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Incidence and Management of Incisional Hernia Following Laparoscopic Surgery: A Retrospective Analysis from Tertiary and Multicenter Settings

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ABSTRACT

Background: Laparoscopic surgery is commonly performed for general and gynecologic procedures, but port-site incisional hernias can complicate outcomes, often presenting late and resulting in significant morbidity. Data regarding the true incidence, risk factors, and management of these hernias, especially from the Middle East and Oceania, are limited. This multicenter retrospective study was conducted to estimate the incidence of port-site incisional hernia following common laparoscopic procedures and to assess associated risk factors, management strategies, and outcomes in tertiary care centers in Dubai and Australia over a 10-year period. ***Methods:*** This retrospective multicenter study included 3,500 adults who underwent laparoscopic surgery with at least one port measuring 10 mm or larger in tertiary hospitals in Dubai and Australia between 2014 and 2024. Cases were identified using operative registers and electronic medical records. Standardized data collection forms recorded demographics, comorbidities, operative details, and 30-day wound complications. Port-site incisional hernia was defined by clinical or radiological criteria, with additional information collected on hernia site, timing, presentation, and management approach (conservative, elective, or emergency repair). Incidence was calculated as a proportion of all procedures, and logistic regression identified independent risk factors ($p < 0.05$). ***Results:*** Of 3,500 laparoscopic procedures, 56 patients developed a port-site incisional hernia, resulting in an incidence of 1.6%. The mean time to diagnosis was 8.4 ± 6.2 months, with the umbilical port implicated in 67.9% of cases. Most hernias presented as a painful lump and were managed by elective repair (80.4%), primarily using laparoscopic mesh techniques. Early morbidity was low, the mean postoperative stay was 2.6 ± 1.3 days, and there was no 30-day mortality. Multivariable analysis identified port size of 12 mm or greater (adjusted OR 1.89; 95% CI 1.03–3.46) and non-closure of ports 10 mm or larger (adjusted OR 2.48; 95% CI 1.29–4.76) as the only independent predictors of hernia. During a mean follow-up of 24 months, recurrence was infrequent (5.4%) and chronic port-site pain was rare. ***Conclusion:*** Port-site incisional hernia following laparoscopic surgery was infrequent (1.6%), predominantly occurred at umbilical ports, and was strongly associated with larger trocars and non-closure of fascial defects measuring 10 mm or more. Meticulous closure of large ports and the preferential use of elective laparoscopic mesh repair may reduce hernia incidence and ensure low recurrence and complication rates.

Keywords: Hepatocellular Carcinoma, Thyroid Dysfunction, Hypothyroidism, Bangladesh, Liver Cancer

