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Review Article

Mitigating hernia risk after abdominal surgery: a review article

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ABSTRACT

Incisional hernias are a frequent and costly complication following abdominal surgery, with a reported incidence ranging from 10% to 50%, depending on patient factors, surgical approach, and follow-up method. This narrative review consolidates contemporary evidence on prevention strategies, with a focus on operative techniques, prophylactic mesh augmentation, and perioperative optimisation. High-quality randomized trials and meta-analyses support the small-bite closure technique (5 mm bites with 5 mm spacing), continuous slowly absorbable monofilament sutures, and maintaining a suture-to-wound length ratio of at least 4:1. Prophylactic mesh placement in selected high-risk populations (retrorectus or pre-peritoneal planes) substantially reduces the incidence of incisional hernias. Modifiable risk factors, such as obesity, smoking, diabetes, malnutrition, and surgical site infection, should be optimized before elective surgery. Emerging resorbable synthetic meshes may provide temporary reinforcement and reduce long-term foreign-body complications. However, data on their long-term durability remain limited. Herein, we present an evidence-based algorithm and four summary tables to assist clinicians in risk stratification and tailored prevention. Implementation requires surgeon training, institutional pathways, and systems for long-term outcome monitoring to confirm durable benefits.

Keywords: Abdominal surgery, Incisional hernia, Prophylactic mesh, Prevention, Risk stratification, Small-bites technique

INTRODUCTION

Incisional hernia (IH) is one of the most common long-term complications of abdominal surgeries. It is associated with substantial patient morbidity (chronic pain, cosmetic concerns, bowel obstruction, and risk of strangulation), frequent re-operations, and considerable healthcare expenditure.[1] Estimates of IH incidence vary widely, typically 10%–50% at 2–5 years, reflecting heterogeneity in patient populations, surgical procedures, closure techniques, and surveillance strategies (clinical as well as imaging-based). Certain procedures, notably open abdominal aortic aneurysm (AAA) repair and emergency laparotomy, have a particularly high risk of IH, whereas midline incisions confer a higher risk than transverse or oblique incisions.[2] IH pathogenesis is multifactorial.[3] Normal wound healing proceeds through haemostasis, inflammation, proliferation, and remodelling, and disruption at any stage (infection, ischemia, or poor collagen synthesis) increases the risk of failure.

Mechanical factors (excess tension on the fascial closure, raised intra-abdominal pressure), patient factors (obesity, diabetes, smoking, immunosuppression, malnutrition), and technical aspects (suture material, stitch size, closure technique) were combined to determine the outcomes. Changes in collagen metabolism and matrix remodelling have been implicated in the development and recurrence of hernias.[4] Over the last decade, high-quality randomized trials, meta-analyses, and clinical guidelines have shifted practice toward evidence-based prevention strategies.[5] Key interventions include the small-bite fascial closure technique, the use of slowly absorbable monofilament sutures, strict adherence to a suture-to-

wound length ratio of 4:1, and selective prophylactic mesh augmentation in high-risk cohorts. Concurrently, pre-operative optimization — weight reduction, smoking cessation, glycaemic control, and nutritional improvement — is recognized as integral to prevention.[6,7]

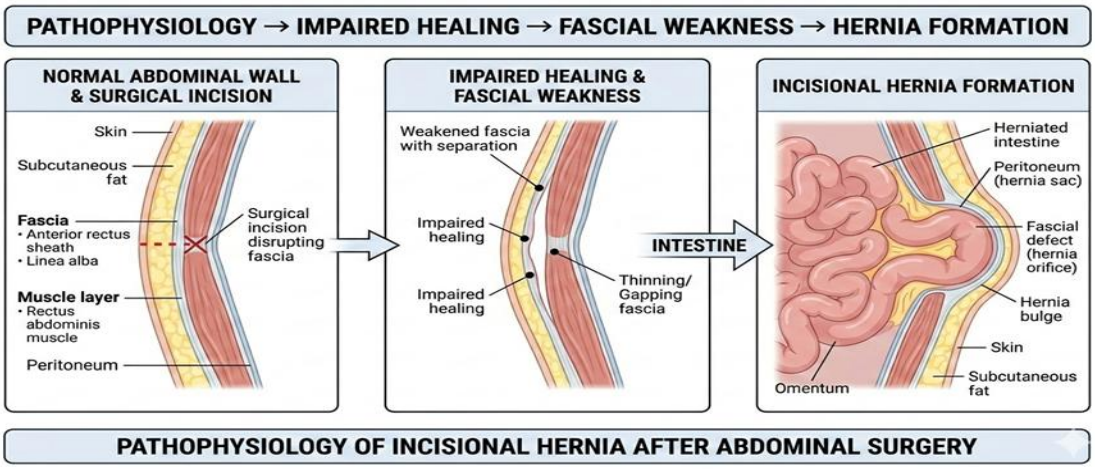

Figure 1: Schematic illustrating development of incisional hernia: incision, impaired healing, fascial weakness, and herniation of intra-abdominal contents.

