



## **A Prospective Study on Incisional Hernias Following Midline Laparotomies: Evaluation of Risk Factors, Time of Onset, and Prevention Strategies**

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### **Abstract**

*Incisional hernias are a common postoperative complication following midline laparotomies, often contributing significantly to patient morbidity, impaired quality of life, increased healthcare costs, and in some cases, the need for complex reoperations. Despite advancements in surgical techniques and materials, the incidence of incisional hernias remains clinically significant. This prospective study was undertaken to evaluate the incidence, associated risk factors, time of onset, and effectiveness of various prevention strategies for incisional hernias following midline laparotomies. The study included patients undergoing elective and emergency midline laparotomies at three tertiary care centers: Santosh Medical College and Hospital, Ghaziabad; Saraswathi Institute of Medical Sciences; and SGPGI, Lucknow. A total of [Insert Number] patients were enrolled between [Insert Time Period], and followed up for a period of [Insert Follow-up Duration] postoperatively. Inclusion criteria consisted of patients above 18 years of age undergoing midline laparotomy with primary wound closure. Exclusion criteria included patients undergoing re-exploration within 30 days, patients with pre-existing hernias, or those lost to follow-up. Patient demographics, comorbid conditions such as diabetes, COPD, anemia, obesity (BMI >30), and hypoalbuminemia, along with intraoperative factors such as type of suture material used, wound closure technique, presence of postoperative wound infection, and duration of surgery were carefully documented. Preliminary findings suggest that the incidence of incisional hernias in our study cohort was approximately [Insert Percentage]%. The most common risk factors identified were postoperative wound infection, obesity, diabetes mellitus, prolonged operative time, and emergency surgeries. Hernias were observed to develop within a median period of [Insert Time] months, with the majority manifesting within the first postoperative year. Notably, the use of prophylactic mesh in selected high-risk patients and proper surgical technique including mass closure with non-absorbable sutures were associated with a lower incidence of hernias. The study emphasizes the importance of comprehensive risk assessment preoperatively, meticulous surgical technique, and vigilant postoperative wound care as key strategies in the prevention of incisional hernias. Early identification and modification of modifiable risk factors*



*can significantly reduce the overall incidence. This study contributes valuable data to the ongoing discourse on the management and prevention of incisional hernias, particularly in resource-constrained settings where such complications can have significant socioeconomic impacts. Further long-term studies with larger sample sizes are warranted to validate these findings and guide the development of standardized preventive protocols.*

**Keywords: Incisional hernia, Midline laparotomy, Risk factors, Wound infection, Surgical complications, Hernia prevention**

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## Introduction

Incisional hernia is one of the most common postoperative complications encountered after abdominal surgeries, particularly those performed through a midline laparotomy incision. It is defined as a protrusion of intra-abdominal contents through a defect in the musculofascial layers of the abdominal wall at the site of a previous surgical incision [1].

Though considered a non-lethal complication, incisional hernia significantly affects the quality of life of patients, leading to physical discomfort, cosmetic disfigurement, chronic pain, and potential life-threatening complications such as bowel obstruction or strangulation. Additionally, it imposes a substantial financial burden on both patients and healthcare systems due to the need for secondary surgeries and prolonged postoperative care [2]. The incidence of incisional hernias varies widely in the literature, ranging from 2% to 20% following midline laparotomies, and may increase to over 30% in high-risk groups. Several factors contribute to this variability, including patient-related factors, surgical technique, postoperative care, and the presence of wound infections. While some hernias become evident within the first few months postoperatively, others may take years to manifest, making long-term follow-up crucial for accurate assessment. Despite numerous studies and evolving surgical practices, the prevention and early detection of incisional hernias continue to be a significant challenge [3]. The midline laparotomy remains one of the most commonly performed abdominal incisions due to its simplicity, speed, and excellent exposure of the abdominal cavity. However, the midline incision is particularly vulnerable to dehiscence and hernia formation due to the relatively avascular nature of the linea alba, the absence of muscle fibers, and the tendency of this area to bear the brunt of intra-abdominal pressure. Postoperative complications such as wound infection, seroma formation, and burst abdomen further predispose the site to herniation [4].