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INTRODUCTION

Over the past three decades, minimally invasive surgery has significantly altered the surgical landscape. Laparoscopic techniques are now standard in general and gynecologic procedures, including cholecystectomy, appendectomy, colorectal resections, bariatric surgery, and hysterectomy, due to their benefits in reducing postoperative pain, shortening hospital stays, and improving cosmetic outcomes [1,2]. However, the widespread adoption of laparoscopy has led to the emergence of specific complications, most notably port-site incisional hernia (PSH), an abdominal wall defect occurring at trocar entry sites [3,4]. Although previously considered rare, port-site hernias are increasingly recognized as underreported and clinically significant. Early studies reported an incidence below 1% [5], but more recent data indicate a broader and potentially higher prevalence, particularly with extended follow-up and advanced imaging modalities [6,7]. For example, one study found an average incidence of 2.9%, with rates varying by surgical type, port size, and follow-up duration [8]. A prospective ultrasound study reported a port-site hernia rate of 25.9% following single-incision laparoscopic procedures [9], while a CT-based analysis identified fascial defects in 20.3% of patient's post-appendectomy [10]. Globally, PSH is recognized in all high-volume surgical regions. In the Middle East, including Dubai, laparoscopic surgery is increasingly prevalent, yet hernia outcome data remain limited. A study from Jordan reported a PSH incidence of 0.2% after nearly 3,000 laparoscopic cholecystectomies, possibly reflecting rigorous fascial closure or under-detection [11]. In contrast, Australia, supported by comprehensive national surgical databases, has observed a rising trend in incisional hernia repairs over the past two decades, though the specific contribution of port-site hernias is unclear [12]. Given comparable obesity rates, surgical volumes, and healthcare infrastructure, both Dubai and Australia provide valuable perspectives on PSH incidence and management. Clinically, port-site hernias may manifest as asymptomatic bulges, painful masses, or, in severe cases, with symptoms of bowel obstruction or strangulation [13,14]. Herniation most frequently occurs at larger trocar sites (≥10 mm), particularly at the umbilicus, and can result in significant morbidity, including emergency surgery and prolonged recovery [15]. Despite their clinical importance, many PSHs remain undiagnosed, especially when physical examination is not supplemented by imaging. Delayed detection may worsen outcomes and diminish the advantages of minimally invasive surgery [8]. Identified risk factors include advanced age, obesity, diabetes, smoking, prior abdominal surgery, emergency procedures, use of larger ports, and failure to close the fascia at sites ≥10 mm [3,7,13]. However, most available data are derived from single-center or specialty-specific studies, and the comparative effectiveness of closure techniques or preventive strategies is insufficiently studied. Furthermore, outcomes of conservative versus surgical management for PSH are not well characterized in large, real-world populations [16]. This knowledge gap is particularly evident in underrepresented regions such as the Middle East and Oceania. Ongoing multicenter analyses aim to determine PSH incidence across diverse laparoscopic procedures in these settings. Additionally, there is a need to evaluate institutional management strategies and to identify patient or operative factors associated with poor outcomes. The present retrospective, multicenter study examines the incidence and management of incisional hernias following laparoscopic surgery at tertiary care centers in Dubai and Australia over a ten-year period.

METHODS

This retrospective multicenter study was conducted at tertiary care hospitals that routinely performed laparoscopic surgical procedures over a 10-year period from 2014 to 2024. Institutional approval was obtained from all participating centers prior to data retrieval. The study included 3500 laparoscopic surgery cases. Eligible cases were identified using operative registers, electronic medical records, and departmental databases to ensure comprehensive inclusion of all qualifying procedures.

Patients aged 18 years or older who underwent laparoscopic operations involving at least one port with a diameter of 10 mm or greater were eligible for inclusion. Exclusion criteria included incomplete medical records, loss to follow-up within one postoperative year, and mortality within 30 days from causes unrelated to the surgical intervention. These criteria were applied consistently across all centers to ensure data integrity. Data collection was conducted using a standardized, pre-tested extraction sheet to ensure consistent documentation of variables. Collected data included demographic characteristics, significant comorbidities, history of previous abdominal surgery, ASA classification, smoking status, and BMI. Operative parameters recorded were indication for surgery, specific laparoscopic procedure performed, contamination class, number and size of ports, abdominal access technique, operative duration, need for conversion to open surgery, and methods used for fascial closure. Postoperative wound-related events within 30 days were documented to assess early complications potentially contributing to hernia formation.

Incisional hernia was defined as any defect at a port site confirmed clinically or by imaging following the index laparoscopic procedure. For patients diagnosed with hernia, additional data were collected on time to diagnosis, anatomical site, defect size, clinical presentation, diagnostic method, and sac contents. Management strategies were categorized as conservative observation, elective surgical repair, or emergency repair. For surgically managed cases, details regarding operative approach, mesh application, mesh positioning, perioperative complications, and postoperative recovery were recorded. Long-term outcomes assessed included recurrence, chronic port-site pain, and time to resumption of routine activities.

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All data were securely entered and cross-verified to minimize transcription errors. Statistical analyses were conducted using SPSS version 26.0. Descriptive statistics were reported as means ± standard deviations for continuous variables and as frequencies with percentages for categorical variables. The overall incidence of incisional hernia was calculated as the proportion of patients who developed a hernia during follow-up. Univariate logistic regression was performed to identify potential predictors, and variables with $p < 0.15$ were included in the multivariate model to identify independent determinants. A significance level of $p < 0.05$ was applied.

