RESEARCH PAPER

Incidence and Predictors of Right Inguinal Hernia After Open Appendectomy: A Retrospective Cohort Study

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Abstract

Background: Open appendectomy remains an important surgical approach in many resource-constrained settings. Although the McBurney/gridiron or Lanz incision is generally considered safe, postoperative groin herniation may occur and has received limited attention. This study evaluated the occurrence of right inguinal hernia after open appendectomy and explored associated patient and postoperative factors.

Methods: This retrospective cohort study included 587 adults who underwent open appendectomy at a tertiary-care hospital. Demographic characteristics, body mass index (BMI), smoking status, diabetes mellitus, hypertension, chronic cough, and postoperative wound infection were extracted from medical records. Patients were followed for up to 36 months, with clinical assessment, review of records, telephone contact when necessary, and ultrasonography for symptomatic or suspected cases. Associations were examined using chi-square testing, followed by multivariable logistic regression. Adjusted odds ratios (ORs) with 95% confidence intervals (CIs) were reported.

Results: The mean age was 34.7 ± 12.4 years and 338 (57.6%) patients were male. Right inguinal hernia was documented in 36 patients, corresponding to a cumulative incidence of 6.13% over 36 months. Compared with patients without hernia, those who developed hernia were more frequently male (80.6% vs 56.1%; p=0.004), had higher mean BMI (26.1 ± 3.5 vs 25.2 ± 3.0 kg/m²; p=0.041), smoked more often (38.9% vs 17.8%; p=0.002), had diabetes more often (25.0% vs 10.5%; p=0.007), and experienced postoperative wound infection more often (33.3% vs 11.3%; p<0.001). In multivariable analysis, male sex (adjusted OR 2.52, 95% CI 1.14–5.59; p=0.022), BMI >25 kg/m² (adjusted OR 1.87, 95% CI 1.03–3.51; p=0.041), smoking (adjusted OR 2.35, 95% CI 1.12–4.92; p=0.023), diabetes mellitus (adjusted OR 2.74, 95% CI 1.12–6.70; p=0.027), and postoperative wound infection (adjusted OR 3.98, 95% CI 1.80–8.78; p<0.001) were independently associated with hernia development.

Conclusion: Right inguinal hernia was identified as a clinically relevant late outcome after open appendectomy in this cohort. Postoperative wound infection showed the strongest independent association. Long-term surveillance and attention to modifiable risk factors may be appropriate, particularly in higher-risk patients. Prospective multicentre studies are needed to confirm these findings and clarify the underlying anatomical and technical mechanisms.

Keywords: appendectomy; inguinal hernia; postoperative complications; wound infection; smoking; diabetes mellitus; body mass index; retrospective cohort.

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Introduction

Acute appendicitis is one of the most common surgical emergencies, and appendectomy remains a frequently performed operation worldwide. Although laparoscopic appendectomy has become widely established, open appendectomy continues to be used in many low- and middle-income settings because of availability, cost, surgeon preference, and resource considerations. The McBurney (gridiron) and Lanz incisions generally provide safe access to the right lower quadrant, but any operation that disrupts the abdominal wall can potentially influence subsequent tissue integrity.

Inguinal hernia is common in the general population, with a strong male predominance and recognized contributions from age, anatomy, connective-tissue characteristics, mechanical exposure, and patient-related factors. The pathophysiology of inguinal hernia is multifactorial rather than attributable to a single mechanical defect. [1,2]

The relationship between previous lower abdominal surgery and later groin herniation is less clearly defined. Postoperative wound infection can impair collagen remodeling and fascial healing, while smoking and diabetes may adversely affect tissue repair. Evidence concerning BMI is less consistent: some population studies have reported an inverse association between BMI and primary groin hernia, whereas higher BMI may contribute to increased

intra-abdominal pressure and other postoperative complications. [2-5]

Published data specifically addressing hernia after open appendectomy are limited. A recent retrospective study from Iraq reported a low incidence of appendectomy-site incisional hernia, emphasizing that postoperative herniation after open appendectomy is uncommon in many cohorts. [6] This distinction is important because an inguinal hernia is anatomically different from an incisional hernia at the appendectomy wound. The present study therefore focused specifically on right inguinal hernia occurring after open appendectomy.

