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ORIGINAL ARTICLE

# A Comparative Study on Quality of Life Between Primary Early Surgery and Late Surgery in Chronic Calcific Pancreatitis using the SF-36 Questionnaire—A Prospective Observational Cohort Study

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## Abstract

**Purpose** We aim to test the hypothesis that "primary early surgery (i.e., within 2 years from symptoms onset) in chronic calcific pancreatitis (CCP) has better durable long-term Quality of Life (QOL) than patients undergoing late surgery (> 2 years from symptom onset)" using the SF-36 questionnaire.

**Methods** This is a prospective observational study conducted between 2016 and 2025. 162 patients with large-duct CCP (MPD diameter ≥ 6 mm) underwent either Frey's procedure or lateral pancreatico-jejunostomy (LPJ). 62/162 patients on regular follow -up were included in the study. The 62 patients were grouped into primary early surgery group (PESG) and late surgery group (LSG). After long term (> 3 year) of follow-up, patient's responses regarding QOL were recorded using the SF-36 questionnaire and compared. The primary outcome measures were pain, physical functioning and role limitations due to physical health and the other components on the SF-36 were taken as secondary outcome measures.

**Results** 27/62 cases were in LSG and 35/62 belonged to PESG. Mann–Whitney U test was used to make group comparisons. 7 out of 8 components namely Pain, Physical Functioning, Role Limitations Due to Physical Health, Role Limitations Due to Emotional Problems, Energy/ Fatigue, Emotional Well-Being, Social Functioning had statistically significant difference favoring better QOL in PESG.

**Conclusion** Primary early surgery has a positive impact on long-term QOL in patients with CCP. However, future RCTs will help to draw solid conclusions to support or refute our observations.

**Keywords** Chronic calcific pancreatitis · Primary early surgery · Quality of Life · Late surgery · SF-36

## Introduction

Chronic pancreatitis (CP) is a chronic inflammatory condition characterized by chronic pain, progressive loss of pancreatic function with an elevated risk of developing pancreatic cancer. Chronic inflammation leads to parenchymal fibrosis, atrophy, MPD strictures, intraparenchymal, and intraductal calcification leading to progressive endocrine and exocrine insufficiency [1]. The pathophysiology of pain in CP is multifactorial. These include intraparenchymal and intraductal hypertension, abnormal proliferation of peripancreatic nerves, activation of neurons containing pro-inflammatory peptides, and hypersensitization of these nerve endings leading to intractable pain [2]. Obstruction of the pancreatic duct by a stone or stricture can result in ductal hypertension with subsequent stretching of the ductal wall and is one of the principal mechanisms proposed to explain pain development in CP [3]. But a recent study has found that duct dilation does not always correlate with pain. The only structural pancreatic alteration having a consistent association with abdominal pain was the presence of severe calcifications, rather than ductal dilatation [4].

The primary goal of treatment in CP is alleviation of pain. There is no treatment modality to halt the progression of the disease till date. The current standard of care generally follows a stepwise approach starting with medical management, progressing to endoscopic interventions and reserving

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surgery for later stages. The emerging clinical evidence strongly supports the benefits of a Primary early surgical intervention with more effective, sustained pain relief and better QOL. It can potentially preserve pancreatic function for a longer period and aims to delay or mitigate the progression toward irreversible pancreatic insufficiency [5].

The previous studies in the literature have primarily focused on comparing pain scores and examining differences between various treatment approaches, with relatively limited data available on assessing patients' QOL after primary early surgery [6]. This study aims to address that gap by evaluating the long-term QOL in individuals who undergo primary early surgical intervention as compared to those undergoing late surgery.

## Methods

This was a prospective observational study conducted between 2016 and 2025 in a GI surgery unit in a tertiary care hospital. A total of 522 patients with dilated MPD, parenchymal atrophy, intraparenchymal, or ductal calcifications on a pancreas protocol CECT abdomen were diagnosed as CP between January 2016 and June 2022. Though the predominant etiology of the disease was due to ethanol ingestion, CP due to any cause was included in the study. Of these, 256 patients with an un-dilated or MPD diameter $\leq 5$ mm were considered as having small-duct disease and excluded. Another 104 patients with a dilated MPD ($\geq 6$ mm) had acute inflammatory activity and were managed conservatively. The remaining 162 patients with a dilated MPD ($\geq 6$ mm) underwent surgical management tailored according to the individual's patho-morphology. Those patients who presented to us within two years of symptom onset and who had not undergone prior medical or endoscopic therapy were classified as primary early surgery group (PESG) (92/162 cases); while those who underwent surgery more than two years after symptom onset and undergone prior step-up approach were classified as late surgery group (LSG) (70/162). Patients with an atrophic pancreas, dilated MPD with intraductal stones underwent ductal clearance of stones and a lateral pancreatico-jejunostomy(LPJ) [7]. Those with a head mass underwent a hybrid procedure, which is the standard Frey's procedure [8].