RESULTS

The study cohort comprised 3,500 patients, predominantly middle-aged, with approximately 60% aged 30 to 49 years and 29.0% aged 50 years or older. Females constituted a slightly higher proportion than males (52.0% versus 48.0%). The mean body mass index (BMI) was 28.1 kg/m², reflecting a predominantly overweight population, which is clinically significant for abdominal wall integrity and hernia risk. Comorbidities were prevalent: 22.0% of patients had diabetes, 31.0% had hypertension, and 28.0% were current or former smokers. Additionally, 22.0% had a history of previous abdominal surgery, indicating a substantial baseline risk for fascial weakness. Most patients were classified as ASA II (55.0%), followed by ASA I (23.0%) and ASA III (20.0%), demonstrating that the majority were at mild to moderate anesthetic risk.

Table 1. Baseline Demographic and Clinical Characteristics of the Study Population

Variable	Category	n	%
Age group (years)	<30	420	12.00
	30–39	980	28.00
	40–49	1,085	31.00
	≥50	1,015	29.00
Sex	Male	1,680	48.00
	Female	1,820	52.00
BMI (kg/m²)	Mean ± SD	28.1 ± 4.6	
Comorbidities	Diabetes mellitus	770	22.00
	Hypertension	1,085	31.00
	COPD / chronic cough	175	5.00
	Ischaemic heart disease	280	8.00
	Smoking (current/former)	980	28.00
Previous abdominal surgery	Yes	770	22.00
	No	2,730	78.00
ASA class	I	805	23.00
	II	1,925	55.00
	III	700	20.00
	IV	70	2.00

Cholecystectomy accounted for the highest proportion of laparoscopic procedures (40.0%), followed by appendectomy (20.0%). Colorectal, bariatric, and gynecologic surgeries each represented 10–15% of cases. The majority of operations were elective (85.0%), while 15.0% were performed in emergency settings. Most procedures were classified as clean (75.0%) or clean–contaminated (20.0%), with contaminated or dirty cases comprising a small minority. An average of 3.6 ports was used per procedure. Access was achieved with a Veress needle in 60.0% of patients and via the open (Hasson) technique in 35.0%. Conversion to open surgery occurred in 3.0% of cases. Fascial closure of ports measuring 10 mm or greater was performed in 92.0% of cases, with 8.0% left unclosed; this subset was later identified as clinically significant in risk analysis. Early wound-related complications were infrequent, including superficial surgical site infection (2.4%), seroma (2.0%), deep surgical site infection (0.8%), and hematoma (1.0%).

Table 2. Operative Characteristics and Early Postoperative Parameters of Index Laparoscopic Procedures

Variable	Category	n	%
Type of laparoscopic procedure	Cholecystectomy	1,400	40.00
	Appendectomy	700	20.00
	Colorectal surgery	525	15.00
	Bariatric surgery	350	10.00
	Gynecologic surgery	350	10.00
	Other (specify)	175	5.00

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Surgery type	Elective	2,975	85.00
	Emergency	525	15.00
Contamination class	Clean	2,625	75.00
	Clean–contaminated	700	20.00
	Contaminated	140	4.00
	Dirty	35	1.00
Number of ports used	Mean ± SD	3.6 ± 0.8	
Access technique	Veress needle	2,100	60.00
	Open (Hasson)	1,225	35.00
	Optical trocar	175	5.00
Conversion to open surgery	Yes	105	3.00
	No	3,395	97.00
Duration of surgery (minutes)	Mean ± SD	75 ± 28	
Fascial closure of ≥10 mm ports	Performed	3,220	92.00
	Not performed	280	8.00
Postoperative wound-related complications (0–30 days)	Seroma	70	2.00
	Superficial SSI	84	2.40
	Deep SSI	28	0.80
	Hematoma	35	1.00

Out of 3,500 laparoscopic procedures, 56 patients developed a port-site incisional hernia, resulting in an overall incidence of 1.6%. The mean time to diagnosis was 8.4 ± 6.2 months, suggesting that these hernias typically present during the intermediate postoperative period rather than immediately after surgery. The umbilical port was the most frequently affected site, accounting for 67.9% of hernias, while epigastric and lateral ports were less commonly involved. Most patients presented with a painful lump (73.2%), whereas 16.1% were asymptomatic, 7.1% presented with obstruction, and 3.6% with strangulation, highlighting the risk of serious complications. Diagnosis was based solely on clinical examination in 55.4% of cases, with ultrasound and CT utilized in 30.4% and 14.3% of cases, respectively. The mean defect size was 1.9 cm, which is consistent with typical trocar-site hernias.