Several risk factors have been identified in the development of incisional hernias. These include patient-specific factors such as obesity, advanced age, diabetes mellitus, chronic obstructive



pulmonary disease (COPD), anemia, malnutrition, immunosuppression, smoking, and poor collagen metabolism. Operative factors, such as emergency surgery, prolonged operative time, surgical site infection, use of absorbable sutures for fascial closure, and suboptimal surgical technique, also play a critical role [2]. In recent years, particular attention has been given to the technique of abdominal wall closure, with a growing body of evidence suggesting that suture length-to-wound length ratio (SL:WL), suture material, and closure technique significantly impact the incidence of incisional hernias. Traditionally, abdominal fascial closure has been performed using either continuous or interrupted suturing techniques with absorbable or non-absorbable materials. However, the ideal method of closure remains a matter of debate. The European Hernia Society (EHS) recommends a continuous suturing technique with a slowly absorbable monofilament suture and an SL:WL ratio of at least 4:1 to minimize the risk of hernia development. Moreover, recent studies have explored the use of prophylactic mesh reinforcement in high-risk patients undergoing midline laparotomies, showing promising results in reducing the incidence of incisional hernias without significantly increasing the risk of infection. Despite the known risk factors and preventive strategies, incisional hernias continue to be a frequent and often underestimated problem [4]. This may be due to the lack of standardization in surgical techniques, inconsistent follow-up practices, and underreporting of minor asymptomatic hernias. Additionally, patient awareness regarding the signs and symptoms of incisional hernia is often low, leading to delayed diagnosis and intervention. The management of incisional hernias, once developed, usually requires surgical repair. Various techniques have been employed for hernia repair, including open or laparoscopic mesh repair and component separation techniques in complex or large hernias. However, recurrence rates remain a concern, especially in patients with multiple comorbidities or previous failed repairs. Hence, prevention becomes a more effective and economical strategy than treatment. The rationale for conducting this prospective study stems from the need to identify, evaluate, and quantify the risk factors associated with incisional hernia following midline laparotomies [5]. This study aims to bridge the gap in knowledge regarding the timing of hernia onset, patient and surgical risk factors, and the effectiveness of commonly employed preventive strategies in a tertiary care setting. Understanding the natural history of incisional hernia formation, especially in a prospective cohort with standardized follow-up protocols, can help refine preventive surgical practices and improve long-term outcomes for patients undergoing abdominal surgeries [6]. This study involves patients operated on at three different tertiary care centers: Santosh Medical College and Hospital, Ghaziabad; Saraswathi Institute of Medical Sciences; and Sanjay Gandhi Postgraduate Institute of Medical Sciences (SGPGI), Lucknow. By including a diverse patient population from multiple institutions, we aim to capture a broad spectrum of surgical practices and patient profiles, enhancing the generalizability of our findings.



The objectives of the study are threefold:

1. To determine the incidence and time of onset of incisional hernia following midline laparotomies;
2. To evaluate the patient-related and surgery-related risk factors contributing to the development of incisional hernias;
3. To analyze the preventive strategies used and assess their effectiveness in reducing hernia formation.

In the long term, we anticipate that the insights gained from this study will inform the development of institutional guidelines for midline laparotomy closure, risk stratification of patients preoperatively, and adoption of evidence-based preventive measures such as prophylactic mesh placement in selected cases. By identifying modifiable risk factors and reinforcing best surgical practices, we hope to reduce the incidence and burden of incisional hernias in our surgical population.

In conclusion, incisional hernias represent a preventable yet prevalent complication of midline laparotomies. The complexity of their etiology requires a multifactorial approach in prevention and management. Through this prospective study, we aim to provide robust data to support targeted interventions and improve patient outcomes following abdominal surgery.

## Materials and Methods

### Study Design and Setting

This is a **prospective observational study** conducted collaboratively at three tertiary care hospitals in North India:

1. **Santosh Medical College and Hospital, Ghaziabad**
2. **Saraswathi Institute of Medical Sciences**
3. **Sanjay Gandhi Postgraduate Institute of Medical Sciences (SGPGI), Lucknow**

The study was conducted over a period of **24 months**, from **May 2009 to April 2011**, with each patient followed up for a minimum period of **12 months** postoperatively. Institutional ethical clearance was obtained from all participating centers prior to commencement.

### Study Population

The study included adult patients undergoing **midline laparotomy** for various surgical indications under general or spinal anesthesia. Both elective and emergency laparotomies were considered.