The objective of this study was to determine the cumulative incidence of right inguinal hernia during 36 months after open appendectomy and to identify demographic and postoperative factors independently associated with its development.

Methods

Study design and setting

This retrospective cohort study was conducted in the Department of General Surgery at Rawal Institute of Health Sciences, Islamabad, Pakistan. Medical records of patients who underwent open appendectomy during January 2020 to December 2025 were reviewed.

Participants

The source dataset contained 642 patients who underwent open appendectomy, of whom 587 met the stated eligibility criteria and were included in the analysis. Inclusion criteria were age ≥18 years, open appendectomy through a right lower-quadrant Lanz or gridiron incision, and documented follow-up of at least 12 months. Exclusion criteria were laparoscopic appendectomy, previous inguinal hernia or hernia repair, recurrent appendicitis treated with interval surgery, and incomplete or missing follow-up information.

Variables and outcome definition

The following variables were extracted from medical records: age, sex, BMI, smoking status, diabetes mellitus, hypertension, chronic cough, incision type, operative findings, postoperative wound infection, length of hospital stay, and follow-up duration. The primary outcome was development of a new right inguinal hernia during follow-up, defined as a hernia not documented before appendectomy and confirmed by clinical examination and/or imaging. Wound infection was defined according to Centers for Disease Control and Prevention criteria as documented by the treating or follow-up surgeon.

Follow-up

Patients were assessed during outpatient follow-up. Patients unable to attend were contacted by telephone. Those reporting a groin bulge, pain, or discomfort were invited for clinical examination and ultrasonography when indicated. Follow-up was evaluated through 36 months after appendectomy.

Ethical considerations

The study was approved by the Institutional Review Board of Rawal Institute of Health Sciences, Islamabad. The analysis used anonymized retrospective data, and the source manuscript states that informed consent was waived by the institutional review body.

Statistical analysis

Analyses were performed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables were summarized as mean ± standard deviation and categorical variables as frequency and percentage. Associations between categorical variables and hernia occurrence were assessed using the chi-square test. Variables identified as significant in univariable analyses were entered into a multivariable logistic regression model. Adjusted ORs with 95% CIs were reported. A two-sided p value <0.05 was considered statistically significant.

Results

Cohort characteristics

Of 642 records reviewed, 587 patients were included in the final analysis. The mean age was 34.7 ± 12.4 years; 338 (57.6%) were male and 249 (42.4%) were female. Mean BMI was 25.3 ± 3.1 kg/m². Smoking was documented in 112 (19.1%) patients, diabetes mellitus in 67 (11.4%), hypertension in 79 (13.5%), chronic cough in 48 (8.2%), and postoperative wound infection in 74 (12.6%). Thirty-six patients developed right inguinal hernia during follow-up, giving a cumulative 36-month incidence of 6.13%.

Table 1. Baseline characteristics of the study population (N=587)

Variable	Value
Age, years, mean ± SD	34.7 ± 12.4
Male sex, n (%)	338 (57.6)
BMI, kg/m², mean ± SD	25.3 ± 3.1
Smoking, n (%)	112 (19.1)
Diabetes mellitus, n (%)	67 (11.4)
Hypertension, n (%)	79 (13.5)
Chronic cough, n (%)	48 (8.2)
Postoperative wound infection, n (%)	74 (12.6)
Right inguinal hernia during follow-up, n (%)	36 (6.13)

The cohort was predominantly young to middle-aged adults and male patients were more numerous. Wound infection occurred in approximately one in eight patients, while right inguinal hernia was documented in 6.13% over the reported follow-up period.