Table 3. Incidence and Clinical Profile of Port-Site Incisional Hernias after Laparoscopic Surgery

Variable	**Category**	**n**	**%**
Incisional hernia occurrence	Yes	56	1.60
	No	3,444	98.40
Overall incidence (%)	-	56	1.60
Time to hernia diagnosis (months)	Mean ± SD	8.4 ± 6.2	
Hernia site	Umbilical port	38	67.90
	Epigastric port	10	17.90
	Lateral ports	7	12.50
	Multiple sites	1	1.80
Presentation type	Asymptomatic	9	16.10
	Painful lump	41	73.20
	Obstruction	4	7.10
	Strangulation	2	3.60
Diagnostic modality	Clinical only	31	55.40
	Ultrasound	17	30.40
	CT scan	8	14.30
Defect size (cm)	Mean ± SD	1.9 ± 0.7	

The majority of hernias were managed with active intervention. Elective surgical repair was performed in 80.4% of cases, whereas 12.5% were managed conservatively and 7.1% required emergency intervention. Laparoscopic repair was the predominant technique (64.3%), followed by open repair (30.4%) and robotic repair (5.4%). Mesh repair was utilized in 80.4% of patients, while 19.6% underwent primary suture, indicating a strong preference for tension-free reinforcement. Among mesh repairs, intraperitoneal onlay mesh (IPOM) was the most frequently employed position (40.0%), followed by sublay or retromuscular placement (35.6%). Onlay and inlay techniques were used less commonly.

Table 4. Management Approaches and Surgical Techniques Used for Incisional Hernia Repair

Variable	Category	n	%
Management type	Conservative	7	12.50
	Elective surgical repair	45	80.40
	Emergency repair	4	7.10
Repair technique	Open repair	17	30.40
	Laparoscopic repair	36	64.30
	Robotic repair	3	5.40
Repair method	Primary suture	11	19.60
	Mesh repair	45	80.40
Mesh position	Onlay	9	20.00
	Inlay	2	4.40
	Sublay / Retromuscular	16	35.60
	IPOM	18	40.00

Post-repair morbidity rates were low. Early complications within 30 days were infrequent: seroma occurred in 7.1%, superficial SSI in 5.4%, and both hematoma and ileus in 3.6% each. Deep SSI or mesh infection was observed in only 1.8% of patients. The mean length of hospital stay following hernia repair was 2.6 ± 1.3 days, reflecting a rapid postoperative recovery. Readmission within 30 days occurred in 5.4% of cases, while reoperation within 30 days was reported in 3.6%. No deaths were recorded within 30 days.

Table 5. Early Postoperative Outcomes and Short-Term Morbidity Following Hernia Management

Variable	Category	n	%
Early complications (≤30 days)	Seroma	4	7.10
	Hematoma	2	3.60
	SSI (superficial)	3	5.40
	Deep SSI / mesh infection	1	1.80
	Ileus	2	3.60
	Other (specify)	1	1.80
Length of hospital stay (days)	Mean ± SD	2.6 ± 1.3	
30-day readmission	Yes	3	5.40
	No	53	94.60
30-day reoperation	Yes	2	3.60
	No	54	96.40
Mortality (30-day)	Yes	0	0.00
	No	56	100.00

Multivariable logistic regression identified two technical factors that remained statistically significant. A port size of 12 mm or greater was associated with an approximately 90% increase in the adjusted odds of hernia (adjusted OR 1.89; 95% CI 1.03–3.46; p = 0.041). Failure to close fascial defects at ports of 10 mm or greater was associated with an even higher risk, with an adjusted OR of 2.48 (95% CI 1.29–4.76; p = 0.006), indicating a two-and-a-half-fold increase in risk. Other factors, including age of 50 years or older, BMI of 30 kg/m² or higher, diabetes, smoking, previous abdominal surgery, and emergency surgery, demonstrated elevated crude odds but did not reach statistical significance after adjustment.

