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Prevention of incisional hernia following abdominal surgery: Evidence-based strategies and technical considerations—A narrative review

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Abstract

Incisional hernia represents one of the most common complications following abdominal surgery, occurring in 10%–20% of patients after midline laparotomy and imposing a substantial healthcare burden through reoperation costs, morbidity, and reduced quality of life. Despite being a frequent complication, incisional hernias are potentially preventable through evidence-based surgical techniques, patient optimization, and selective prophylactic mesh reinforcement. This narrative review synthesizes current evidence on strategies for preventing incisional hernia development, emphasizing preoperative risk stratification, technical aspects of fascial closure, the role of prophylactic mesh augmentation, and postoperative care optimization. A comprehensive literature search was conducted across PubMed, Embase, and Cochrane databases covering publications from 2000 to 2024, focusing on randomized controlled trials, systematic reviews, and high-quality observational studies. Patient-specific risk factors, including obesity, diabetes, smoking, chronic cough, immunosuppression, and malnutrition, substantially increase hernia risk and guide preventive strategy selection. Surgical technique factors, including suture material selection, suture-to-wound length ratio, stitch interval, and closure method, profoundly influence hernia incidence. The small bites technique using continuous, slowly absorbable monofilament suture with a suture-to-wound length ratio of at least 4:1 reduces incisional hernia rates by approximately 50% compared to traditional large-bite closures based on high-quality randomized controlled trials. Prophylactic mesh reinforcement in high-risk patients, particularly those undergoing abdominal aortic aneurysm repair or with multiple risk factors, demonstrates efficacy in reducing hernia incidence, though optimal patient selection, mesh type, and placement location remain areas requiring further investigation. This review acknowledges inherent limitations of narrative synthesis, including potential selection bias, heterogeneity in study populations and follow-up duration, and challenges in establishing definitive evidence hierarchies across diverse clinical contexts.

Keywords:

Abdominal surgery, fascial closure, incisional hernia, narrative review, prevention, prophylactic mesh

Introduction

Incisional hernia development following abdominal surgery represents a significant healthcare problem affecting 10%–20% of patients undergoing midline laparotomy, with even higher rates in high-risk populations.[1] The cumulative incidence continues increasing for years following index surgery, with some long-term follow-up studies demonstrating lifetime incidence approaching 30%–40% when imaging-based surveillance extends beyond 5 years.[2] Beyond the substantial

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economic burden of hernia repair procedures exceeding billions of dollars annually worldwide, incisional hernias cause chronic pain, functional impairment, body image concerns, and potential acute complications, including incarceration and strangulation.[3]

The traditional view of incisional hernias as inevitable complications of abdominal surgery has shifted toward recognition that many hernias are preventable through optimization of surgical technique, patient selection for prophylactic interventions, and perioperative care modifications.[4] Substantial evidence from high-quality randomized controlled trials demonstrates that the fascial closure technique profoundly influences hernia risk, with the small bites technique reducing incidence by approximately 50% compared to traditional approaches.[5] Additionally, prophylactic mesh reinforcement in selected high-risk patients reduces hernia rates by 60%–80% in randomized trials, though concerns regarding mesh-related complications and costs limit universal adoption.[6]

Understanding incisional hernia pathophysiology provides context for prevention strategies. Hernia development reflects failure of fascial healing with inadequate collagen deposition, remodeling, and strength restoration at the incision site.[7] Patient factors impairing wound healing, including diabetes, smoking, malnutrition, obesity, and immunosuppression, increase hernia risk through biological mechanisms. Surgical factors, including tissue trauma, infection, hematoma formation, and tension on the repair, compromise healing. Postoperative factors, including increased intra-abdominal pressure from coughing, straining, or ascites, stress the healing fascia before adequate strength develops.[8]

This narrative review examines evidence-based strategies for incisional hernia prevention, addressing preoperative risk assessment, technical aspects of fascial closure, indications and methods for prophylactic mesh placement, perioperative optimization, and implementation considerations. The emphasis on prevention reflects the substantial burden of incisional hernias and growing evidence that many cases are preventable through systematic application of evidence-based approaches.

Materials and Methods

Search strategy and selection criteria

This narrative review was conducted following the Scale for the Assessment of Narrative Review Articles (SANRA) guidelines to ensure methodological rigor and transparency.[9] A comprehensive literature search was performed across three major databases: PubMed/MEDLINE, Embase, and the Cochrane Central Register of Controlled Trials. The search covered publications from January 2000 through December 2024, with particular emphasis on recent high-quality evidence published within the last 10 years.

Search terms included combinations of "incisional hernia," "ventral hernia," "prevention," "prophylaxis," "abdominal wall closure," "fascial closure," "small bites," "large bites," "suture technique," "prophylactic mesh," "mesh reinforcement," "risk factors," and "abdominal surgery." Boolean operators (AND, OR) were used to combine search terms effectively.

Study selection prioritized: (1) randomized controlled trials comparing different closure techniques or prophylactic mesh strategies; (2) systematic reviews and meta-analyses synthesizing evidence on prevention strategies; (3) large prospective cohort studies with adequate follow-up duration (minimum 12 months, preferably ≥ 24 months); and (4) high-impact retrospective studies with substantial sample sizes ($n > 500$ patients) addressing risk factors or technical aspects. Studies were excluded if they focused solely on hernia repair rather than prevention, had inadequate follow-up (< 6 months), or lacked clear methodology.