Factors associated with right inguinal hernia

Patients who developed right inguinal hernia were more likely to be male, to have a higher mean BMI, to

smoke, to have diabetes mellitus, and to have experienced postoperative wound infection. Age did not differ significantly between the hernia and non-hernia groups.

Table 2. Comparison of patients with and without right inguinal hernia

Variable	Hernia (n=36)	No hernia (n=551)	p value
Age, years, mean ± SD	37.8 ± 11.6	34.5 ± 12.5	0.103
Male sex, n (%)	29 (80.6)	309 (56.1)	0.004
BMI, kg/m², mean ± SD	26.1 ± 3.5	25.2 ± 3.0	0.041
Smoking, n (%)	14 (38.9)	98 (17.8)	0.002
Diabetes mellitus, n (%)	9 (25.0)	58 (10.5)	0.007
Postoperative wound infection, n (%)	12 (33.3)	62 (11.3)	<0.001

BMI was also analyzed categorically in the multivariable model, with BMI >25 kg/m² used as the threshold reported in the source manuscript.

Table 3. Multivariable logistic regression for predictors of right inguinal hernia

Predictor	Adjusted OR	95% CI	p value
Male sex	2.52	1.14–5.59	0.022
BMI >25 kg/m²	1.87	1.03–3.51	0.041
Smoking	2.35	1.12–4.92	0.023
Diabetes mellitus	2.74	1.12–6.70	0.027
Postoperative wound infection	3.98	1.80–8.78	<0.001

Postoperative wound infection had the strongest reported independent association with right inguinal hernia (adjusted OR 3.98, 95% CI 1.80–8.78; p<0.001). Male sex, BMI >25 kg/m², smoking, and diabetes mellitus also remained statistically significant in the multivariable model.

Timing of hernia occurrence

The reported cumulative event counts indicate that 7 hernias had been identified by 6 months, 17 by 12 months, 28 by 24 months, and 36 by 36 months. Thus, most events occurred during the first 24 months, but additional cases continued to be identified during the third year of follow-up.

Table 4. Cumulative incidence of right inguinal hernia over follow-up

Follow-up interval	Cumulative cases, n	Cumulative incidence, %
6 months	7	1.19
12 months	17	2.90
24 months	28	4.78
36 months	36	6.13

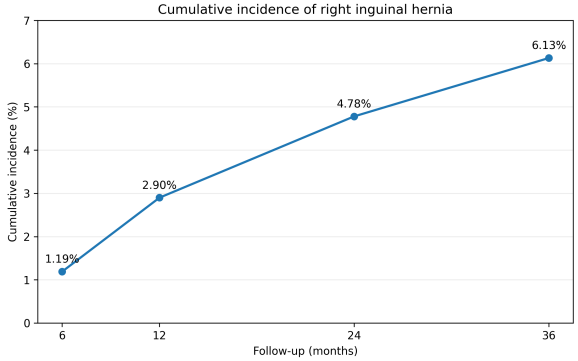

Figure 2. Cumulative incidence of right inguinal hernia during 36 months of follow-up.

Discussion

In this retrospective cohort of 587 adults who underwent open appendectomy, 36 patients developed right inguinal hernia during the reported 36-month follow-up, corresponding to a cumulative incidence of 6.13%. The principal finding was the strong association between postoperative wound infection and subsequent hernia, with an adjusted OR of 3.98. Male sex, BMI >25 kg/m², smoking, and diabetes mellitus were also independently associated with the outcome.

The predominance of men among patients who developed hernia (80.6%) is consistent with the established epidemiology of groin hernia. Adult inguinal hernia has a strong male predominance, and anatomical and connective-tissue factors contribute to susceptibility. [1,2] A large case-control study also identified male-specific activity and family history as important determinants of primary inguinal hernia, underscoring that postoperative events may occur against a background of pre-existing susceptibility. [8]

The association with postoperative wound infection is biologically plausible. Surgical-site infection can disrupt normal tissue repair and collagen remodeling, potentially reducing the mechanical strength of the abdominal wall. In the present study, one-third of patients who developed hernia had a documented postoperative wound infection compared with 11.3% of those without hernia, and infection remained the strongest predictor after adjustment. Although the present retrospective design cannot establish causality, the magnitude of association supports careful infection prevention and early management of wound complications.

