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Comparison of Outcome in Single Incision Laparoscopic Cholecystectomy and Conventional Laparoscopic Cholecystectomy in Tertiary Care Hospital, Faisalabad, Pakistan

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ABSTRACT

Objective: The study aimed to compare the outcomes of Single-Incision Laparoscopic Cholecystectomy (SILC) and Conventional Multi-Port Laparoscopic Cholecystectomy (CLC). **Study Design:** Quasi-experimental study. **Settings:** Allied Hospital/FMU, Faisalabad Pakistan. **Duration:** February 15, 2025 to June 15, 2025. **Methods:** A total of 74 patients undergoing elective laparoscopic cholecystectomy were divided into two groups: 37 undergoing SILC and 37 undergoing CLC. Postoperative pain was assessed using the Visual Analog Scale (VAS) at different time points, wound infection was categorized according to CDC criteria, return to work was recorded in days, and cosmetic outcomes were assessed using the Patient and Observer Scar Assessment Scale (POSAS). **Results:** SILC patients experienced significantly lower pain scores at 6, 24, 48 hours, and 7 days postoperatively ($p<0.001$). The incidence of superficial SSIs was lower in the SILC group (2.7%) compared to the CLC group (29.7%) ($p=0.012$). SILC patients returned to work significantly earlier (62.1% within 4-7 days, $p<0.001$), and a higher percentage rated their cosmetic outcome as excellent (43.2% vs. 18.9% in CLC, $p=0.005$). **Conclusion:** SILC provides superior postoperative pain relief, lower SSI rates, faster return to work, and better cosmetic outcomes compared to CLC. However, challenges such as increased operative time and a steeper learning curve remain.

Keywords: *Single-incision laparoscopic cholecystectomy, Conventional laparoscopic cholecystectomy, Postoperative pain, Surgical site infection, Cosmetic outcome, Return to work.*

INTRODUCTION

Gallstone disease has plagued man since antiquity. Its recognition and treatment have changed over the years as surgical technique and imaging technology have become more advanced.[1] With the advent of the obesity epidemic and metabolic syndrome, its prevalence is increasing. The incidence of gallstones is 20%, and it is one of the most frequent reasons for surgical ward admissions.[2] Whereas in Pakistan, its range varies between 9% to 60% with a higher incidence in the female gender, i.e., 80%, while the common age is 35 to 40 years.[3-4] Gallstones are created in the gallbladder but can also develop in the biliary tree, and the majority are composed of cholesterol, which is ingested. Risk factors for gallstones and gallstone disease are obesity, weight loss, and female gender. The majority of gallstone patients do not ever have any symptoms, but there is a two percent chance of developing complications related to gallstones annually. Gallstone patients may manifest with pain or other complications requiring surgery and follow-up.[2]

Being the gold standard, laparoscopic cholecystectomy is a top choice for patients and surgeons as well even knowing its controversial theories.[5] One of the key advantages of this technique is that it results in less discomfort, a shorter period of hospitalization, and a quicker return to daily activities. By reducing post-

operative pain and accelerating the recovery process, laparoscopic cholecystectomy enhances patient well-being and allows for an earlier resumption of normal functioning.[6]

For years, standard multi-port laparoscopic cholecystectomy (CMLC) was the popular method. CMLC is distinct from any laparoscopic procedure and needs sophisticated technology and proficiency.[5] The advantages in CMLC compound the learning curve and surgical residua. In CMLC, numerous modifications and adjustments are incorporated; at its core, CMLC involves four ports. The adaptations can be in the form of decreased port size, i.e., 10 mm to 5 mm or 5 mm to 2/3 mm, or fewer port numbers. These alterations are aimed at modifying patient outcomes in any dimension. The interest in single-incision laparoscopic cholecystectomy (SILC) has grown over recent years. A single incision means that multiple ports are placed at one location (umbilicus). Most studies have proven technical challenges and rising complications.[7] Another study recently suggested a viable and worthy technique with better cosmetic results, pain alleviation, and no complications.[8] We assume knowledge about SILC will increase in the coming years.

Laura Evers[9] reveals that nine RCTs (860 patients) found that single-incision laparoscopic cholecystectomy (SILC) had better cosmesis and lower postoperative pain but significantly higher serious adverse events, longer operative time, and greater need for additional ports.[9] Another study[10] showed that SILC had a higher same-day discharge rate (85% vs. 70%) and comparable costs but required longer operative time. Regarding post-operative pain score in patients of SILC was 2.87±1.30 while in patients of CLC was 5.16±2.31, (p-0.001).[11]

The evolution of laparoscopic cholecystectomy has led to multiple modifications, including reduced port sizes and single-incision approaches, aimed at optimizing patient outcomes. However, the clinical superiority of SILC over CMLC remains debated. Some studies advocate for SILC due to better cosmesis and lower pain scores, while others raise concerns about its longer learning curve, increased operative time, and greater risk of complications. Standardized guidelines for SILC are lacking, and more robust comparative studies are required to establish its safety and efficacy. This study will provide critical data to guide future recommendations for laparoscopic cholecystectomy.