This review provides a description of the current evidence, highlights procedure-specific considerations, and proposes an operational algorithm for risk-stratified prevention of IH.

METHODS

This narrative literature review was designed to synthesize high-level evidence and practical guidance for the prevention of incisional hernia. A literature search was performed (PubMed, Scopus, Cochrane Library, Google Scholar) for English-language articles published between January 2000 and March 2026. Search terms included combinations of: "incisional hernia,"", "abdominal surgery,""; "laparotomy,""; "hernia prevention,"; "prophylactic mesh,"; "small bites,"; "suture-to-wound ratio, risk factors,"; "pre-habilitation"". RCTs, systematic reviews, meta-analyses, cohort studies, and clinical practice guidelines were prioritized. Case reports and animal studies were excluded. The reference lists of included articles were manually searched for additional relevant studies. Evidence was synthesized and organized into the following themes: patient risk factors, surgical technique, prophylactic mesh, pre-operative optimization, and procedure-specific considerations. Emphasis was placed on high-quality RCTs, guideline statements, and large cohort analyses.

Epidemiology and timing

Incidence rates vary depending on the procedure and surveillance, and clinical follow-up underestimates IH compared to CT-based surveillance. IH rates increases with the length of follow-up; many patients experience recurrences and late presentation as IH is captured only with long-term imaging. The highest rates have been reported after midline laparotomy, open AAA repair, and emergency surgery.[8-10]

Patient-related risk factors

Consistently reported independent predictors include:

Obesity: High BMI increases intra-abdominal pressure and provides mechanical stress leading to IH; odds ratios in some series approach or exceed 2–8 depending on the cohort.

Smoking: It impairs tissue oxygenation and collagen synthesis, hence predisposing to IH.

Diabetes/hyperglycemia: Impairs healing and predisposes to SSI.

Malnutrition/low albumin level: Associated with impaired collagen deposition is also a risk factor for IH.

SSI and contamination: Strongly associated with subsequent IH. Risk stratification models allow the calculation of individual risks and help to focus on prophylactic interventions for those who are most likely to benefit from it.[11-13]

Suture technique and materials

Randomized evidence and meta-analyses strongly support:

Small-bites technique: Sutures were placed approximately 5 mm from the fascial edge and 5 mm apart to reduce IH compared to large bites (STITCH trial and subsequent studies).

Continuous running closure suturing technique: Achieves a more even distribution of tension than interrupted techniques.

Suture material: Slowly absorbable monofilament sutures (polydioxanone (PDS), poly-4-hydroxybutyrate (Monomax)) maintain tensile strength during early healing (6–12 months) and are preferable to rapidly absorbable or multifilament braided sutures.

Suture-to-wound ratio: A minimum ratio of 4:1 is recommended both biomechanically and clinically to reduce dehiscence and IH. Although the small-bite technique may increase the operative time and requires training, the reduction in IH incidence and re-operation appears to justify its adoption wherever feasible.[14-16]

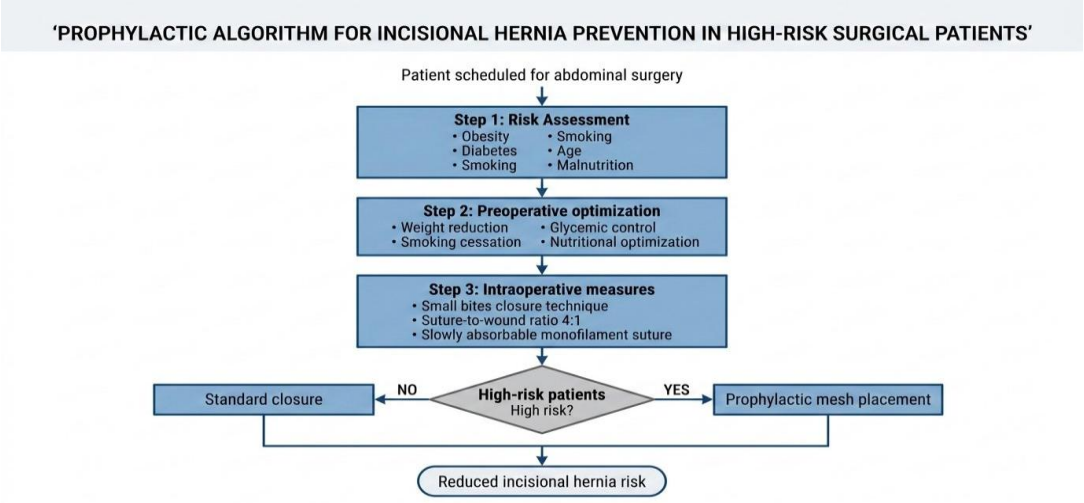

Figure 2: Multidisciplinary prevention algorithm for high-risk IH patients: triage, optimization, surgical threshold, intraoperative measures, postoperative monitoring.

