Prevalence and Severity of Surgical Adhesions Among Women Undergoing Laparoscopic Surgery at Women's Health Hospital: A Prospective Cross-sectional Study

Mostafa Ibrahim, Mohamad S. Abdellah, Ibrahim I. Mohamed, Mahmoud S. Mohamed*, Ahmed Farouk,

Department of Obstetrics & Gynecology, Woman's Health University Hospital, Assiut, Egypt.

Corresponding Author: Mahmoud Shaban

E-mail: *Mahmoudshaban8.ms@gmail.com*

Abstract:

Background: Postoperative adhesions are a frequent complication of gynecological surgeries, affecting up to 93% of patients and causing chronic pain, infertility, and bowel obstruction. Despite advancements in surgical techniques and anti-adhesion strategies, the incidence remains high. Adhesions result from surgical trauma, endometriosis, and pelvic infections. Current preventive measures, including pharmacological agents and mechanical barriers, yield inconsistent results, necessitating further research.

Patients and Methods: A prospective cross-sectional study from February 1, 2023, to January 1, 2024, at Women's Health Hospital, Assiut University, included 127 women undergoing laparoscopic surgery. Participants were aged 14 years or older and provided informed consent. Data collection included demographic, medical, and surgical histories and intraoperative findings. Adhesion severity was evaluated using the Modified Togas Tulandi classification system. Statistical analysis was performed using SPSS, with significance at $p < 0.05$.

Results: Of the 127 participants, 50.3% had adhesions, 29.7% classified as mild, 20.3% as moderate, and 50% as severe. Severe adhesions were significantly associated with older age, higher parity, and a history of cesarean sections. No significant differences were observed in BMI or residence between groups.

Conclusions: Surgical adhesions are common in women undergoing laparoscopic surgery. The Modified Togas Tulandi classification effectively stratifies adhesion severity, aiding clinical management. These findings underscore the need for improved surgical techniques and preventive measures. Further research is required to develop innovative strategies for adhesion prevention and management.

Keywords: Pelvic adhesion, adhesion score, gynecologic surgery, laparoscopy, and a Cesarean section.

Introduction:

Postoperative adhesions are connective tissue bands formed between normally separated anatomical structures. They are among the most prevalent and impactful complications of gynecological surgeries. Affecting 75–93% of such procedures, these adhesions lead to significant morbidity, including chronic pain, infertility, and bowel obstruction (1).

Despite advances in surgical techniques, adhesion-related complications remain a major global challenge for surgeons and healthcare systems. Epidemiological studies, such as those by the Surgical and Clinical Adhesions Research (SCAR), have highlighted the extensive burden of adhesion-related readmissions, which persist

for years after the initial surgeries (2). Moreover, even minimally invasive laparoscopic procedures, previously considered less likely to induce adhesions, are now understood to carry a comparable risk to laparotomies in specific scenarios (3).

While significant efforts have been directed toward developing anti-adhesion strategies, including improved surgical techniques and pharmacological agents, the results have been inconsistent. Existing adhesion prevention methods, such as pharmacological agents and mechanical barriers, have shown varying degrees of efficacy, underscoring the need for further investigations (4).

The current research addresses the prevalence and severity of surgical adhesions in women undergoing laparoscopic surgeries at Women's Health Hospital. This study's Modified Togas Tulandi classification system provides a novel approach to categorizing adhesion severity and identifying factors contributing to adhesion formation.

This investigation adds to the existing literature and proposes actionable insights to refine adhesion prevention techniques, contributing to safer and more effective gynecological surgical practices.

Patients and Methods:

This prospective cross-sectional study was conducted at the Department of Obstetrics and Gynecology Laparoscopy Unit, Women's Health Hospital, Assiut University, Assiut, Egypt, between February 1, 2023, and January 1, 2024. The study was registered at ClinicalTrials.gov (NCT05703451) and approved by the Ethics Committee of Assiut Faculty of Medicine (IRB local approval number: 04-2023-200159). All participants provided informed written consent before inclusion in the study.

