N.H., Lee, K.H., Olavarria, O.A., Young, C., Primus, F., Holihan, J.L., *et al.* (2023) Biologic versus Synthetic Mesh in Ventral Hernia Repair: Participant-Level Analysis of Two Randomized Controlled Trials at Twenty-Four to Thirty-Six Months. *Surgical Infections*, **24**, 554-560. <https://doi.org/10.1089/sur.2022.342>

- [17] Siddiqui, A., Lyons, N.B., Anwoju, O., Cohen, B.L., Ramsey, W.A., O'Neil, C.F., *et al.* (2023) Mesh Type with Ventral Hernia Repair: A Systematic Review and Meta-Analysis of Randomized Trials. *Journal of Surgical Research*, **291**, 603-610.
<https://doi.org/10.1016/j.jss.2023.07.003>
- [18] Carbonell, A.M., Criss, C.N., Cobb, W.S., Novitsky, Y.W. and Rosen, M.J. (2013) Outcomes of Synthetic Mesh in Contaminated Ventral Hernia Repairs. *Journal of the American College of Surgeons*, **217**, 991-998.
<https://doi.org/10.1016/j.jamcollsurg.2013.07.382>
- [19] Majumder, A., Winder, J.S., Wen, Y., Pauli, E.M., Belyansky, I. and Novitsky, Y.W. (2016) Comparative Analysis of Biologic versus Synthetic Mesh Outcomes in Contaminated Hernia Repairs. *Surgery*, **160**, 828-838.
<https://doi.org/10.1016/j.surg.2016.04.041>
- [20] Warren, J., Desai, S.S., Boswell, N.D., Hancock, B.H., Abbad, H., Ewing, J.A., *et al.* (2020) Safety and Efficacy of Synthetic Mesh for Ventral Hernia Repair in a Contaminated Field. *Journal of the American College of Surgeons*, **230**, 405-413.
<https://doi.org/10.1016/j.jamcollsurg.2019.12.008>
- [21] Rodriguez-Quintero, J.H., Romero-Velez, G., Lima, D.L., Huang, L., Sreeramaju, P. and Malcher, F. (2023) Permanent vs Absorbable Mesh for Ventral Hernia Repair in Contaminated Fields: Multicenter Propensity-Matched Analysis of 1-Year Outcomes Using the Abdominal Core Health Quality Collaborative Database. *Journal of the American College of Surgeons*, **236**, 374-386.
<https://doi.org/10.1097/xcs.0000000000000433>
- [22] Polcz, M.E., Pierce, R.A., Olson, M.A., Blankush, J., Duke, M.C., Broucek, J., *et al.* (2023) Outcomes of Light and Midweight Synthetic Mesh Use in Clean-Contaminated and Contaminated Ventral Incisional Hernia Repair: An ACHQC Comparative Analysis. *Surgical Endoscopy*, **37**, 5583-5590.
<https://doi.org/10.1007/s00464-022-09739-0>
- [23] Itani, K.M.F., Rosen, M., Vargo, D., Awad, S.S., DeNoto, G. and Butler, C.E. (2012) Prospective Study of Single-Stage Repair of Contaminated Hernias Using a Biologic Porcine Tissue Matrix: The RICH Study. *Surgery*, **152**, 498-505.
<https://doi.org/10.1016/j.surg.2012.04.008>
- [24] Christopher, A.N., Morris, M.P., Jia, H., Broach, R. and Fischer, J.P. (2021) Resorbable Synthetic Ventral Hernia Repair in Contaminated Fields: Outcomes with Poly-4-Hydroxybutyrate Mesh. *Plastic & Reconstructive Surgery*, **148**, 1367-1375.
<https://doi.org/10.1097/prs.00000000000008579>
- [25] Huang, E.Y., Broderick, R.C., Spurzem, G.J., Li, J.Z., Blitzer, R.R., Cheverie, J.N., *et al.* (2024) Long-Term Outcomes of PGA-TMC Absorbable Synthetic Scaffold in Both Clean and Contaminated Ventral Hernia Repairs. *Surgical Endoscopy*, **38**, 2231-2239. <https://doi.org/10.1007/s00464-024-10777-z>
- [26] Khan, S., Hornick, M.M., Voytik, M., Broach, R.B., Kovach, S.J. and Fischer, J.P. (2025) Biosynthetic Compared with Synthetic Mesh in Retrorectus Ventral Hernia Repair: A Matched Analysis with 3-Year Outcomes. *Surgery*, **186**, Article 109579.