Table 1: Independent risk factors for incisional hernia (IH) development.

Risk factor	Impact / significance
Obesity (BMI >30 kg/m2)	Odds ratio up to 8.2; strong correlation with early development
Trainee-led closure	20% IH rate vs 12% for consultants; HR 1.85 reported in some series
Diabetes mellitus	Independent risk factor (or ≈1.7)
Extraction site widening	Identified as independent risk factor for trocar-site hernia
Low albumin (<3.5 g/dl)	Independent risk factor for IH (or ≈1.8)

Table 2: Evidence-based technical parameters for abdominal closure.

Parameter	Recommendation	Clinical rationale
Suture material	Slowly absorbable monofilament (PDS, Monomax)	Sustained tensile strength, lower bacterial adherence
Suture technique	Running / continuous	Evenly distributes pressure; reduces suture knot burden
Stitch size	Small bites (<10 mm)	Reduced fascial ischemia and tearing
Suture-to-wound ratio	Minimum 4:1	Biomechanical standard, reduces dehiscence

Table 3: Comparison of IH rates by procedure and mitigation tool.

Procedure type	Reported IH rate	Key mitigation strategy
Stoma reversal	36%	Polydioxanone suture; consider prophylactic stoma-site mesh
AAA repair	Up to 69% (older series)	Prophylactic retrorectus/sublay mesh
Emergency laparotomy	~18.5% (control cohorts)	Subcutaneous closed suction drainage reported to reduce SSI and IH in some series
Laparoscopic trocar-site hernia (TSH)	5–28% dependent on port size	Close fascial defects 10 mm; off midline trocar placement

Prophylactic mesh augmentation

A body of RCTs, meta-analyses, individual patient data studies support prophylactic mesh in selected high-risk patients.

Efficacy: Trials in AAA repair and other high-risk groups reported large relative reductions in IH incidence; some reported absolute reductions, translating into clinically meaningful prevention.[17,18]

Mesh type: Permanent synthetic (lightweight polypropylene) has shown robust efficacy in many trials. Slowly resorbable synthetic meshes aim to provide the temporary mechanical support and reduce long-term foreign body effects; however, long-term recurrence data are still pending.19,20

Anatomical plane: The retro rectus (sublay) and pre-peritoneal positions favored for mesh incorporation and avoidance of visceral contact. Onlay placement is easier, associated with higher risk of seroma formation.[21,22]

Complications: In prophylactic settings, mesh infection and chronic pain rates are low (reported mesh infection 0.6% in pooled series), but remain a possibility and must be weighed against the large reduction in IH risk.[23,24]

Procedure-specific considerations

Open AAA repair: This is among the highest risk factors for IH. Multiple RCTs have demonstrated the benefit of prophylactic mesh (often recommended routinely) for these patients.[25,26]

Emergency laparotomy: High baseline risk owing to contamination and hemodynamic instability; ongoing trials evaluate prophylactic mesh in emergency settings.[27,28]

Colorectal and HPB surgery: The risk varies with incision type and contamination; stoma sites and their reversal are important contributors to the risk of IH.[29, 30]

Laparoscopic extraction/port sites: Fascial closure for ports of 10 mm is important for reducing trocar site hernias.[31]

Transplant recipients: Immunosuppression increases the risk of IH. Selective prophylactic mesh strategies for prevention are currently being investigated.[32]

Pre-operative optimization (pre-habilitation)

Pre-operative interventions to reduce perioperative complications and IH incidence as part of a bundle.[33-35]

Weight reduction: Structured programs (including GLP-1 agonist–assisted approaches) can substantially reduce the BMI before elective surgery.

Table 4: Impact of pre-operative weight optimization (GLP-1 agonists).

Metric	Outcome value
Mean total weight loss (%TWL)	14.0%
Mean BMI reduction	5.3 kg/m2
Time to surgery (average)	8.2 months
30-day post-op morbidity	9.1% (reported cohorts)

Smoking cessation: Ideally, four weeks prior to surgery showed some reduction in risk.

Glycemic control: HbA1c optimization and perioperative glucose control reduce SSI risk.

Nutritional optimization: Protein supplementation and correction of hypoalbuminemia when possible.