METHODS

This quasi-experimental study was conducted at Allied Hospital/FMU, Faisalabad, Pakistan. The duration of the study was six months from February 15, 2025, to June 15, 2025, vide ethical approval letter no. 48.ERC/FMU/2024-25/22 Dated: 12-02-2025 The patients undergoing elective laparoscopic cholecystectomy were recruited and divided into two groups. Group A consisted of patients undergoing single-incision laparoscopic cholecystectomy (SILC), whereas Group B included those undergoing conventional multi-port laparoscopic cholecystectomy (CLC). All procedures were performed by experienced laparoscopic surgeons following standardized perioperative protocols. A sample size of 74 patients (37 in each group) was calculated using the formula for comparing two means, assuming a 5% significance level and 80% power. We used mean pain scores of 2.87 ± 1.30 in Group A (SILC) and 5.16 ± 2.31 in Group B (Conventional Cholecystectomy), with a pooled standard deviation of 1.875 for sample size calculation on openepi calculator.[11] Patients of a wide range of ages, i.e., 20-70 years of either gender and symptomatic gallstones (confirmed on ultrasound) were included in our trial. Patients were not considered eligible for the study if they had conditions prohibiting laparoscopic procedures, such as pregnancy, coagulation disorders, or morbid obesity (BMI >35 kg/m^2). Additionally, those with uncontrolled diabetes (fasting blood sugar >150 mg/dL) or requiring CBD exploration were excluded.

The study protocol was reviewed and approved by the Hospital Ethical Review Committee, ensuring compliance with ethical guidelines. Informed written consent was obtained from all patients before participation in the study, explaining the objectives of the study, procedures, risks, and benefits. Our outcome value include: Wound Infection: It was assessed based on the Centers for Disease Control and Prevention (CDC) criteria for surgical site infections (SSI) and categorized as: Superficial SSI (infection involving only the skin and subcutaneous tissue), Deep SSI (infection extending into deeper tissues such as fascia or muscle), Organ-space SSI (infection involving intra-abdominal structures such as abscess formation). Patients were evaluated clinically on postoperative days 3, 7, and 14, and at 4 weeks for signs of infection, including redness, swelling, purulent discharge, fever, or wound dehiscence. If deep infection is suspected, imaging studies (ultrasound or CT scan) are performed for confirmation. Another outcome variable, i.e., postoperative pain, was assessed using the Visual Analog Scale (VAS, 0–10) at 6 hours, 24 hours, 48 hours, and 7 days postoperatively. Patients were instructed to rate their pain from 0 (no pain) to 10 (worst imaginable pain). The mean pain scores at each time point were compared between groups using independent t-tests. Return to work, being the outcome variable, was also assessed by documenting the time (in days) from surgery to full-time work resumption without significant discomfort. Patients were contacted weekly to record when they resumed light and full work activities. Cosmetic outcomes, being the last outcome variable, were

assessed using the Patient and Observer Scar Assessment Scale (POSAS) at 4 weeks and 3 months postoperatively. Cosmetic outcomes were compared between SILC and CLC using chi-square tests for ordinal data. While other outcome variables like post-operative infection and return to work were also compared with the help of chi-square test, we used independent t-tests for continuous variables like post-operative pain through SPSS-26.

RESULTS

Table 1 focuses on age and gender distribution. The majority of the patients, accounting for 64.9%, were aged between 20 to 50 years, while the remaining 35.1% were older than 50 years. This distribution suggests that a larger proportion of the study sample comprised younger to middle-aged individuals. Regarding gender distribution, the table shows that 62.2% of the participants were female, whereas 37.8% were male. This indicates a higher representation of females in the study population, which may be an important factor when analyzing the study outcomes, particularly in terms of gender-based differences in postoperative recovery and pain perception.