In both groups, patients who have lost follow-up, not given consent or died due to other causes were excluded. 35/92 cases and 27/70 cases in the PESG and LSG, respectively, were included in the study as detailed in the Fig. 1. All the patients were followed up on a regular basis and

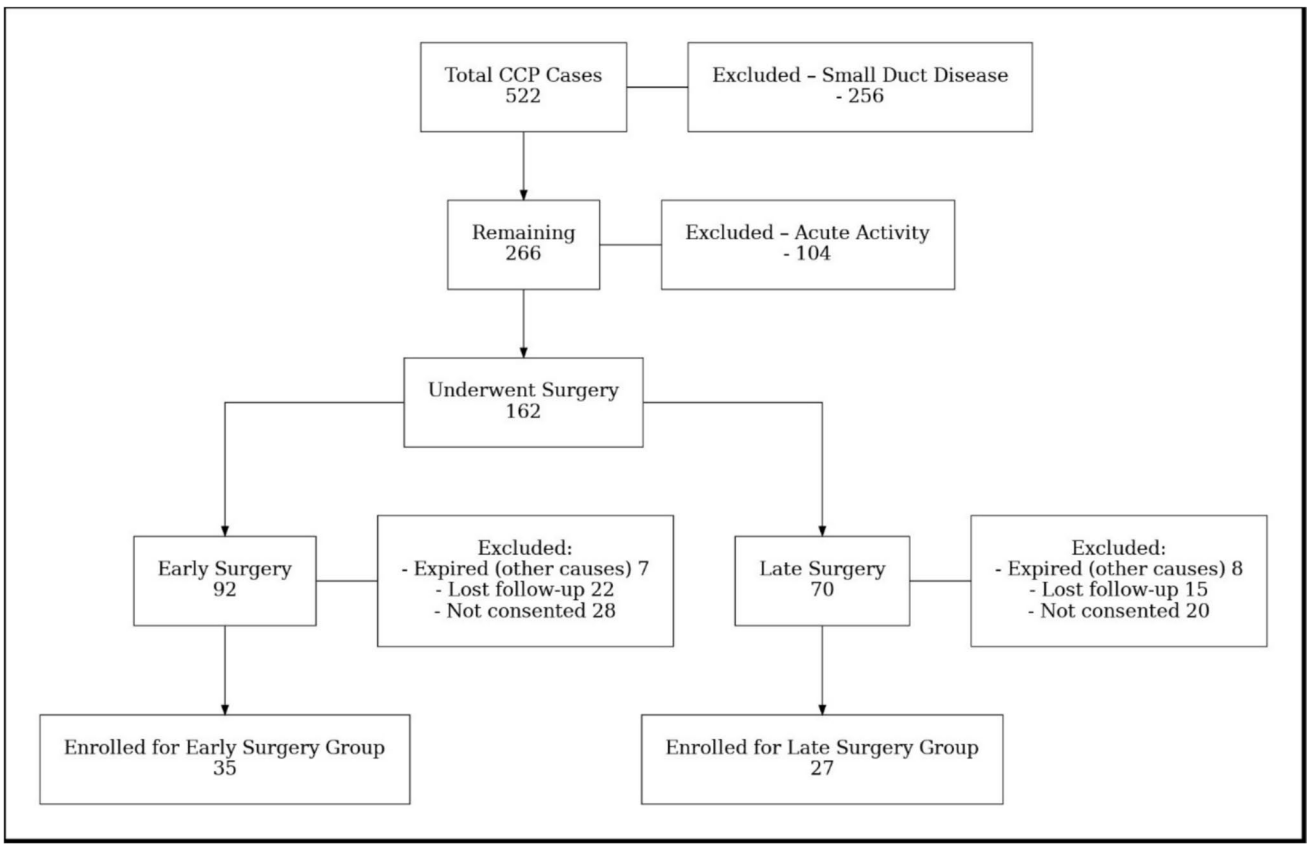


**Fig.1** Flow diagram for enrollment and follow-up

their responses on a SF-36 questionnaire were recorded after 3 years of follow-up. We have obtained approval from the institutional ethical committee and an informed consent was obtained from all patients prior to enrollment in the study.