Women aged 14 years or older who underwent laparoscopic surgery at the Laparoscopy Unit were eligible for inclusion. Exclusion criteria included refusal to participate and any contraindications to laparoscopic surgery. Patients were counseled regarding the study after being identified and listed for the procedure, and written consent was obtained.

Data collection included history taking, clinical examination, investigations, and documentation of surgical interventions. Personal history covered age and demographic factors, while obstetric history addressed parity, last delivery, and history of abortion. Menstrual history explored the regularity of cycles and the presence of pain or complaints. Past medical history included chronic conditions such as diabetes, hypertension, endometriosis, chronic pelvic pain, and pelvic inflammatory disease (PID). Surgical history assessed previous abdominal or pelvic surgeries, including laparoscopies, laparotomies, or cesarean sections. The clinical complaints and indications for laparoscopy were also documented. Clinical examination included general assessments of vital signs (pulse, blood pressure, temperature, and respiratory rate), body mass index (BMI), and pallor and abdominal examination for scars of previous surgeries.

Investigations included ultrasonography to evaluate the uterus and adnexa, and blood tests to assess complete blood count, coagulation profile, and renal function. Surgical intervention was standardized, using a Karl Storz 9627NB/KS-27 monitor. Equipment was examined before each procedure. Under general anesthesia, the umbilicus was cleaned with povidone iodine. The Veress needle was inserted at a 90-degree angle for obese patients and a 45-degree angle for non-obese patients. Following adequate peritoneal insufflation, the incision was extended to accommodate an 11-mm primary trocar. The intra-abdominal pressure was then kept at 12–15 mmHg, and a telescope was inserted. Pelvic compartments were systematically inspected in an anticlockwise pattern, starting with the right ovary, followed by the right ovarian fossa, right broad ligament, vesico-uterine pouch, left broad ligament, left ovarian fossa, left ovary, uterosacral ligaments, Douglas pouch, omentum, and anterior abdominal wall. Findings were documented, and videos were captured. At the conclusion of the

procedure, the abdomen was deflated, and the incision was sutured with 2-0 silk.

The severity of adhesions was assessed using a modified version of the Togas Tulandi classification (5), which evaluates adhesions based on location, consistency (filmy or dense), and size (<3 cm, 3–6 cm, >6 cm). Adhesions were scored and categorized as mild (1–10), moderate (11–20), or severe (>20). This system was adapted to include additional adhesion sites, such as between the fallopian tubes and uterus, ovaries, omentum, and pelvic walls.

Table (1): Modified Togas Tulandi classification of intra-abdominal adhesions (5)

Adhesions	**Consistency of adhesions**	**<3 cm**	**3-6 cm**	**>6 cm**
Between the uterus and bladder	Filmy	1	2	4
	Dense	4	8	16
Between the uterus and abd. Fascia	Filmy	1	2	4
	Dense	4	8	16
Between the uterus and omentum	Filmy	1	2	4
	Dense	4	8	16
Between omentum and abd. Fascia	Filmy	2		
	Dense	8		
Between the Rt tube and the back of the uterus	Filmy	4		
	Dense	8		
Between the Lt tube and the back of the uterus	Filmy	4		
	Dense	8		
Between the Rt tube and the Rt ovary	Filmy	4		
	Dense	8		
Between Lt tube and Lt ovary	Filmy	4		
	Dense	8		
Between the Rt tube and the pelvic wall	Filmy	4		
	Dense	8		
Between the Lt tube and the pelvic wall	Filmy	4		
	Dense	8		
Between the Rt tube and the omentum	Filmy	4		
	Dense	8		
Between the Lt tube and the omentum	Filmy	4		
	Dense	8		
Between Rt ovary and the pelvic wall	Filmy	4		
	Dense	8		
Between Lt ovary and the pelvic wall	Filmy	4		
	Dense	8		
Between the Rt ovary and the omentum	Filmy	4		
	Dense	8		
Between the Lt ovary and the omentum	Filmy	4		
	Dense	8		
Crossing adhesions	Filmy	4		
	Dense	8		

The study's primary outcome was to determine the prevalence of surgical adhesions in women undergoing laparoscopy. Secondary outcomes included evaluating the severity of adhesions and examining correlations between adhesion scores and participants' demographic, obstetric, medical, and surgical histories.