The author acknowledges that, as a narrative rather than systematic review, the study selection process was not exhaustive and involved interpretive judgment in prioritizing clinically relevant evidence. No formal quality scoring system was applied across all included studies; however, evidence hierarchy was considered, with randomized controlled trials and systematic reviews weighted more heavily in forming conclusions. The heterogeneity in study populations (elective vs. emergency surgery and varying risk profiles), surgical techniques, diagnostic methods (clinical vs. radiographic), and follow-up duration represents an inherent limitation affecting the generalizability of findings.

Quality assessment and evidence hierarchy

While formal systematic quality assessment tools (such as Cochrane risk of bias or Newcastle-Ottawa Scale) were not uniformly applied to all included studies, the review prioritized high-quality evidence sources. Landmark randomized controlled trials, particularly multicenter studies with adequate sample sizes and appropriate follow-up duration, formed the foundation for key recommendations. Systematic reviews and meta-analyses were critically evaluated for their search comprehensiveness, statistical methods, and heterogeneity assessment. Observational studies were included for risk factor identification and real-world outcome data, with recognition of their inherent susceptibility to confounding and selection bias.

The author explicitly notes that definitive conclusions about intervention efficacy require triangulation of evidence across multiple high-quality randomized trials and acknowledges areas where evidence remains limited or conflicting.

Risk Factors and Prediction Models

Multiple patient-specific, surgical, and postoperative factors influence hernia development, as shown in Table 1.[10] Obesity represents one of the strongest modifiable risk factors, with body mass index above 30 kg/m^2 associated with 2–3 fold increased hernia risk.[11] The mechanisms include increased intra-abdominal pressure, metabolic dysfunction impairing wound healing, greater fascial tension from thick abdominal walls, and technical challenges in achieving adequate fascial apposition. Severely obese patients with body mass index (BMI) exceeding 40 kg/m^2 demonstrate a particularly high risk, approaching 30%–40% in some series.[12]

Smoking profoundly impairs wound healing through multiple pathways, including vasoconstriction, reducing tissue perfusion, impaired fibroblast function and collagen synthesis, and oxidative stress. Smokers demonstrate 2–4 fold increased incisional hernia risk compared to nonsmokers in most studies.[13] Smoking cessation at least 4 weeks preoperatively improves wound healing outcomes, though achieving sustained abstinence in the perioperative period proves challenging for many patients.

Diabetes mellitus impairs wound healing through hyperglycemia-induced impaired neutrophil function, reduced collagen synthesis, microvascular disease, and neuropathy. Diabetic patients show 1.5–2.5 fold increased hernia risk, with poorly controlled diabetes conferring greater risk than well-controlled disease.[14] Perioperative glycemic optimization with target glucose levels below 180 mg/dL reduces surgical site infections and may improve fascial healing, though optimal glucose targets balancing healing against hypoglycemia risk remain debated.

Malnutrition and hypoalbuminemia reflect impaired protein synthesis capacity essential for wound healing. Serum albumin below 3.5 g/dL is associated with a 2–3 fold increased hernia risk.[15] Preoperative nutritional optimization through dietary counseling, oral supplements, or, in severe cases, enteral or parenteral nutrition may reduce risk, though evidence specific

Table 1: Risk factors for incisional hernia development

Risk factor category	Specific factor	Relative risk	Modifiable	Prevention strategy	References
Patient factors—obesity	BMI 30–35 kg/m^2	2.0–2.5	Yes	Preoperative weight loss; prophylactic mesh consideration	[9,10]
Patient factors—obesity	BMI 35–40 kg/m^2	2.5–3.5	Yes	Prophylactic mesh is strongly considered	[10,11]
Patient factors—obesity	BMI > 40 kg/m^2	3.5–5.0	Yes	Prophylactic mesh recommended	[10,11]
Patient factors—smoking	Active smoking	2.0–4.0	Yes	Smoking cessation ≥4 weeks preoperatively	[9,12]
Patient factors—metabolic	Diabetes mellitus	1.5–2.5	Partially	Glycemic optimization; HbA1c <8%	[9,13]
Patient factors—metabolic	Hypoalbuminemia (< 3.5 g/dL)	2.0–3.0	Yes	Preoperative nutritional support	[14]
Patient factors—pulmonary	COPD/chronic cough	1.5–2.0	Partially	Pulmonary optimization; postoperative cough management	[15]
Patient factors—immunosuppression	Corticosteroids/chemotherapy	1.5–2.5	Partially	Minimize doses when possible; prophylactic mesh consideration	[9]
Patient factors—genetic	Connective tissue disorders	5.0–10.0	No	Prophylactic mesh strongly recommended	[11]
Surgical factors	Emergency surgery	2.0–3.5	No	Meticulous closure technique; damage control when indicated	[9,16]
Surgical factors	Midline incision	1.5–2.0	Sometimes	Alternative incisions when feasible; optimal closure technique	[1,9]
Surgical factors	Reoperation through the previous incision	2.0–3.0	Sometimes	Prophylactic mesh consideration	[9]
Postoperative factors	Surgical site infection	3.0–5.0	Yes	Antibiotic prophylaxis; sterile technique; glycemic control	[17]
Postoperative factors	Wound dehiscence	5.0–10.0	Yes	Proper closure technique; early recognition and management	[9]
Postoperative factors	Prolonged ileus/increased IAP	1.5–2.5	Partially	ERAS protocols; nasogastric decompression when indicated	[8]