The SF-36 consists of 36 multiple-choice questions categorized into eight components, namely Pain, Physical Functioning, Role Limitations Due to Physical Health, Role Limitations Due to Emotional Problems, Energy/Fatigue, Emotional Well-Being, Social Functioning, and General Health. Each answer is assigned a score ranging from 0 to 100 according to the RAND scoring system [9]. These scores were applied to the patients' responses, and the average score for each component was calculated and tabulated for both groups. Basic patient characteristics including age, gender, endocrine and exocrine function, symptom onset to diagnosis, intractability of pain, preoperative opioid usage, preoperative endo-therapy, alcohol use, and smoking were compared between the two groups. The primary outcome measures were pain, physical functioning and role limitations due to physical health and the rest of the components of the SF-36 were taken as secondary outcome measures in our study. We used statistical tests to compare the two groups.

## Results

We will first analyze the demographic and preoperative clinical data between the two groups (Table 1). Fisher's exact test was used to explore the association between "Group" and "Age" as more than 20% of the total number of cells had an expected count of less than 5 which revealed a significant association between group and age ($\chi^2 = 9.437$, $p = 0.021$). The LSG had a higher proportion of patients aged 21–30, 31–40, and 51–60 years, while the PESG had more patients in the 41–50-year range (Fig. 2). No significant association was found between group and gender ($\chi^2 = 0.004$, $p = 0.953$) or group and diabetes ($\chi^2 = 1.359$, $p = 0.244$). Gender distribution was nearly identical (PESG: 77.1% male, 22.9% female; LSG: 77.8% male, 22.2% female) in both the groups.

**Table 1** Comparison summary of basic characteristics on admission between PESG and LSGs

| Parameters | Group | | p value |
|---|---|---|---|
| | Early (n = 35) | Late (n = 27) | |
| Age (Years) | 44.26 ± 6.26 | 40.63 ± 9.90 | 0.103[1] |
| Age*** | | | 0.021[2] |
| 21–30 Years | 0 (0.0%) | 4 (14.8%) | |
| 31–40 Years | 9 (25.7%) | 10 (37.0%) | |
| 41–50 Years | 20 (57.1%) | 7 (25.9%) | |
| 51–60 Years | 6 (17.1%) | 6 (22.2%) | |
| Gender | | | 0.953[3] |
| Male | 27 (77.1%) | 21 (77.8%) | |
| Female | 8 (22.9%) | 6 (22.2%) | |

****Significant at p < 0.05, 1: t-test, 2: Fisher's exact test, 3: chi-squared test, 4: Wilcoxon–Mann–Whitney U test*

In comparing preoperative clinical characteristics (Table 2), symptom onset – diagnosis time duration between PESG and LSG, the mean duration was 16.43 and 43.9 months and median was 18 and 43 months, respectively. Median IQR was 8 months in PESG (12 to 20 months) and 14 months in LSG (36 to 50 months). LSG had statistically significant difference in the symptom onset to diagnosis time duration with $p < 0.0001$ (highly significant difference) than PESG.

In all the study participants in both the groups, abdominal pain was the foremost symptom prompting the patients to seek medical attention. The pain was recurrent requiring multiple hospital admissions and with intervening asymptomatic periods in some and in the others, the pain was intractable. Recurrent pain requiring hospitalization was seen in 22/35 cases (62%) in PESG and 15/27 cases (55.5%) in LSG which is not significant ($p = 0.609$). Intractable pain was seen in 11(31.4%) in PESG and 14(51.8%) in LSG which is not significant ($p = 0.12$). All the patients in the PESG underwent primary early surgery as per the study protocol. Chronic preoperative opioid usage was seen in 12/27 cases (44.2%) in LSG. Preoperative endotherapy was done in 7/27 cases in the LSG. History of alcohol consumption was present in 30/35(85.7%) in PESG and 20/27(74.1%) in LSG, which is not statistically significant. Among the alcohol users, smoking history was also present in 17(48.6%) in PESG and 12(44.4%) in LSG which is not significant. The distribution of endocrine and exocrine insufficiency in both the groups at diagnosis is as shown in Table 2 which is not statistically significant. In both the groups, only Frey's procedure and LPJ was done. Frey's procedure was done in 18(53%) in PESG and 12(46%) in LSG which is not statistically significant as shown in Table 3.