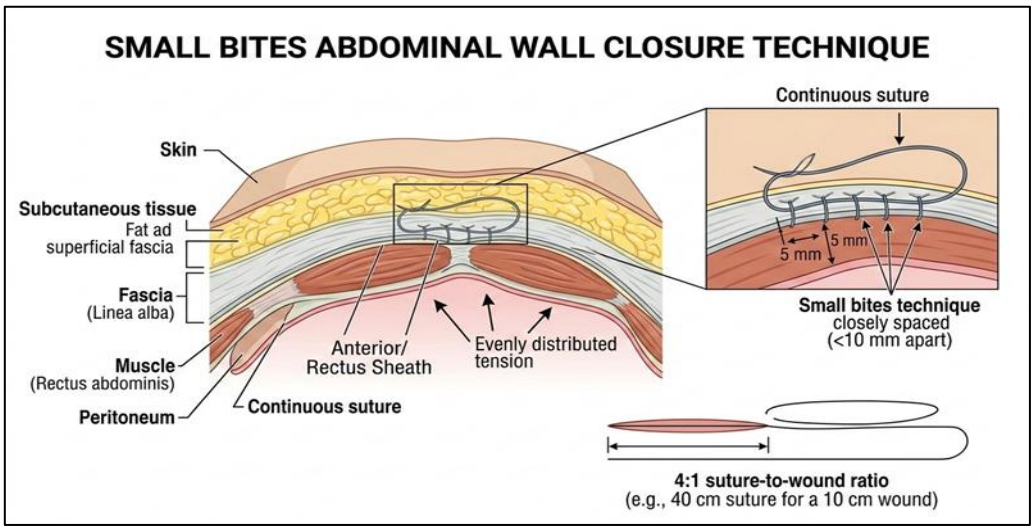

Figure 3: Small-bites closure technique demonstrating stitch placement, continuous running suture, and the principle of achieving a suture-to-wound length ratio ≥4:1.

DISCUSSION

This review reinforces the notion that IH prevention requires a multifaceted approach that combines optimized surgical techniques, selective prophylactic mesh in high-risk patients, and perioperative risk optimization.[36]

Interpretation of evidence

High-quality RCTs (e.g., STITCH/ESTOIH) provide level I evidence for the superiority of small-bite closure and the importance of the suture-to-wound ratio. Prophylactic mesh trials and pooled analyses showed large relative and meaningful absolute reductions in IH in the high-risk cohorts. The balance between benefits (reduced IH and re-operation) and harm (mesh-related complications) favours mesh use in selected patients when performed with appropriate mesh selection and placement.[37]

Strengths of current evidence

Multiple RCTs and meta-analyses have supported the recommendations for closure technique. Consistent identification of patient risk factors across large cohorts enables targeted prophylaxis. Long-term follow-up in some mesh trials has demonstrated a durable benefit.[38]

Limitations and gaps

Study heterogeneity

Variable definitions of IH, follow-up duration, and diagnostic modality. Research and implementation priorities remain an important focus in the field of hernia repair. Comparative data on different mesh types and placement techniques are still limited, and high-quality head-to-head randomized trials are relatively scarce. In addition, long-term outcomes (5–10 years) of resorbable and newer-generation meshes have not yet been adequately established, leaving uncertainty regarding durability and late complications. Beyond clinical evidence gaps, practical implementation barriers—including surgeon training, cost considerations, and patient preferences—continue to influence real-world adoption of newer techniques and materials. Therefore, future research should prioritize well-designed comparative studies alongside implementation science approaches to bridge the gap between evidence generation and routine clinical practice.[39]

Future priorities include

Future research should prioritize well-designed comparative randomized controlled trials evaluating different mesh types and placement techniques with long-term follow-up to better define durability and complication profiles. In parallel, there is a need to develop, validate, and implement robust risk prediction models that integrate clinical variables with emerging biomarkers and potentially genetic data to improve individualized patient stratification. Additionally, pragmatic trials assessing implementation strategies—such as structured training programs, standardized checklists, and audit-and-feedback mechanisms—are essential to improve adherence to evidence-based practices in routine surgical care. Finally, comprehensive health economic analyses across different patient risk strata are required to determine cost-effectiveness and support resource allocation in hernia management pathways.

CONCLUSION

Prevention of incisional hernias should be proactive and personalized. Evidence supports the routine adoption of continuous small bite closure with slowly absorbable monofilament sutures and a 4:1 suture-to-wound ratio for midline closure. Prophylactic mesh is effective in defined high-risk populations, particularly when placed in the retrorectus or pre-peritoneal planes. Perioperative optimization of modifiable risk factors complements technical measures and is essential for achieving optimal outcomes. Implementation requires training, local protocols, and the monitoring of long-term outcomes.

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