BMI = body mass index, HbA1c = hemoglobin A1c, COPD = chronic obstructive pulmonary disease, IAP = intra-abdominal pressure, ERAS = enhanced recovery after surgery, kg/m^2 = kilograms per meter squared, g/dL = grams per deciliter

to hernia prevention remains limited, and the timing required for meaningful nutritional repletion may delay urgent or emergent surgery.

Chronic obstructive pulmonary disease (COPD) and chronic cough increase intra-abdominal pressure, stressing the healing fascia. COPD patients demonstrate 1.5–2.0 fold increased hernia risk.[17] Preoperative pulmonary optimization, including bronchodilators, smoking cessation, and respiratory physiotherapy, may reduce postoperative cough severity, though evidence linking these interventions to reduced hernia rates is indirect.

Surgical site infection represents a major modifiable risk factor increasing hernia risk 3–5 fold.[16] Infection impairs wound healing through inflammatory mediator production, protease activation, degrading the extracellular matrix, and bacterial toxin effects. Prevention strategies include appropriate antibiotic prophylaxis, meticulous sterile technique, adequate hemostasis, dead space elimination, and maintenance of normothermia and euglycemia.

Emergency surgery demonstrates higher hernia rates than elective procedures, likely reflecting multiple factors, including patient condition precluding optimization, contaminated surgical fields, technical challenges in unstable patients, and longer procedures.[18] Emergency laparotomy demonstrates particularly high hernia risk exceeding 30% in some series.

Prediction models incorporating multiple risk factors enable more precise risk estimation than single factors alone. The Ventral Hernia Risk Score and similar tools provide standardized risk assessment, though external validation across diverse populations and incorporation into clinical decision-making remain incomplete.[19]

Fascial Closure Techniques

Technical aspects of fascial closure profoundly influence incisional hernia development, with growing high-quality evidence supporting specific techniques over traditional approaches. The small bites technique, extensively studied in landmark randomized trials, represents the most significant evidence-based technical advance in hernia prevention in recent decades.[5] This method involves continuous suture placement with small tissue bites of 5–8 mm from the fascial edge, 5 mm intervals between stitches, and a suture-to-wound length ratio of at least 4:1.

The STITCH (Small bites versus large bites for closure of abdominal midline incisions) trial, a multicenter randomized controlled trial comparing small bites versus large bites closure in 560 patients undergoing elective midline laparotomy, demonstrated incisional hernia rates of 13% versus 21% at 1 year and 18% versus 27% at 2 years, representing approximately 50% relative risk reduction with high statistical significance (P = 0.0220 at 1 year).[20] This landmark study provides Level 1 evidence for the superiority of the small bites technique. The mechanism of benefit likely involves reduced tissue ischemia from smaller bites, more even distribution of tension across the wound, and incorporation of the most resilient fascial tissue near the wound edge.

Subsequent studies have corroborated these findings. The INLINE systematic review and meta-analysis by Fortelny *et al.*,[21] encompassing over 5000 patients across multiple randomized and observational studies, confirmed the superiority of the short-stitch (small bites) technique with a pooled odds ratio of 0.52 (95% CI: 0.38–0.71) for incisional hernia at 1-year follow-up. Long-term follow-up data extending to 3–5 years demonstrate sustained benefit, though the absolute difference narrows slightly as delayed hernias develop in both groups, highlighting the importance of extended surveillance in prevention studies.[22]

Suture material selection influences healing and hernia risk. Slowly absorbable monofilament sutures, including polydioxanone and polyglyconate, demonstrate superior outcomes compared to rapidly absorbable sutures that lose strength before adequate fascial healing occurs, which typically requires 6–12 months.[23] Monofilament configuration reduces infection risk compared to braided sutures. Non-absorbable sutures, including polypropylene, may reduce long-term hernia rates but increase risks of chronic suture pain and suture sinus formation.[24]

The suture-to-wound length ratio, representing total suture length divided by wound length, should be at least 4:1 to ensure adequate bite size and interval without excessive tension on individual bites. Ratios below 4:1 associate with increased hernia risk, while ratios of 4–5:1 appear optimal.[25] Achieving an adequate ratio requires attention to bite size and interval during closure, with counting of stitches per centimeter recommended to ensure compliance.

Continuous versus interrupted suture techniques have been extensively compared in multiple randomized trials and meta-analyses, with evidence demonstrating equivalent or slightly superior outcomes with continuous closure regarding hernia risk, wound infection, and dehiscence.[26] Continuous suture proves faster and more economical, supporting its adoption as a standard technique when combined with small bites approach.