Sample size was calculated using Epi-Info7. Based on a previous study reporting a 62% prevalence of intraperitoneal adhesions (6), the minimum required sample size was 127 patients, with a confidence level of 80% and a 5% margin of error.

Data analysis was performed using SPSS version 27. Continuous variables were tested for normality using the Shapiro-Wilk test. Normally distributed data were presented as mean ± standard deviation (SD), while non-normally distributed data were presented as median and range. Categorical variables were expressed as proportions. Comparisons between groups were made using one-way ANOVA for normally distributed continuous variables, the Kruskal-Wallis test for non-normally distributed data, and the Chi-square test for categorical variables. The Pearson correlation test assessed correlations between adhesion scores and various patient characteristics. A p-value <0.05 was considered statistically significant.

Results:

This study included 127 patients recruited from the Women's Health Hospital Laparoscopy Unit of Assiut University, with 63 patients (49.7%) having no adhesions and 64 (50.3%) having adhesions. The adhesion group was further classified based on the modified Togas Tulandi classification into mild (19 cases, 29.7%), moderate (13 cases, 20.3%), and severe (32 cases, 50%) categories.

The mean age of patients in the adhesions group was significantly higher (31.2 ± 5.5 years) compared to the non-adhesions one (27.5 ± 6.8 years, $p < 0.001$). However, no significant difference was observed in BMI between the two groups ($p = 0.1$). The distribution of urban and rural residency was similar (Table 2). Within the adhesion group, age and BMI did not vary significantly across severity levels ($p = 0.3$ and $p = 0.6$, respectively).

Table (2): Baseline demographic data of the study population of both groups

Variable	Group with no adhesions (N=63)	Group with Adhesions (N=64)	P value
Age in years (Mean, SD)	27.5 (6.8)	31.2 (5.5)	<0.001*
BMI in kg/m² (Mean, SD)	25.5 (4.7)	26.7 (4.4)	0.1
Residence (N, %)			
Urban	21 (33.3%)	18 (28.1%)	
Rural	42 (66.7%)	46 (71.9%)	0.5

SD: Standard deviation **BMI:** Body mass index

Regarding obstetric characteristics, the adhesion group had a significantly higher median parity (1 vs. 0, $p < 0.001$). Nearly half of the women with adhesions had a history of cesarean section (48.4%), compared to only 6.3% in the no-adhesions group ($p < 0.001$). Additionally, the number of previous cesarean sections was significantly higher in the adhesion group, with more diverse distributions. Patients with adhesions were more likely to have undergone their previous cesarean sections at private hospitals or both Assiut University Hospital and private hospitals, compared to the no-adhesion group, where cesarean sections were uncommon. (Table 3)

Table (3): Obstetric Characteristics in both groups

Variable	Group with no adhesions (N=63)	Group with adhesions (N=64)	P value
Parity (Median, Range)	0 (0-5)	1 (0-5)	<0.001*
History of previous CS (N, %)			
No	59 (93.7%)	33 (51.6%)	
Yes	4 (6.3%)	31 (48.4%)	<0.001*
Number of previous CS (Median, Range)	0 (0-2)	0 (0-4)	<0.001*
Place of previous CS (N, %)			
No	59 (93.7%)	33 (51.6%)	
Assiut University Hospital	1 (1.6%)	6 (9.4%)	
Private hospital	3 (4.8%)	23 (35.9%)	
Both (Assiut University Hospital & private hospital)	0 (0.0%)	2 (3.1%)	<0.001*
History of previous miscarriage (N, %)			
No	50 (79.4%)	42 (65.6%)	
Yes	13 (20.6%)	22 (34.4%)	0.08
History of ectopic pregnancy (N, %)			
No	63 (100%)	56 (87.5%)	
Yes	0 (0.0%)	8 (12.5%)	0.004*

CS: Cesarean section

Gynecological characteristics showed a statistically significant difference in the history of pelvic inflammatory disease (PID), which was more common in the adhesion group (12.5%) compared to the non-adhesion one (3.2%, p = 0.05). However, there were no significant differences between the groups in the prevalence of endometriosis, chronic pelvic pain, or menstrual irregularities **(Table 4)**.