### **Inclusion Criteria:**

- Patients aged **>18 years**
- Undergoing **primary midline laparotomy**
- Both elective and emergency surgeries included
- Consent to participate and comply with follow-up protocol

### **Exclusion Criteria:**

- Patients with **pre-existing incisional hernias**
- **Re-laparotomy within 30 days**
- Lost to follow-up
- Laparoscopic surgeries converted to open via non-midline incisions
- Immunocompromised status (e.g., transplant patients, chemotherapy)

### **Sample Size Calculation**

Based on previous literature citing a 10–20% incidence of incisional hernia after midline laparotomy, and considering an expected incidence of **15%**, with **95% confidence level** and **5% margin of error**, the minimum sample size was calculated to be **196**. However, to enhance reliability and account for loss to follow-up, a total of **250 patients** were included.

### **Data Collection and Variables**

Data were collected using a **pre-validated structured proforma**. Demographic, clinical, intraoperative, and postoperative parameters were recorded. Follow-up assessments were conducted at **1 month, 3 months, 6 months, and 12 months**.

### **Baseline Data:**

- Age, sex, BMI, nutritional status (albumin levels)
- Smoking and alcohol history
- Presence of comorbidities (diabetes, COPD, anemia)

### **Operative Variables:**



- Type of surgery (elective/emergency)
- Indication for laparotomy
- Type of suture material used (absorbable vs. non-absorbable)
- Suture technique (continuous vs. interrupted)
- Suture length-to-wound length (SL:WL) ratio
- Surgeon experience (junior resident/senior resident/consultant)
- Duration of surgery

#### **Postoperative Variables:**

- Presence of surgical site infection (SSI)
- Wound dehiscence
- Use of drains
- Need for reoperation
- Length of hospital stay

#### **Follow-up Protocol**

Patients were followed up physically and via telephone at **1, 3, 6, and 12 months**. Clinical examination was used to detect hernia; in doubtful cases, **ultrasound** or **CT scan** was used for confirmation.

#### **Operational Definitions**

- **Incisional Hernia:** Palpable defect with or without bulge at the surgical incision site confirmed by imaging if necessary.
- **Wound Infection:** Redness, discharge, or wound gaping observed within 30 days.
- **Obesity:** Defined as **BMI  $\geq 30$  kg/m<sup>2</sup>**
- **Hypoalbuminemia:** Serum albumin  $< 3.5$  g/dL

#### **Statistical Analysis**

Data were entered in **MS Excel** and analyzed using **SPSS version 26.0**. Categorical variables were presented as frequencies and percentages, continuous variables as mean  $\pm$  SD.



Chi-square test was used to compare categorical variables, and **t-test/ANOVA** for continuous variables. **Multivariate logistic regression** was used to identify independent predictors of incisional hernia. A p-value <0.05 was considered statistically significant.

## Tables and Data Presentation

**Table 1: Demographic Profile of Study Population (n = 250)**

Parameter	Value
Mean Age (years)	46.8 ± 13.2
Gender	Male: 154 (61.6%) Female: 96 (38.4%)
BMI	Mean: 26.2 ± 3.8
Obese (BMI ≥ 30 kg/m <sup>2</sup> )	47 (18.8%)
Smokers	71 (28.4%)
Diabetic Patients	62 (24.8%)
COPD	31 (12.4%)
Hypoalbuminemia	44 (17.6%)

**Table 2: Surgical Characteristics**

Variable	Frequency (%)
Type of Surgery	Elective: 174 (69.6%) Emergency: 76 (30.4%)
Type of Closure	Continuous: 201 (80.4%) Interrupted: 49 (19.6%)
Suture Material	Non-absorbable: 163 (65.2%) Absorbable: 87 (34.8%)



Variable	Frequency (%)
Surgeon Category	Consultant: 83 (33.2%)
	Senior Resident: 91 (36.4%)
	Junior Resident: 76 (30.4%)
Duration of Surgery >2 hrs	109 (43.6%)
Surgical Site Infection (SSI)	61 (24.4%)
Prophylactic Mesh Used	19 (7.6%)

**Table 3: Follow-up Outcomes**

Follow-up Period	Number of New Hernia Cases	Cumulative Incidence (%)
1 Month	5	2.0%
3 Months	11	6.4%
6 Months	13	11.6%
12 Months	8	14.8%

**Risk Factor Analysis**

Among the **37 patients (14.8%)** who developed incisional hernia, the following variables showed significant associations:

- **Wound Infection (SSI)** (p < 0.001)
- **Obesity (BMI >30)** (p = 0.02)
- **Diabetes Mellitus** (p = 0.03)
- **Emergency Surgery** (p = 0.01)
- **Absorbable Suture Use** (p = 0.005)
- **Operative Time >2 hours** (p = 0.04)

**Multivariate Logistic Regression (Adjusted Odds Ratios):**



Risk Factor	Odds Ratio (OR)	95% Confidence Interval	p-value
SSI	4.62	2.21–9.65	<0.001
Obesity	2.12	1.01–4.42	0.045
Emergency Surgery	1.89	1.01–3.56	0.038
Absorbable Suture	2.37	1.22–4.59	0.010

### Ethical Consideration

Informed written consent was obtained from all participants. Confidentiality of data was maintained. The study was approved by the **Institutional Ethics Committees** of all three participating institutions.

### Limitations

- A relatively **short follow-up** period (12 months) may have missed late-onset hernias.
- **No randomization** of suture technique or material (surgeon's discretion).
- Possibility of **loss to follow-up** despite reminders.

### Results

Out of 250 patients undergoing midline laparotomy, 37 developed incisional hernias, giving an overall incidence of **14.8%** over a 12-month follow-up period. The mean time to hernia onset was **4.3 months**, with most cases occurring between 3 to 6 months postoperatively.

### Demographics and Clinical Profile

- Mean age of hernia group: **49.7 ± 11.4 years**
- Male to female ratio in hernia group: **2.4:1**
- BMI >30 kg/m<sup>2</sup> observed in 18 of 37 hernia patients (48.6%)
- Hypoalbuminemia was present in 15 of 37 hernia cases (40.5%)

### Surgical Variables and Hernia Occurrence

- Emergency surgery was significantly associated with hernia formation (p = 0.01)
- Use of absorbable sutures showed a higher incidence (p = 0.005)



- Surgical site infection (SSI) was the **strongest predictor**, found in **59.4%** of patients who developed hernia ( $p < 0.001$ )
- Prophylactic mesh was used in 19 cases; none of these patients developed hernia.

### Time of Hernia Detection

Time After Surgery	New Hernia Cases	Cumulative Incidence
1 Month	5	2.0%
3 Months	11	6.4%
6 Months	13	11.6%
12 Months	8	14.8%

### Discussion

Incisional hernia continues to be a significant postoperative complication following midline laparotomy, with a reported incidence between **10–20%** in global literature. Our study found an incidence of **14.8%**, aligning with previous reports by Luijendijk et al. and Mudge & Hughes.

### Key Risk Factors

- **Surgical Site Infection (SSI)** emerged as the most significant risk factor (OR = 4.62). This finding supports the role of wound contamination and impaired healing in hernia development, echoing earlier studies (Manninen et al., 2007).
- **Obesity** was also significant (OR = 2.12). Excess intra-abdominal pressure and poor wound healing contribute to fascial dehiscence.
- **Emergency surgeries** had a higher hernia rate, likely due to inadequate preoperative optimization and higher contamination risk.
- **Suture type** influenced outcomes: non-absorbable sutures fared better in long-term wound support.

### Prevention Strategies

The use of **prophylactic mesh** in high-risk patients showed promising results; none of these patients developed hernia. Though controversial due to infection risk, recent studies suggest mesh reinforcement reduces long-term complications (Jenkins et al., 2016).



Optimizing **nutritional status**, ensuring **antibiotic prophylaxis**, and following **meticulous surgical techniques** were key components of prevention.

### Comparative Analysis with Literature

Study	Incidence (%)	Major Risk Factors
Luijendijk et al. (2000)	11%	SSI, suture technique
Mudge & Hughes (1985)	18%	Obesity, wound infection
Present Study	14.8%	SSI, obesity, emergency surgery

Our study reaffirms the multifactorial etiology of incisional hernia and suggests actionable intraoperative and postoperative strategies to mitigate the risk.

### Conclusion

This prospective study underscores that **incisional hernias remain a common and preventable complication** of midline laparotomies. The major risk factors identified were:

- Surgical site infection
- Obesity
- Emergency surgery
- Use of absorbable sutures

Implementation of **prophylactic mesh** in high-risk cases, use of **non-absorbable sutures**, and strict adherence to **infection control** can significantly reduce hernia incidence.

Future large-scale randomized controlled trials are warranted to validate the routine use of prophylactic mesh in high-risk groups.

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