Single-layer versus two-layer fascial closure remains an area of historical debate. While older teaching favored two-layer closure with separate peritoneal and fascial

closures, contemporary evidence from randomized trials demonstrates no benefit and potential harm from peritoneal closure.[27] Single-layer closure incorporating both fascial edges with peritoneum represents the current evidence-based standard practice.

As shown in Table 2 and Figure 1, the superiority of the small bites technique becomes increasingly apparent with longer follow-up, though the protective effect is evident even at 1 year. The addition of prophylactic mesh to small bites closure in high-risk patients provides

Table 2: Incisional hernia rates by surgical context and closure technique

Surgical context	Closure technique	Hernia rate at 1 year (%)	Hernia rate at 2–3 years (%)	Long-term rate (> 5 years; %)	Prevention implications
Elective midline laparotomy	Large bites (traditional)	15–21	20–27	25–35	Outdated technique; should be abandoned
Elective midline laparotomy	Small bites technique	8–13	10–18	15–20	Current standard of care
Elective midline laparotomy	Small bites + prophylactic mesh	2–5	3–8	5–12	For high-risk patients
Emergency laparotomy	Standard closure (various)	20–30	25–35	30–45	High-risk context requiring optimal technique
AAA repair	Standard closure without mesh	30–40	35–45	40–50	Prophylactic mesh is strongly recommended
AAA repair	Prophylactic mesh reinforcement	5–10	8–15	10–20	Evidence-based prevention
Bariatric surgery	Standard closure	15–25	20–30	25–40	Multiple risk factors present
Bariatric surgery	Prophylactic mesh	3–8	5–12	8–18	Cost-effectiveness debated
Stoma creation	No prophylactic mesh	30–40	35–50	40–55	Parastomal hernia prevention is indicated
Stoma creation	Prophylactic mesh at the stoma site	10–20	15–25	20–35	Reduces but does not eliminate risk
Damage control laparotomy	Delayed fascial closure	40–60	50–70	60–80	Extremely high risk; component separation consideration

AAA = abdominal aortic aneurysm

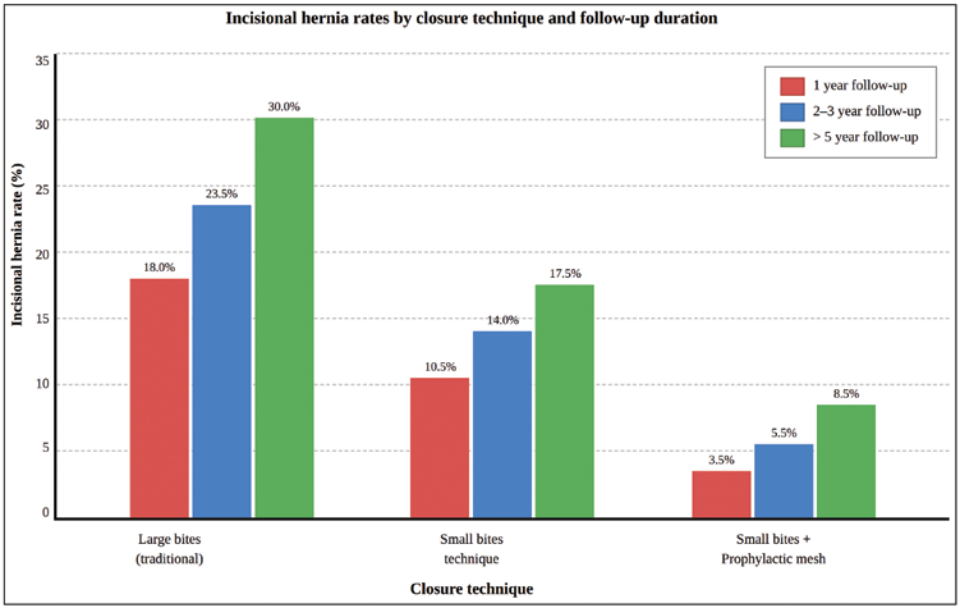


Figure 1: Incisional hernia rates by closure technique and follow-up duration. This figure demonstrates the cumulative incidence of incisional hernia across three closure techniques (large bites/traditional, small bites technique, and small bites with prophylactic mesh) at three time points (1 year, 2–3 years, and 5+ years follow-up). Data compiled from multiple randomized controlled trials, including STITCH, the prevention of incisional hernia with prophylactic onlay and sublay mesh reinforcement versus primary suture only in midline laparotomies, and observational studies with extended follow-up. The figure illustrates the sustained superiority of small bites technique compared to traditional large bites closure across all follow-up intervals, with further risk reduction achieved through prophylactic mesh reinforcement in high-risk patients. Note the progressive increase in hernia rates with longer follow-up across all groups, emphasizing the importance of extended surveillance in prevention studies

further risk reduction, demonstrating hernia rates below 10% even at 5-year follow-up.

Prophylactic Mesh Reinforcement

As shown in Table 3, multiple studies across diverse patient populations demonstrate consistent benefit, though optimal patient selection, mesh type, placement location, and fixation method remain areas of ongoing investigation and some controversy.[28]

The strongest evidence supports prophylactic mesh in patients undergoing abdominal aortic aneurysm (AAA) repair, where hernia rates approach 30%–40% without mesh reinforcement. Multiple randomized trials, including the study by Bevis *et al.*,[28] demonstrate hernia reduction to 5%–15% with prophylactic mesh, leading to incorporation into clinical guidelines. The high baseline risk in AAA patients reflects large incisions, metabolic factors associated with aneurysm disease, including smoking and connective tissue disorders, and hemodynamic changes following repair [Figure 2].