Table 2 provides a comparison of postoperative pain scores, measured using the Visual Analogue Scale (VAS), between patients who underwent SILC and those who had a CLC at different time points after surgery. The results indicate that patients in the SILC group experienced significantly lower pain scores than those in the CLC group, with statistically significant p-values at all time intervals. At 6 hours postoperatively, the mean VAS score for the SILC group was 3.11 ± 1.48, which was notably lower than the 4.37 ± 2.18 recorded in the CLC group ($p = 0.005$). This trend continued at 24 hours, where the pain score in the SILC group further decreased to 2.58 ± 1.11, whereas the CLC group reported a significantly higher score of 5.20 ± 1.93 ($p < 0.001$). By 48 hours post-surgery, the pain score in the SILC group was recorded at 2.00 ± 1.17, which remained substantially lower than the 3.91 ± 1.92 observed in the CLC group ($p < 0.001$). The difference persisted even at 7 days postoperatively, with the SILC group reporting a minimal pain score of 1.44 ± 0.84, compared to 3.83 ± 1.73 in the CLC group ($p < 0.001$).

Table 3: Among patients in the SILC group, 89.2% had no infection, whereas in the CLC group, only 59.5% remained infection-free. Superficial surgical site infections (SSI) were significantly more frequent in the CLC group (29.7%) compared to just 2.7% in the SILC group. Deep SSIs occurred at an equal rate of 5.4% in both groups, while organ-space SSIs were observed in 2.7% of SILC patients and 5.4% of CLC patients ($p = 0.012$). These findings suggest that SILC is associated with a lower risk of superficial infections compared to CLC, potentially due to the single incision minimizing surgical trauma and contamination risks. A substantial proportion of SILC patients (62.1%) were able to resume work within 4-7 days, whereas none of the CLC patients returned within this period. The majority of CLC patients (54.1%) required 11-14 days to return, while 45.9% resumed work between 8-10 days. Conversely, 37.9% of SILC patients also returned within 8-10 days, but none required more than 10 days for recovery. The Pearson Chi-Square test ($p < 0.001$) and Likelihood Ratio test ($p < 0.001$) indicate a highly significant association between the surgical approach and the time required to return to work. These results strongly suggest that SILC facilitates a faster recovery and earlier return to normal activities compared to CLC, likely due to its less invasive nature, reduced postoperative pain, and lower complication rates.

In the SILC group, a higher percentage of patients (43.2%) rated their cosmetic outcome as excellent, compared to only 18.9% in the CLC group. Similarly, a greater proportion of SILC patients (40.5%) rated their outcome as good, whereas the CLC group had a slightly lower percentage (32.4%). In contrast, fair cosmetic outcomes were reported more frequently in the CLC group (45.9%) compared to only 10.8% in the SILC group. Poor outcomes were rare, with 5.4% in the SILC group and 2.7% in the CLC group. The Pearson Chi-Square test ($p = 0.007$) and the Likelihood Ratio test ($p = 0.005$) indicate a statistically significant difference between the groups in terms of cosmetic satisfaction. These findings suggest that SILC provides superior cosmetic outcomes compared to CLC, likely due to its single, smaller incision, which results in minimal scarring and improved aesthetic appearance.

Table 1: Age and gender distribution(n=74)

Variable	Group	Count	Percent
Age	20-50 years	48	64.9%
	>50 years	26	35.1%
Gender	Male	28	37.8%
	Female	46	62.2%

Table 2: Comparison of post-operative pain in SILC and CLC (n=74)

Time Point	Group	Mean	Std. Deviation	N	P-value[a]
VAS 6 hrs	SILC	3.11	1.48	37	0.005
	CLC	4.37	2.18	37	
VAS 24 hrs	SILC	2.58	1.11	37	0.0
	CLC	5.20	1.93	37	
VAS 48 hrs	SILC	2.00	1.17	37	0.0
	CLC	3.91	1.92	37	
VAS 7 days	SILC	1.44	0.84	37	0.0
	CLC	3.83	1.73	37	

An independent t-test

Table 3: Comparison of wound infection, return to work(days), and cosmetic outcome in SILC and CLC(n=74)

Variables		SILC (n=37)	CLC (n=37)	Total (n=74)	P value[a]
Wound Infection	No Infection	33 (89.2%)	22 (59.5%)	55 (74.3%)	0.012
	Superficial SSI	1 (2.7%)	11 (29.7%)	12 (16.2%)	
	Deep SSI	2 (5.4%)	2 (5.4%)	4 (5.4%)	
	Organ-space SSI	1 (2.7%)	2 (5.4%)	3 (4.1%)	
Return to Work (Days)	4-7	23 (62.1%)	0 (0.0%)	23 (31.1%)	0.000
	8-10	14 (37.9%)	17 (45.9%)	31 (41.9%)	
	11-14	0 (0.0%)	20 (54.1%)	20 (27.0%)	
Cosmetic Outcome	Poor	2 (5.4%)	1 (2.7%)	3 (4.1%)	0.005
	Fair	4 (10.8%)	17 (45.9%)	21 (28.4%)	
	Good	15 (40.5%)	12 (32.4%)	27 (36.5%)	
	Excellent	16 (43.2%)	7 (18.9%)	23 (31.1%)	