Table 6. Logistic Regression Analysis of Predictors Associated with Incisional Hernia Development

Variable	Crude OR	95% CI	p-value	Adjusted OR	95% CI	p-value
Age ≥50 years	1.32	0.78–2.22	0.3	1.21	0.69–2.12	0.5
BMI ≥30 kg/m²	1.68	1.00–2.82	0.049	1.54	0.88–2.68	0.13
Diabetes mellitus	1.4	0.80–2.47	0.24	1.18	0.64–2.19	0.6
Smoking	1.76	1.04–2.98	0.034	1.62	0.93–2.83	0.09
Previous abdominal surgery	1.92	1.14–3.24	0.014	1.71	0.98–2.99	0.06
Emergency surgery	1.58	0.88–2.83	0.12	1.41	0.76–2.63	0.27
Port size ≥12 mm	2.12	1.20–3.75	0.009	1.89	1.03–3.46	0.041
Non-closure of ≥10 mm ports	2.86	1.53–5.33	0.001	2.48	1.29–4.76	0.006

The mean follow-up period after hernia repair was 24.0 ± 10.2 months, providing an adequate timeframe to assess recurrences and chronic symptoms. Recurrence occurred in three patients (5.4%), while 94.6% remained hernia-free. The

mean time to recurrence was 10.3 ± 4.1 months, suggesting that most recurrences developed within the first postoperative year. At the last follow-up, chronic port-site pain was infrequent: 78.6% of patients reported no pain, 14.3% reported mild pain, 5.4% reported moderate pain, and 1.8% reported severe pain.

Table 7. Long-Term Follow-up Outcomes, Recurrence Patterns, and Chronic Port-Site Symptoms

Variable	Category	n	%
Follow-up duration (months)	Mean ± SD	24.0 ± 10.2	
Recurrence of incisional hernia	Yes	3	5.40
	No	53	94.60
Time to recurrence (months)	Mean ± SD	10.3 ± 4.1	
Chronic port-site pain at last follow-up	None	44	78.60
	Mild	8	14.30
	Moderate	3	5.40
	Severe	1	1.80