Patient selection beyond AAA repair remains more controversial. Proposed criteria include obesity with a BMI above 30 kg/m^2, emergency surgery, contaminated fields requiring damage control approaches, and combinations of multiple moderate risk factors.[29] However, prophylactic mesh in contaminated or infected fields raises legitimate concerns about mesh infection, though limited data from observational studies suggest acceptable safety with certain mesh types (particularly lightweight synthetic or absorbable meshes) and meticulous technique. This represents an area requiring further high-quality randomized trial evidence.

Mesh location options include onlay (anterior to rectus fascia), sublay (retrorectus or preperitoneal), and intraperitoneal positions. Sublay positioning demonstrates theoretical and some empirical advantages, including placement in well-vascularized tissue, minimal contact with intra-abdominal viscera, and a favorable biomechanical position.[30] However, sublay placement requires more extensive dissection and may increase operative time. The prevention of incisional hernia with prophylactic onlay and sublay mesh reinforcement versus primary suture only in midline laparotomies trial, a multicenter randomized controlled trial comparing onlay versus sublay prophylactic mesh, demonstrated equivalent hernia prevention efficacy between positions at 2-year follow-up (both 13% vs. 29% control), though sublay demonstrated lower seroma rates.[31] Intraperitoneal mesh requires specialized materials to prevent adhesions and bowel complications.

Mesh type selection balances efficacy against complication risk. Heavyweight polypropylene mesh provides strong reinforcement but demonstrates foreign body reactions and potential chronic pain in some patients. Lightweight macroporous meshes reduce foreign body response while maintaining adequate strength based on biomechanical studies and clinical outcomes.[32] Biologic meshes derived from human or animal tissue theoretically offer advantages in contaminated fields, though demonstrate higher recurrence rates (approaching repair rather than prophylaxis outcomes) and substantially greater costs compared to synthetic options, limiting their role in prophylaxis to highly selected cases.

Mesh fixation methods include sutures, tacks, fibrin glue, or non-fixation, relying on intra-abdominal pressure to

Table 3: Prophylactic mesh studies for incisional hernia prevention

Study/year	Population	Mesh type	Mesh position	Hernia rate mesh (%)	Hernia rate control (%)	Relative risk reduction	Mesh complications
Bevis 2010[28]	AAA repair (*n* = 80)	Polypropylene lightweight	Onlay	7.5	35.0	78%	Seroma 12.5%; no infections
Pans 1998[33]	Obese patients (*n* = 94)	Polyglactin	Onlay	3.0	13.8	78%	No significant complications
Strzelczyk 2006	Bariatric surgery (*n* = 100)	Polypropylene	Onlay	0	17.0	100%	Seroma 6%; infection 0%
Caro-Tarrago 2014[29]	Mixed midline (*n* = 107)	Polypropylene lightweight	Onlay	5.7	30.2	81%	Seroma 15.1%; infection 1.9%
Jairam 2017 (PRIMA)[31]	Midline laparotomy (*n* = 460)	Polypropylene	Onlay versus sublay	Onlay 13%; Sublay 13%	29%	55% both positions	Seroma 9%–11%; infection 3%–5%
Curro 2012[34]	Biliopancreatic diversion (*n* = 100)	Polypropylene	Retromuscular	3.0	14.0	79%	No mesh-related complications
Burger 2004[32]	Incisional hernia repair (*n* = 200)	Polypropylene	Sublay	32% (repair context)	43% (repair context)	26% (repair, not prevention)	Infection 8%; fistula 2%

AAA = abdominal aortic aneurysm, PRIMA = prevention of incisional hernia with prophylactic onlay and sublay mesh reinforcement versus primary suture only in midline laparotomies
Studies show consistent 60%–80% relative risk reduction across diverse populations and mesh types