Table (4): Gynecological characteristics of both groups

Variable	Group with no adhesions (N=63)	Group with adhesions (N=64)	P value
History of PID (N, %)			0.05
No	61 (96.8%)	56 (87.5%)	
Yes	2 (3.2%)	8 (12.5%)	
History of Endometriosis (N, %)			0.319
No	63 (100%)	63 (98.4%)	
Yes	0 (0%)	1 (1.6%)	
History of Chronic Pelvic Pain (N, %)			0.17
No	58 (92.1%)	54 (84.4%)	
Yes	5 (7.9%)	10 (15.6%)	
Menstrual History (N, %)			0.12
Regular	41 (65.1%)	52 (81.3%)	
Irregular	20 (31.7%)	11 (17.2%)	
Amenorrhea	2 (3.2%)	1 (1.6%)	

PID: pelvic inflammatory disease

Similarly, the two groups' history of chronic diseases was comparable (p = 0.45). **(Table 5)**

Table (5): Medical characteristics of both groups

Variable	Group with no adhesions (N=63)	Group with adhesions (N=64)	P value
History of Chronic Diseases (N, %)			0.45
No	56 (88.9%)	60 (93.8%)	
DM (Diabetes Mellitus)	1 (1.6%)	2 (3.1%)	
HTN (Hypertension)	1 (1.6%)	0 (0%)	
Hypothyroidism	3 (4.8%)	2 (3.1%)	
HCV (Hepatitis C Virus)	2 (3.2%)	0 (0%)	

Surgical history differed significantly between the groups, with 37.5% of patients in the adhesion group having a history of surgery compared to 17.5% in the no-adhesion group (p = 0.01). Women with adhesions were also more likely to have undergone open surgeries (p = 0.02). Although the types of previous surgeries were not significantly different (p = 0.07), adnexal surgeries and appendectomies were more common in the adhesion group. **(Table 6)**

Table (6): Surgical characteristics of both groups

Variable	Group with no adhesions (N=63)	Group with adhesions (N=64)	P-value
Surgical History (N, %)			0.01*
No	52 (82.5%)	40 (62.5%)	
Yes	11 (17.5%)	24 (37.5%)	
Types of Previous Surgery (N, %)			0.07
(Gynecological)			
Adnexal Surgery	0	6 (9.4%)	
Myomectomy	0	1 (1.6%)	
(Nongynecological)			
Appendectomy	5 (7.9%)	9 (14.1%)	
Cholecystectomy	1 (1.6%)	1 (1.6%)	
Others	5 (7.9%)	7 (10.9%)	
Approach of Previous Operation (N, %)			0.02
Open	6 (9.5%)	18 (28.1%)	
Lap	5 (7.9%)	6 (9.4%)	

In terms of current surgical data, operative laparoscopy was more frequently performed in the adhesion group (40.6%) compared to the no-adhesions group (28.6%), although this difference was not statistically significant (p = 0.15). Indications of laparoscopy varied significantly between the two groups (p = 0.008), with secondary infertility and lower abdominal pain being more common in the adhesion group, while primary infertility was more prevalent in the no-adhesion group. **(Table 7)**

Table (7): Current Surgical Data of both groups

Variable	Group with no adhesions (N=63)	Group with adhesions (N=64)	P-value
Type of Laparoscopy (N, %)			0.15
Diagnostic	45 (71.4%)	38 (59.4%)	
Operative	18 (28.6%)	26 (40.6%)	
Indication of Laparoscopy (N, %)			0.008*
OMA	2 (3.2%)	1 (1.6%)	
Primary Infertility	31 (49.2%)	13 (20.3%)	
Secondary Infertility	15 (23.8%)	31 (48.4%)	
Lower Abdominal Pain	14 (22.2%)	18 (28.1%)	
Removal of Abdominal Cerclage	0 (0%)	1 (1.6%)	
Tubal Sterilization	1 (1.6%)	0 (0%)	