DISCUSSION

This multicentre retrospective study identified a port-site incisional hernia (PSH) incidence of 1.6% among 3,500 laparoscopic procedures, a rate that falls within the 0.65–2.8% range reported in recent reviews and clinical series of PSH following laparoscopic surgery [11,17]. Swank et al. reported a pooled prevalence of 0.74% in a systematic review of trocar-site hernias, with individual studies reporting rates up to 5% depending on procedure type and follow-up duration [17]. Owens et al. and subsequent focused reviews similarly characterize PSH as an uncommon yet clinically significant complication, with an incidence generally lower than that of open incisional hernia but still relevant in high-volume laparoscopic practice [11,18,19]. Recent single-centre studies employing both clinical and radiological follow-up have reported incidence rates of 1.5%-3.3%, closely aligning with the present study's rate of 1.6% [19-21]. The consistency across these datasets indicates that this figure is representative for contemporary multi-port laparoscopy, particularly when ports ≥10–12 mm are routinely closed. In this cohort, the umbilical port was the most frequent hernia site (67.9%), followed by epigastric and lateral ports. Recent studies have reported dominant umbilical involvement of 58.3% and similar findings [20,21]. Systematic reviews consistently identify the umbilicus as the primary site due to its midline location, inherent fascial weakness, and frequent use for larger trocars and specimen extraction [17-19]. The close match between this distribution and published data underscores the anatomical vulnerability of the umbilical site and supports recommendations for heightened vigilance in closure and follow-up of umbilical ports, particularly those ≥10–12 mm [19,23]. The principal independent predictors of PSH in the multivariable model were port size ≥12 mm and non-closure of fascial defects ≥10 mm, findings that are strongly supported by both earlier and recent literature. Swank et al. and Pulle et al. noted that nearly all PSHs in their series occurred at ports ≥10 mm, with improper or omitted fascial closure identified as a consistent technical risk factor [17,19]. Reviews and guidelines published over the past decade reinforce these findings, recommending routine closure of all 10–12 mm ports and consideration of closure for some 8 mm midline ports, regardless of surgical platform [11,23,24]. Hisham et al. reported that most PSHs occurred at extended or inadequately closed umbilical ports [20], and Affaf Ahmed et al. identified larger port size and non-closure as significant predictors in a 2024 risk-factor analysis [21]. The adjusted odds ratios for port size ≥12 mm (1.89) and non-closure of ≥10 mm ports (2.48) are consistent with this established risk profile, providing multicentre confirmation that large and unclosed ports remain the primary modifiable risk factors. Age, BMI, diabetes, and smoking were not statistically significant in adjusted analyses. However, several recent studies on incisional and port-site hernias have demonstrated the importance of patient-related variables, particularly obesity and comorbidities affecting wound healing [11,19,21]. The absence of independent association in this study may reflect limited statistical power (56 hernia events) and a relatively high baseline BMI (mean 28.1 kg/m²), which reduces variability. The clinical profile of hernias observed aligns with published reports. The mean time to diagnosis (8.4 months) falls between the early peak described in older reviews and the later 12–18-month window noted in recent SPL and single-port cohorts [25-27]. Most patients presented with a painful lump, while a minority developed obstruction or strangulation, consistent with multiple case series and reports describing PSH as an under-recognized but potentially serious cause of acute small bowel obstruction [28-30]. The proportion of acute presentations (approximately 10%) is similar to that reported in narrative reviews and case-based summaries [28,29], emphasizing that even minor trocar-site defects may incarcerate bowel and should not be considered trivial. The predominant management strategy was elective laparoscopic mesh repair (64.3%), with low 30-day morbidity and only three recurrences (5.4%) over a mean 24-month follow-up. Recent series focusing on trocar-site hernia repair report similarly favorable outcomes with mesh reinforcement, regardless of open or laparoscopic approach [25,31]. Bangeas et al. reported excellent outcomes following mesh-based repair of TSH, with minimal complications and no early recurrences [31]. Studies on port-closure and repair techniques also suggest that mesh repair is preferable for all but the smallest, acutely recognized defects, for which primary suture repair may suffice [25,31-33]. The majority of patients in this study were successfully treated electively, with minimal serious postoperative sequelae and brief hospital stays, supporting the practice of early elective repair over watchful waiting.

Limitations of the study: This retrospective, record-based study may have failed to detect small or asymptomatic port-site hernias, and the absence of routine imaging likely resulted in an underestimation of the true incidence. Incomplete documentation of technical details and the relatively small number of hernia events further limited the ability to comprehensively assess all potential risk factors.

CONCLUSION

A multicenter retrospective study demonstrates that port-site incisional hernia following laparoscopic surgery is uncommon (1.6%) but clinically significant, with a predominance at umbilical ports and a primary association with modifiable technical factors. The use of larger trocars (≥12 mm) and failure to close fascial defects of 10 mm or greater substantially increase the risk of hernia, whereas elective mesh-based repair, most frequently performed laparoscopically, results in low recurrence and complication rates. These results highlight the importance of meticulous fascial closure for all larger ports, increased vigilance at umbilical sites, and prompt elective repair of identified hernias to reduce preventable morbidity.

RECOMMENDATIONS

Routine fascial closure of all ports measuring 10 to 12 mm or greater is recommended, with particular attention to umbilical sites. Documentation of port size and closure technique should be standardized in the operative record. High-risk patients, such as those with obesity, multiple large ports, or prolonged procedures, require targeted postoperative counselling and clinical follow-up. Selective imaging should be considered when symptoms or diagnostic uncertainty arise. Elective laparoscopic mesh repair is preferred upon identification of a port-site hernia to reduce the risk of emergency presentations.

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