Smoking was independently associated with the outcome in this cohort. The broader hernia literature shows that smoking is biologically relevant to tissue

healing and is associated with adverse outcomes in some hernia populations, although its relationship with development of primary groin hernia is not uniform across studies. A 2024 meta-analysis found a higher risk of recurrence after inguinal hernia repair among smokers, while population-based studies have reported conflicting associations with primary groin hernia. [9,10] The present finding should therefore be interpreted as an association within this postoperative cohort rather than proof that smoking directly causes post-appendectomy inguinal hernia.

Diabetes mellitus was another independent predictor. Diabetes is associated with impaired wound healing and postoperative complications, and registry data have shown increased short-term postoperative complications among patients with diabetes undergoing groin hernia surgery. [11] In the current cohort, diabetes may represent both a systemic healing factor and a marker of broader comorbidity burden.

The association between BMI and inguinal hernia requires cautious interpretation. The current study used BMI >25 kg/m² in its regression model and found a modest but statistically significant association. However, epidemiological studies have reported an inverse relationship between BMI and primary groin hernia, and the literature remains heterogeneous regarding whether higher BMI increases the risk of developing a primary inguinal hernia. [3,4,10] Accordingly, the present finding may reflect postoperative abdominal-wall mechanics or cohort-specific characteristics rather than a universal causal relationship.

The timing of events is clinically important. More than three-quarters of the reported hernia cases had been identified by 24 months, but additional cases occurred during the third year. This supports the value of longer follow-up when studying delayed abdominal-wall outcomes. Published evidence on open appendectomy has largely focused on appendectomy-site incisional hernia, which appears uncommon in some cohorts. For example, Barzinjy and Habeeb reported an appendectomy-site incisional hernia rate of 0.5% among 598 patients followed for approximately 2–3 years. [6] The substantially higher frequency observed in the present study should not be directly compared with that estimate because the anatomical outcome differs: this study evaluated right inguinal hernia rather than incisional hernia at the appendectomy site.

The study also has implications for surgical technique and follow-up. Contemporary hernia guidelines emphasize the importance of abdominal-wall anatomy and standardized approaches to groin hernia care, while evidence from broader abdominal surgery indicates that minimally invasive access can reduce incisional hernia occurrence compared with open surgery. [12,13] These data do not demonstrate that laparoscopic appendectomy prevents postoperative inguinal hernia, but they support prospective comparative research addressing whether operative access, incision geometry, tissue handling, and nerve preservation influence later groin-wall integrity.

Strengths and limitations

Strengths include a defined cohort of 587 patients, a reported 36-month follow-up, use of both clinical and imaging assessment for symptomatic cases, and multivariable analysis of several clinically relevant factors. The study also addresses a relatively underreported postoperative outcome.

Several limitations should be considered. First, the retrospective single-centre design is susceptible to selection, information, and follow-up bias. Second, the source manuscript does not provide a detailed accounting of the 55 excluded records or the number of patients completing each follow-up interval. Third, asymptomatic or subclinical hernias may have been missed, particularly among patients who did not return for examination. Fourth, operative technical variables such as exact incision length, fascial closure technique, suture material, nerve identification, postoperative activity, and surgeon experience were not reported, limiting mechanistic interpretation. Fifth, family history, connective-tissue disorders, occupational physical activity, and chronic increases in intra-abdominal pressure were not available for adjustment.

Conclusion

In this retrospective cohort, the cumulative incidence of right inguinal hernia after open appendectomy was 6.13% over 36 months. Male sex, BMI >25 kg/m², smoking, diabetes mellitus, and postoperative wound infection were independently associated with hernia development, with postoperative wound infection showing the strongest association. The findings support attention to wound complications and longer-term surveillance after open appendectomy, particularly in patients with additional risk factors.

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