OMA: Obstructive mullerian anomalies

Correlation analysis revealed a moderate positive relationship between the presence of adhesions and age ($r = 0.3$, $p = 0.002$), parity ($r = 0.3$, $p < 0.001$), and the number of previous cesarean sections ($r = 0.4$, $p < 0.001$). BMI showed a weak correlation with adhesions ($r = 0.2$, $p = 0.08$). Overall, the findings highlight significant demographic, obstetric, and surgical factors associated with the presence and severity of adhesions, providing valuable insights for clinical practice. **(Table 8)**

Table (8): Correlation Results

Variable	Correlation Coefficient (r)	P-value
Age	0.3	0.002*
BMI	0.2	0.08
Parity	0.3	<0.001*
Number of previous CS	0.4	<0.001*

BMI: Body mass index **CS:** Cesarean section

Discussion:

Adhesion formation remains a significant postoperative complication in gynecological surgery, with reported prevalence rates ranging from 75% to 93% (7). These adhesions have profound clinical implications, including infertility, intestinal obstruction, chronic abdominal/pelvic pain, and potential damage to intra-abdominal structures during subsequent surgical interventions. Given these serious outcomes, exploring and implementing effective strategies for preventing and reducing adhesion formation is imperative.

A growing body of evidence supports using microsurgical guidelines and minimally invasive techniques to mitigate the risk of postoperative adhesions. Adopting materials that facilitate tissue separation with minimal adverse effects has emerged as the gold standard in adhesion prevention.

Laparoscopy, in particular, represents a significant advancement in this regard. This novel, smaller-diameter centrally inserted

technique allows entry via less sensitive locations, reducing tissue trauma and, consequently, the likelihood of adhesion formation (11). Evidence-based guidelines have further enhanced European surgeons' understanding and strategies for reducing postoperative adhesions, as highlighted by a recent study conducted in 2023 (8).

Recent studies have provided further insight into the prevalence and diagnostic approaches for adhesion formation. For instance, Van den Beukel et al. (2023) utilized CineMRI to assess 266 individuals for chronic abdominal discomfort potentially attributable to surgical adhesions. Their imaging modality revealed that 29.7% of these individuals had no adhesions, suggesting that 70.3% had possible adhesion formation (12).

In another study, Al-Husban et al. (2020) examined a cohort of 654 patients, identifying adhesions in 296 cases and an adhesion prevalence of approximately 45.2% (1). Additionally, research by Levrant et al. (1997) compared adhesion formation in patients with different surgical histories. Their study, which included 124 patients with prior abdominal surgery and 91 without, demonstrated that patients who had undergone prior laparoscopy exhibited fewer anterior abdominal wall adhesions than those with midline vertical incisions, among whom 59% had adhesions (13).

Anterior abdominal wall adhesions were notably prevalent among patients undergoing specific surgical approaches. In one study, 11 out of 39 patients (28%) who underwent a suprapubic transverse incision exhibited anterior wall adhesions ($p < 0.001$ compared to those who did not have surgery or a laparoscopy) (13). The omentum was involved in 96% of these adhesions, while the bowel was involved in 29% (13). Moreover, Lim et al. (2016) (14) observed that conversion to laparotomy after laparoscopic hysterectomy was associated with moderate or severe adhesive disease (15).

The influence of surgical technique on adhesion formation is further underscored by studies comparing different incision types and approaches. Brill et al. (1995) (16) examined adhesion presence during laparoscopy in 360 patients with previous laparotomies and found that adhesion rates varied markedly with incision style: 67% of patients with vertical wounds extending above the umbilicus, 55% with midline incisions below the umbilicus, and only 27% with prior Pfannenstiel incisions exhibited adhesions (16).

Similarly, Levrant et al. (1997) (13) reported that among 215 patients undergoing laparoscopic procedures for gynecologic indications, no anterior abdominal adhesions were observed in patients with a history of laparoscopy. In contrast, anterior abdominal wall adhesions occurred in 59% of patients with a midline vertical incision and 28% of those with a suprapubic transverse incision (13).