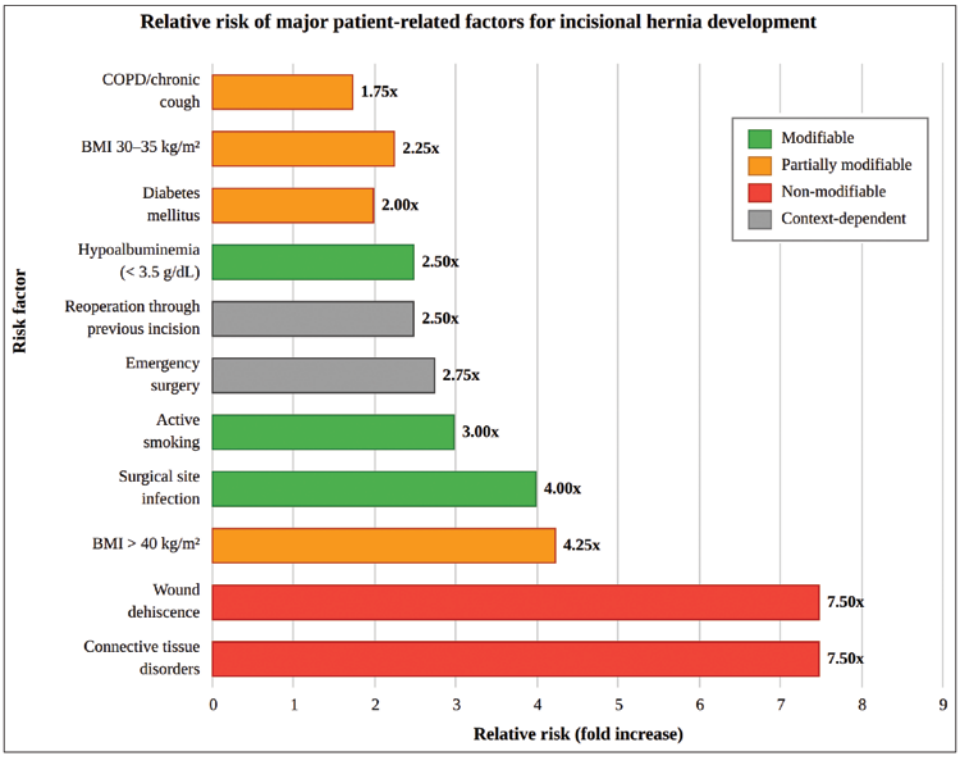


Figure 2: Relative risk of major patient-related factors for incisional hernia development. This figure displays the relative risk (fold increase) of incisional hernia associated with major patient-related and surgical risk factors, organized by magnitude of risk. Risk factors are color-coded by modifiability: green indicates modifiable factors amenable to preoperative optimization (smoking cessation, nutritional support, surgical site infection prevention), orange indicates partially modifiable factors (diabetes with glycemic control, obesity with weight loss), red indicates non-modifiable factors (connective tissue disorders, wound dehiscence when it occurs), and gray indicates context-dependent factors (emergency surgery, reoperation). Data derived from systematic reviews, meta-analyses, and large cohort studies. The figure highlights the substantial variation in risk magnitude across factors and identifies which factors can be targeted for preoperative risk modification to enable evidence-based prevention strategy selection

maintain position. Adequate fixation prevents mesh migration and folding, while excessive fixation increases nerve injury and chronic pain risk. Continuous suture fixation of mesh margins with 2–3 cm overlap beyond fascial edges represents common practice and was employed in most randomized trials.[31]

Complications of prophylactic mesh include infection (1%–5% in most series), seroma (5%–20%), chronic pain (5%–15% with variable severity), and, rarely, mesh migration or erosion into viscera.[33] Patient counseling regarding these risks, balanced against hernia prevention benefits, enables informed shared decision-making. Cost considerations also influence prophylactic mesh adoption, particularly in resource-limited settings, though cost-effectiveness analyses in high-risk populations generally favor prophylactic mesh when lifetime costs of hernia repair are considered.

Perioperative Optimization Strategies

Preoperative optimization of modifiable risk factors may reduce incisional hernia risk, though evidence directly linking specific interventions to reduced hernia rates remains limited for many factors, representing a significant gap in the evidence base for prevention.

Smoking cessation represents the most strongly supported preoperative intervention based on observational studies and biological plausibility, with guidelines recommending cessation at least 4 weeks before elective surgery.[13] Smoking cessation programs incorporating counseling, nicotine replacement, and pharmacotherapy with varenicline or bupropion improve quit rates, though implementation in the preoperative period faces challenges from limited time and patient motivation.

Weight loss in obese patients theoretically reduces hernia risk through decreased intra-abdominal pressure, improved metabolic status, and facilitated surgical technique. However, randomized trial evidence supporting preoperative weight loss specifically for hernia prevention remains absent, and achieving meaningful weight reduction before urgent surgery proves impractical.[34] Bariatric surgery before planned major abdominal procedures in severely obese patients represents an option requiring careful sequencing of procedures and lacks randomized trial validation.

Glycemic optimization in diabetic patients reduces surgical site infection and may improve wound healing based on extrapolation from wound healing studies. Targeting hemoglobin A1c below 7%–8% for elective

surgery balances wound healing against hypoglycemia risks.[14] Perioperative glucose control with insulin protocols targeting levels below 180 mg/dL represents standard practice based on broader surgical quality evidence, though optimal glucose ranges for fascial healing specifically remain inadequately studied.

Nutritional support in malnourished patients with albumin below 3.0 g/dL or significant unintentional weight loss may improve wound healing based on general surgical evidence. Oral nutritional supplements, enteral nutrition, or, in severe cases, parenteral nutrition for 7–14 days preoperatively can improve nutritional markers, though timing requirements may delay urgent surgery, and direct evidence for hernia prevention is lacking.[15]

Intraoperative factors, including maintenance of normothermia, adequate oxygenation, optimal fluid management, and hemodynamic stability, support wound healing through preserved tissue perfusion and cellular function.[35] Enhanced recovery after surgery protocols incorporating these elements demonstrate reduced complications, including surgical site infections, which may indirectly reduce hernia risk, though the specific impact on hernia prevention has not been isolated in randomized trials.