a chi-square test

Figure 1: Comparison of outcome in both groups

DISCUSSION

Gallstone disease and its complications are a frequent clinical challenge,[12-13] with presentations ranging from asymptomatic cases to severe biliary colic requiring intervention. Bile duct stones occur in 5%-15% of cholelithiasis cases and may develop postoperatively. Effective management is essential to prevent serious complications.[14] While open surgery was once the standard, modern approaches now include endoscopic, radiologic, and minimally invasive techniques. Single-session management offers comparable success to staged procedures but with shorter hospital stays and lower costs.[15-17]

This study compared the outcomes of SILC versus CLC concerning post-operative pain, surgical site infections (SSI), return to work, and cosmetic outcomes. Our findings indicate that SILC resulted in significantly lower post-operative pain scores at all time intervals, a lower incidence of superficial SSIs, earlier return to work, and better cosmetic outcomes compared to CLC. These findings align with the growing interest in SILC as a minimally invasive alternative to conventional techniques, but challenges such as technical complexity and potential complications must be carefully considered.

Our study population comprised 64.9% of patients aged 20-50 years, while 35.1% were older than 50 years, with a female predominance of 62.2%. This demographic distribution is in line with Shakya *et al*, [18] who reported a higher prevalence of gallstones in females. Fang-han Li *et al*[19] also emphasized that gallstone disease is more common in women due to hormonal factors, reinforcing the gender distribution seen in our study.

Several studies have highlighted the benefits of SILC, particularly in terms of pain reduction, cosmesis, and recovery time. Liangyuan Geng *et al*[20] conducted a meta-analysis that found SILC resulted in lower post-operative pain scores and better cosmetic satisfaction but was associated with longer operative times and higher technical complexity.[20] Similarly, Sarat Chandra

Jayasingh *et al*[21] acknowledged that SILC, while offering superior cosmesis, requires advanced surgical expertise and has a prolonged learning curve. Our study supports these findings, demonstrating that SILC patients experienced significantly lower pain scores at 6, 24, and 48 hours postoperatively compared to CLC patients. Helena Subirana and others[22] also validate our results, showing that SILC has significant advantages over LC in terms of late post-operative analgesic requirements and aesthetics. Another study also confirms this hypothesis.[23]

Infection rates were notably lower in the SILC group, aligning with the results of Xin Liu *et al*, [24] who found that single-incision laparoscopic procedures reduce surgical site infections due to decreased tissue handling and minimal port-site contamination. Additionally, Fang-han Li *et al*[19] reported that SILC patients had significantly fewer wound complications compared to CLC, suggesting that the single-incision approach may reduce surgical trauma and the risk of infection.

Despite these advantages, SILC remains a technically demanding procedure. Laura Evers *et al*[9] found that SILC had a significantly higher rate of serious adverse events and longer operative times compared to CLC. Similarly, Liangyuan Geng *et al*[20] reported that SILC procedures frequently required additional ports due to anatomical difficulties, which is a potential drawback in complex cases. Our study did not measure operative time, but given the evidence from prior research, this remains an important factor to consider in assessing the feasibility of SILC.

The return-to-work outcome in our study was significantly better in SILC patients, with 62.1% resuming work within 4-7 days compared to none in the CLC group. Sarat Chandra Jayasingh *et al*[21] similarly reported that SILC patients returned to daily activities sooner due to reduced post-operative discomfort. However, the question remains whether these benefits justify the longer learning curve and technical challenges associated with SILC.

CONCLUSION

SILC offers significant advantages over CLC, including reduced post-operative pain, lower superficial SSI rates, quicker return to work, and superior cosmetic results. However, it presents challenges such as a higher learning curve, increased technical difficulty, and longer operative times. cholecystectomy.

LIMITATIONS

Despite promising findings, this study is limited by its relatively small sample size and single-center design, which may affect the generalizability of the results. Additionally, operative time and long-term follow-up were not evaluated, which are important factors in assessing the complete clinical impact of SILC.

SUGGESTIONS / RECOMMENDATIONS

Our study contributes valuable insights into the ongoing debate regarding SILC versus CLC, reinforcing its advantages while acknowledging its limitations. Future research should focus on assessing long-term complications, evaluating operative times, and refining surgical techniques to improve safety and efficiency. Standardized guidelines for patient selection and SILC training protocols could enhance their feasibility and adoption in clinical practice.

CONFLICT OF INTEREST / DISCLOSURE

The authors declare no conflict of interest.

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