In addition to surgical technique, patient demographic factors and surgical history play critical roles in adhesion development. In the current study, the presence of adhesions was significantly predicted by age, parity, the number of prior cesarean sections, and previous surgical experience, whereas body mass index did not emerge as a major predictor.

These findings align with previous research; for example, Ikechebelu et al. (2018) (17) reported a 40.5% adhesion rate at the surgical site in patients with a history of open appendectomy, emphasizing the role of prior surgical history in adhesion formation. Demographic analyses further revealed that the mean age of individuals with adhesions was higher than that of participants without adhesions (31.2 vs. 27.5 years, $P = 0.001$).

Comparable trends have been observed in other studies: Al-Husban et al. (2020) (1) reported mean ages of 34.3 years for the adhesion group and 32.2 years for the non-adhesion group; Kubinova et al. (2012) (18) noted mean ages of 32.6 and 32.7 years, respectively; and Conforti et al. (2014) (19) found the mean age for the adhesion group to be 41.23 years versus 38.4 years for the non-adhesion group.

There are several reasons for the observed differences in mean age across studies. First, age statistics are heavily influenced by the demographics of the populations under investigation. Studies with a larger proportion of older women or those with a history of multiple surgeries may naturally yield a higher mean age. Moreover, research focusing on specific surgical procedures tends to attract distinct age groups due to differing inclusion criteria, which further affects the age distribution of participants.

Cultural and geographic factors—such as variations in healthcare availability and family planning customs—also influence the age at which women undergo gynecological procedures. In addition, the lower mean ages reported in more recent studies may reflect advancements in surgical methods, including the increased use of minimally invasive techniques that allow for surgery at younger ages.

The adhesions group in our study exhibited a slightly higher average body mass index (BMI) (26.7 kg/m²) compared to the non-adhesions group (25.5 kg/m²). However, this difference did not reach statistical significance ($p = 0.1$). These findings are consistent with previous research by Mohamed et al. (2023) (20), which reported that intra-abdominal adhesions are more common among individuals with higher BMIs.

This correlation suggests that increased BMI may contribute to the development of adhesions, although further investigation is warranted to clarify this relationship.

Our study further categorized the degree of surgical adhesions in women undergoing laparoscopies into three groups: mild, moderate, and severe. Among the 64 patients with adhesions, 19 cases (29.7%) were classified as mild, 13 cases (20.3%) as moderate, and 32 cases (50%) as severe.

This distribution indicates that a substantial proportion of patients experienced severe adhesions, which highlights the potential complications associated with previous surgical interventions—particularly cesarean sections—in this population.

Elprince et al. (2021) also provided further insights into adhesion severity by comparing striae severity scores between groups. In their study, which included 203 women in the research group and 205 women in the control group, the mean Davey scores for mild, moderate, and severe striae were reported as 1.82 ± 0.39, 3.57 ± 0.5, and 6.73 ± 0.94, respectively ($p < 0.001$) (21).

These results reinforce the clinical relevance of adhesion severity, as they correlate with other measures of tissue alteration and underscore the potential for significant morbidity in affected patients.

This study explores the relationship between surgical, demographic, and obstetric factors with the formation of adhesions in women undergoing laparoscopic procedures. The findings reveal that age, parity, and prior cesarean sections play significant roles in adhesion development.

A moderate positive correlation was observed between age and adhesion formation ($r = 0.3$, $p = 0.002$), suggesting that older women are at a higher risk of developing adhesions. Similarly, higher parity was associated with increased adhesion formation ($r = 0.3$, $p < 0.001$). Notably, the strongest positive association was identified between the number of prior cesarean sections and adhesion formation ($r = 0.4$, $p < 0.001$), emphasizing the substantial influence of surgical history.

In contrast, no significant relationship was found between body mass index (BMI) and adhesion severity ($r = 0.2$, $p = 0.08$), indicating that BMI may not be a crucial factor in this context.