<https://doi.org/10.1016/j.surg.2025.109579>
- [27] Amro, C., Ewing, J.N., Romeo, D.J., Rhodes, I.J., Gala, Z., Lemdani, M.S., *et al.* (2025) Onlay Resorbable Biosynthetic versus Underlay Biologic Mesh Ventral Hernia Repair in Contaminated Fields. *Journal of Surgical Research*, **305**, 398-405.
<https://doi.org/10.1016/j.jss.2024.10.044>
- [28] Wieser, M., van den Berg, R. and Romain, B. (2026) Complications after Biosynthetic Long-Term Absorbable Mesh Implantation for Ventral Hernia Repair in Clean and

- Contaminated Environments: A Systematic Review and Meta-Analysis. *Hernia*, **30**, Article No. 220. <https://doi.org/10.1007/s10029-026-03699-3>
- [29] Evans, L., Rhodes, A., Alhazzani, W., Antonelli, M., Coopersmith, C.M., French, C., *et al.* (2021) Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock 2021. *Intensive Care Medicine*, **47**, 1181-1247. <https://doi.org/10.1007/s00134-021-06506-y>
- [30] Birolini, C., de Miranda, J.S., Tanaka, E.Y., Utiyama, E.M., Rasslan, S. and Birolini, D. (2019) The Use of Synthetic Mesh in Contaminated and Infected Abdominal Wall Repairs: Challenging the Dogma—A Long-Term Prospective Clinical Trial. *Hernia*, **24**, 307-323. <https://doi.org/10.1007/s10029-019-02035-2>
- [31] Joliat, G., Passot, G. and Romain, B. (2025) Mesh Removal and Ventral Hernia Repair with Long-Term Absorbable Mesh in Case of Mesh Infection. *Hernia*, **29**, Article No. 298. <https://doi.org/10.1007/s10029-025-03475-9>
- [32] Diab, M.M., Patel, S., Young, C., Allen, I.E. and Harris, H.W. (2024) Quality of Life Measures and Cost Analysis of Biologic versus Synthetic Mesh for Ventral Hernia Repair: The Preventing Recurrence in Clean and Contaminated Hernias Randomized Clinical Trial. *Surgery*, **175**, 1063-1070. <https://doi.org/10.1016/j.surg.2023.11.013>
- [33] Rodriguez-Quintero, J.H., Estrada, A., Arias-Espinosa, L., Jindani, R., Huang, L., Pereira, X., *et al.* (2024) Elective Complex Ventral Hernia Repair in Contaminated Fields: A Propensity Score-Matched Analysis of Long-Term Quality of Life and Outcomes between Different Prostheses. *Surgery*, **176**, 1668-1675. <https://doi.org/10.1016/j.surg.2024.08.017>
- [34] Martinez Ugarte, S., Fajemisin, M.O., Guy-Frank, C.J., Ferguson, D.M., Stulberg, J.J., Kao, L.S., *et al.* (2025) Hernia Recurrence Risk Matters More than Mesh Type to Patients Undergoing Ventral Hernia Repair. *Journal of Surgical Research*, **311**, 212-220. <https://doi.org/10.1016/j.jss.2025.04.028>
- [35] Schneeberger, S., Phillips, S., Huang, L., Pierce, R.A., Etemad, S.A. and Poulouse, B.K. (2019) Cost-Utility Analysis of Biologic and Biosynthetic Mesh in Ventral Hernia Repair: When Are They Worth It? *Journal of the American College of Surgeons*, **228**, 66-71. <https://doi.org/10.1016/j.jamcollsurg.2018.10.009>
- [36] Fischer, J.P., Basta, M.N., Krishnan, N.M., Wink, J.D. and Kovach, S.J. (2016) A Cost-Utility Assessment of Mesh Selection in Clean-Contaminated Ventral Hernia Repair. *Plastic and Reconstructive Surgery*, **137**, 647-659. <https://doi.org/10.1097/01.prs.0000475775.44891.56>