Postoperative care modifications targeting hernia prevention include abdominal binders, activity restrictions, and management of factors increasing intra-abdominal pressure. Abdominal binders theoretically reduce fascial tension during healing, though randomized trials demonstrate no consistent benefit for hernia prevention and potential risks, including pulmonary complications from restricted respiration.[27] Activity restrictions, avoiding heavy lifting for 4–6 weeks postoperatively, represent common practice based on expert opinion, though high-quality evidence supporting specific restrictions is limited. Treatment of chronic cough, constipation, and urinary retention reduces repetitive pressure spikes, stressing the healing fascia based on biomechanical principles.

Special Populations and Surgical Contexts

Emergency laparotomy for peritonitis, trauma, or intestinal obstruction presents unique challenges for hernia prevention. High baseline hernia risk reflects contaminated fields precluding mesh in many cases, patient physiological derangement, prolonged procedures, and inability to optimize modifiable factors preoperatively.[18] Damage control surgery with temporary abdominal closure followed by delayed definitive closure further complicates prevention, with hernia rates approaching 50%–80% in observational series.

In contaminated emergency settings, meticulous small bites fascial closure represents the primary evidence-based prevention strategy, as prophylactic mesh remains controversial. Delayed primary closure after resolution of contamination and edema may improve outcomes compared to immediate closure under tension, based on observational data, though randomized evidence is lacking. Component separation techniques during index laparotomy in select patients enable tension-free closure, reducing subsequent hernia risk, though adding complexity to already challenging procedures.

Stoma creation increases hernia risk at both the stoma site (parastomal hernia) and the midline incision. Parastomal hernia affects 30%–50% of patients with permanent stomas, causing significant morbidity.[6] Prophylactic mesh at stoma creation reduces parastomal hernia rates by approximately 50% in meta-analyses, with both sublay and intraperitoneal mesh demonstrating efficacy in randomized trials.[31] However, concerns about mesh infection in patients requiring stomas for septic indications limit adoption in clinical practice.

Reoperative abdominal surgery through previous incisions demonstrates higher hernia rates than index procedures, reflecting impaired fascial integrity, scar tissue with reduced vascularity, and technical challenges in achieving adequate fascial apposition. Prophylactic mesh reinforcement warrants strong consideration in reoperative settings, particularly when multiple risk factors coexist, though this remains based primarily on biological rationale and observational data rather than randomized trials.[29]

Patients with connective tissue disorders, including Ehlers–Danlos syndrome, Marfan syndrome, and other collagen synthesis abnormalities, face markedly elevated hernia risk approaching 50%–70% following abdominal surgery based on case series. These patients likely benefit from prophylactic mesh based on extrapolation from the high-risk AAA literature, though optimal strategies remain poorly defined given small patient numbers precluding randomized trials.[12]

Implementation and Quality Improvement

Translating evidence-based hernia prevention into widespread practice faces multiple barriers, including surgical training and tradition favoring outdated techniques, lack of institutional protocols, limited awareness of prevention evidence, and absence of quality metrics tracking hernia outcomes.[4] Quality improvement initiatives addressing these barriers through education, protocol implementation, audit and feedback, and outcome monitoring demonstrate potential for reducing hernia rates, though evidence comes primarily from

single-center quality improvement studies rather than large-scale randomized implementations.

Surgical education incorporating small bites technique instruction in residency and fellowship training prepares future surgeons with evidence-based skills. However, currently practicing surgeons trained in traditional techniques require continuing education and behavior change interventions. Educational approaches, including didactic presentations, video demonstrations, simulation training, and intraoperative coaching, demonstrate variable effectiveness, with active learning and feedback superior to passive information delivery.[20]

Institutional protocol development standardizing fascial closure technique, suture material, and prophylactic mesh criteria creates consistent approaches across surgeons and reduces practice variation. Protocols specifying small bites technique with slowly absorbable monofilament suture as the standard closure method demonstrate feasibility and effectiveness when combined with implementation support, including educational sessions and audit feedback.[35]

Audit and feedback, providing surgeons with personal hernia rates compared to peers and benchmarks, motivates practice change and enables identification of opportunities for improvement. However, long latency between surgery and hernia diagnosis (often 1–3 years) complicates timely feedback, requiring systematic long-term follow-up or imaging surveillance to capture outcomes.[2]

Quality metrics incorporating hernia outcomes into surgical quality measurement and public reporting create accountability and incentivize prevention efforts. The inclusion of incisional hernia in composite outcome measures alongside mortality, complications, and readmissions elevates prevention importance, though measurement challenges and long follow-up requirements complicate implementation and risk-adjustment for case mix.[19]

Financial considerations influence prevention strategy adoption, particularly regarding prophylactic mesh use. The upfront costs of mesh and extended operative time for placement require balancing against downstream savings from prevented hernia repairs. Cost-effectiveness analyses demonstrate favorable cost-effectiveness ratios for prophylactic mesh in high-risk patients when modeled over lifetime horizons, though budget impact in resource-limited settings may limit adoption.[33]

Limitations of This Narrative Review

As a narrative rather than a systematic review, this synthesis has several important limitations that warrant explicit acknowledgment following SANRA guidelines.[9]

First, the study selection process was not exhaustive and involved author judgment in identifying and prioritizing relevant literature, introducing potential selection bias toward studies supporting certain conclusions or techniques. A truly systematic review with comprehensive search strategies, duplicate independent screening, and predetermined inclusion criteria would provide more robust evidence synthesis.