These findings are consistent with earlier studies in the literature. For instance, Lim et al. (2016) reported that greater specimen weight and severe adhesive disease were linked to the conversion of laparoscopic hysterectomy to laparotomy, possibly due to serosal surface damage and ischemia. Ten Broek et al. (2013) also highlighted that minimally invasive

procedures do not necessarily reduce adhesion severity, noting that CO_2 pneumoperitoneum may cause damage across the peritoneal surface (15).

Moreover, Al-Husban et al. (2020) found that severe adhesions were strongly correlated with cesarean procedures (1), while DeCherney and diZerega (1997) demonstrated that adhesions increase with age, the number of laparotomies, and overall surgical complexity (22). Conversely, Dawood and Elgergawy (2018) found no link between prior cesarean sections and adhesion severity (23). Additionally, Mohamed et al. (2023) reported that while BMI was associated with intra-abdominal adhesion formation, it did not affect scar thickness; however, it was linked to larger adhesion size and longer operative duration (20).

The study's strengths include its prospective design, which minimizes recall bias and facilitates real-time data collection. This methodological approach enhances the reliability of the findings by ensuring that data are gathered as events occur. Moreover, the study successfully identified key associations, notably the strong link between prior cesarean sections and adhesion formation.

This finding provides valuable insights for clinical decision-making and underscores the critical role of surgical history in predicting adhesion development. In addition, the study highlights the need for standardized methods to evaluate and record adhesions, a recommendation that could improve consistency and reliability in future research.

Despite these strengths, several limitations should be acknowledged. The relatively small sample size restricts the generalizability of the findings to larger, more diverse populations. Furthermore, the study's reliance on self-reported medical and surgical histories introduces the potential for inaccuracies, as patients may not fully recall or disclose all prior procedures. Another concern is the subjective evaluation of adhesions, which may vary among surgeons and compromise the consistency of the assessments.

Declarations:

Ethics approval and consent to participate.

The study was approved by the ethical committee of Assiut Faculty of Medicine (IRB local approval number: 04-2023-200159), and written informed consent was taken from patients who agreed to participate.

Consent for publication, "Not applicable"

The data, materials, and datasets used and/or analyzed during the current study are available from the corresponding author at reasonable request.

Competing interests: "The authors declare that they have no competing interests."

Funding:

Not Applicable.

The authors' contributions included Mohamed Sayed and Ibrahim Ibrahim, who participated in the design, wrote the study protocol, and helped revise the data and draft the manuscript. Mostafa Nasr participated in the design and coordination and helped to draft the manuscript. Mahmoud Shaban and Ahmed Farouk collected the data, performed the statistical analysis, and wrote the manuscript. All authors read and approved the final manuscript.

Acknowledgements:

Not Applicable.

References:

1. **Al-Husban N**, **Elayyan Y**, **El-Qudah M**, et al. Surgical adhesions among women undergoing laparoscopic gynecological surgery with or without adhesiolysis - prevalence, severity, and implications: retrospective cohort study at a University Hospital. *Ther Adv Reprod Health*. 2020;14:2633494120906010.
2. **Parker MC**, **Wilson MS**, **Menzies D**, et al. The SCAR-3 study: 5-year adhesion-related readmission risk following lower abdominal surgical

procedures. *Colorectal Dis*. 2005;7(6):551-558.
3. **Gutt CN**, **Oniu T**, **Schemmer P**, et al. Fewer adhesions induced by laparoscopic surgery? *Surg Endosc*. 2004;18(6):898-906.
4. **Ahmad G**, **Thompson M**, **Kim K**, et al. Fluid and pharmacological agents for adhesion prevention after gynaecological surgery. *Cochrane Database Syst Rev*. 2020;7(7): CD001298.
5. **Tulandi T**, **Lyell DJ**. Classification of intra-abdominal adhesions after cesarean delivery. *Gynecol Surg*. 2013;10(1):25-29.
6. **Aboshama RA**, **Taha OT**, **Abdel Halim HW**, et al. Prevalence and risk factor of postoperative adhesions following repeated cesarean section: A prospective cohort study. *Int J Gynaecol Obstet*. 2023;161(1):234-240.
7. **Chen J**, **Tang X**, **Wang Z**, et al. Techniques for navigating postsurgical adhesions: Insights into mechanisms and future directions. *Bioeng Transl Med*. 2023;8(6):e10565.
8. **Torres-De La Roche L**, **Catena U**, **Clark T**, et al. Perspectives in adhesion prevention in gynaecological surgery. *Facts Views Vis Obgyn*. 2023;15(4):291-300.
9. **Penzias A**, **Bendikson K**, **Falcone T**, et al. Postoperative adhesions in gynecologic surgery: a committee opinion. *Fertil Steril*. 2019;112(3):458-463.
10. **Nezhat CH**, **Dun EC**, **Katz A**, et al. Office visceral slide test compared with two perioperative tests for predicting periumbilical adhesions. *Obstet Gynecol*. 2014;123(5):1049-1055.
11. **Raimondo D**, **Raffone A**, **Travaglino A**, et al. Laparoscopic entry techniques: Which should you prefer? *Int J Gynaecol Obstet*. 2023;160(3):742-750.
12. **van den Beukel BA**, **Toneman MK**, **van Veelen F**, et al. Elective adhesiolysis for chronic abdominal pain reduces long-term risk of adhesive small bowel obstruction. *World J Emerg Surg*. 2023;18(1):8.
13. **Levrant SG**, **Bieber EJ**, **Barnes RB**. Anterior abdominal wall adhesions after laparotomy or laparoscopy. *J Am Assoc Gynecol Laparosc*. 1997;4(3):353-356.
14. **Lim CS**, **Mowers EL**, **Mahnert N**, et al. Risk factors and outcomes for conversion to laparotomy of laparoscopic hysterectomy in benign gynecology. *Obstet Gynecol*. 2016;128(6):1295-1305.
15. **Ten Broek RP**, **Kok-Krant N**, **Bakkum EA**, et al. Different surgical techniques to reduce postoperative adhesion formation: a systematic review and meta-analysis. *Hum Reprod Update*. 2013;19(1):12-25.
16. **Brill AI**, **Nezhat F**, **Nezhat CH**, et al. The incidence of adhesions after prior laparotomy: a laparoscopic appraisal. *Obstet Gynecol*. 1995;85(2):269-272.
17. **Ikechebelu J**, **Eleje G**, **Joe-Ikechebelu N**, et al. Comparison of the prevalence of adhesions at the time of diagnostic laparoscopy for infertility between patient who had open myomectomy and those who had no previous pelvic-abdominal surgery or pelvic inflammatory disease. *Niger J Clin Pract*. 2018;21(11):1415-1421.
18. **Kubinova K**, **Mara M**, **Horak P**, et al. Reproduction after myomectomy: comparison of patients with and without second-look laparoscopy. *Minim Invasive Ther Allied Technol*. 2012;21(2):118-124.
19. **Conforti A**, **Krishnamurthy GB**, **Dragamestianos C**, et al. Intrauterine adhesions after open myomectomy: an audit. *Eur J Obstet Gynecol Reprod Biol*. 2014;179:42-45.
20. **Mohamed MM**, **Elboghdady AA**, **Mohamed MI**. The correlation between Intra-abdominal Adhesions and body mass index in Women Undergoing elective repeated Cesarean Section. *Al-Azhar Int Med J*. 2023;4(3):6-12.

21. **Elprince M**, **Taha OT**, **Ibrahim ZM**, et al. Prediction of intraperitoneal adhesions using striae gravidarum and scar characteristics in women undergoing repeated cesarean sections. *BMC Pregnancy Childbirth*. 2021;21:1-7.
22. **DeCherney AH**, **diZerega GS**. Clinical problem of intraperitoneal postsurgical adhesion formation following general surgery and the use of adhesion prevention barriers. *Surg Clin North Am*. 1997;77(3):671-688.
23. **Dawood AS**, **Elgergawy AE**. Incidence and sites of pelvic adhesions in women with post-caesarean infertility. *J Obstet Gynaecol*. 2018;38(8):1158-1163.