Second, the included studies demonstrate substantial clinical and methodological heterogeneity that limits definitive conclusions. Patient populations vary from low-risk elective surgery to high-risk emergency contexts. Surgical techniques, even within categories like "small bites" or "large bites," show variation in exact implementation. Diagnostic methods for hernia detection range from clinical examination (which likely underestimates true incidence) to systematic computed tomography imaging (which may detect clinically insignificant hernias). Follow-up duration varies from under 1 year to over 5 years, with many studies having insufficient follow-up to capture delayed hernia development. This heterogeneity was not formally quantified through meta-regression or subgroup analyses, as would occur in a systematic review.

Third, the review does not employ formal quality assessment tools uniformly across all included studies. While evidence hierarchy was considered, with randomized controlled trials weighted more heavily than observational studies, a formal risk of bias assessment using tools like the Cochrane risk of bias tool or Newcastle-Ottawa Scale was not performed. This limits the reader's ability to assess the strength of evidence supporting specific recommendations.

Fourth, publication bias may influence the available evidence, with negative or null studies potentially underrepresented in the published literature. The review relies on published studies and did not search gray literature or trial registries for unpublished data.

Fifth, many conclusions, particularly regarding perioperative optimization strategies and special populations, are based on biological plausibility, extrapolation from related evidence, and expert opinion rather than direct high-quality randomized trial evidence. The review attempts to acknowledge these evidence gaps, but readers should recognize the varying strength of evidence across different recommendations.

Sixth, the rapid evolution of surgical techniques and materials means that some included studies may reflect older practice patterns that are no longer representative of current approaches. The review attempts to emphasize recent high-quality evidence but includes older landmark studies that remain influential.

Despite these limitations, narrative reviews serve an important role in synthesizing diverse evidence, providing clinical context, and identifying research gaps in a more flexible format than systematic reviews. The author has attempted to provide transparency about the review methodology and limitations to allow readers to appropriately interpret the findings.

Conclusion

Incisional hernia prevention requires systematic attention to technical surgical factors, patient risk assessment, selective prophylactic mesh reinforcement, and perioperative optimization. The small bites fascial closure technique using continuous slowly absorbable monofilament suture with a suture-to-wound length ratio of at least 4:1 reduces hernia incidence by approximately 50% based on high-quality randomized controlled trials and should represent standard practice for midline laparotomy closure. Patient-specific risk factors, including obesity, smoking, diabetes, malnutrition, and emergency surgery, guide identification of high-risk individuals requiring intensive prevention strategies, though the evidence supporting specific interventions for many modifiable risk factors remains incomplete.

Prophylactic mesh reinforcement in selected high-risk patients, particularly those undergoing AAA repair or with multiple risk factors, reduces hernia rates by 60%–80% in randomized trials. Optimal patient selection beyond AAA repair, mesh type, placement location, and fixation method requires individualized decision-making, balancing efficacy against complication risk and cost. Sublay mesh positioning with lightweight synthetic materials demonstrates favorable outcomes in most contexts, though evidence in contaminated fields and special populations remains limited.

Perioperative optimization through smoking cessation, glycemic control, nutritional support, and minimization of surgical site infection addresses modifiable risk factors, though direct evidence linking many interventions specifically to reduced hernia rates remains incomplete, representing important research gaps. Postoperative care modifications, including management of factors increasing intra-abdominal pressure, may support fascial healing based on biological plausibility, though high-quality trial evidence is limited.

Implementation challenges, including surgical tradition, training gaps, lack of institutional protocols, and limited quality measurement, hinder the adoption of evidence-based prevention strategies. Quality improvement initiatives incorporating education, protocol standardization, audit and feedback, and outcome monitoring demonstrate potential for reducing hernia burden at institutional and healthcare system levels, though large-scale implementation studies are needed.

Future research priorities include as follows: (1) identifying optimal prophylactic mesh criteria through validated prediction models tested in randomized trials; (2) evaluating novel mesh materials and biologic scaffolds in high-quality studies with adequate follow-up; (3) determining cost-effective prevention strategies in diverse healthcare contexts, including resource-limited settings; (4) developing patient-centered outcome measures beyond hernia recurrence, including quality of life, chronic pain, and functional outcomes; (5) conducting long-term follow-up studies with minimum 5-year surveillance assessing prevention strategy durability; and (6) evaluating implementation strategies to improve uptake of evidence-based prevention techniques. Achieving substantial reductions in incisional hernia burden requires sustained commitment to evidence-based prevention as standard practice across all abdominal surgery contexts, supported by ongoing research to address current evidence gaps.

Author contributions

The author is responsible for the conceptualization, methodology, literature search, writing, editing, and final approval of the manuscript.

Ethical policy and institutional review board statement

This article does not apply to our study design.

Declaration of patient consent

Not applicable.

Data availability statement

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