All the 8 variables of the SF-36 were not normally distributed in the 2 subgroups of the variable Group. Thus, nonparametric tests (Wilcoxon–Mann–Whitney U test) were used to make group comparisons. The results of outcomes of SF-36 components are as summarized in Table 4 and depicted in Fig. 3

The mean (SD) of Pain in the PESG was 78.64 (24.87) and in LSG was 63.98 (21.40). The median (IQR) of Pain in the PESG was 87.5 (77.5–95) and in the LSG was 55 (50–78.75). There was a significant difference between the 2 groups in terms of Pain ($W = 653.500$, $p = 0.010$), with the median Pain score being highest in the PESG indicating good pain response in PESG. Strength of association (point-biserial correlation) = 0.3 (medium effect size). Distribution of Pain score in violin plot is shown in Fig. 4.

The mean (SD) of Physical Functioning in the PESG was 89.14 (11.85) and in LSG was 72.78 (22.07). The

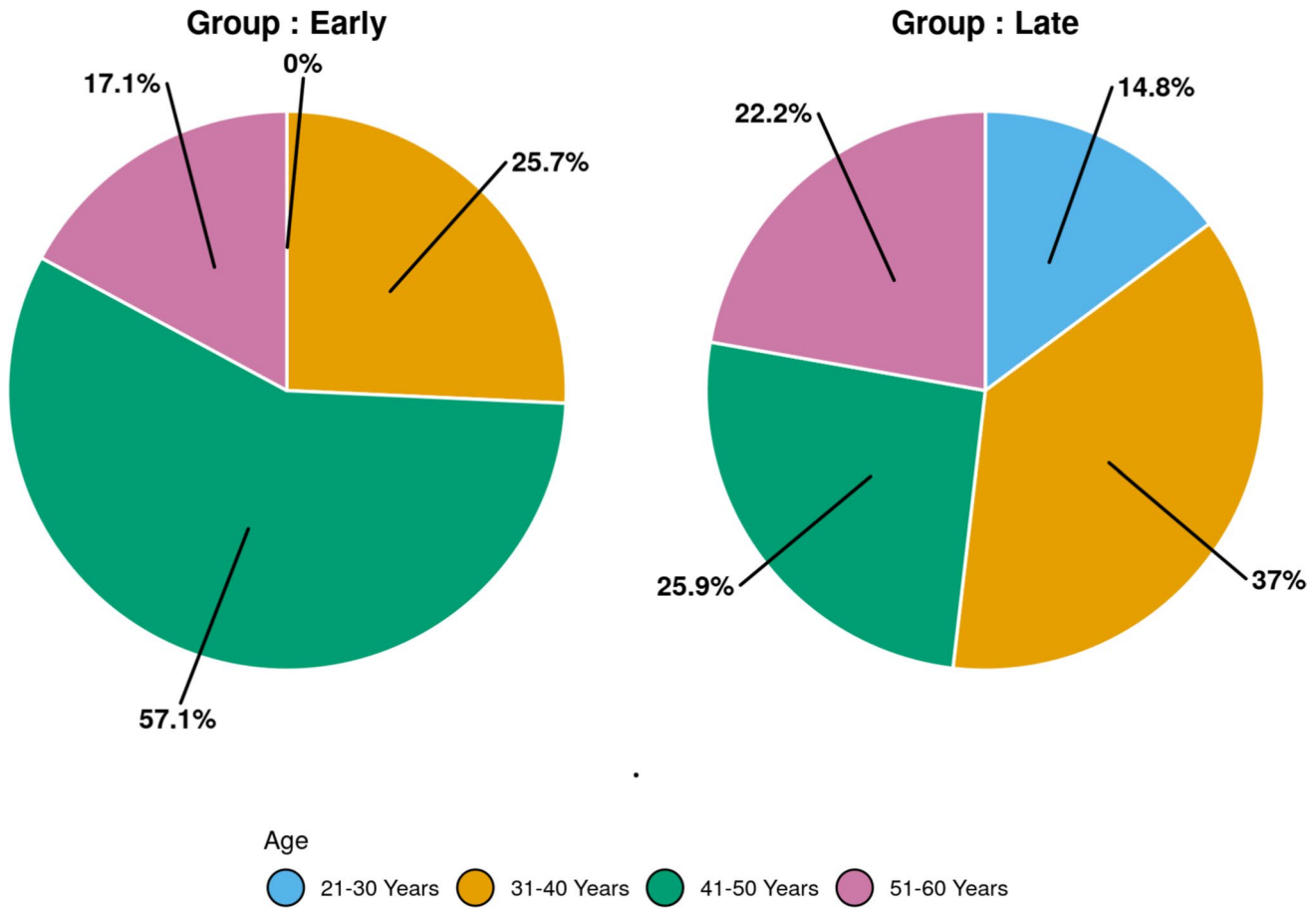


**Fig. 2** Age group comparison in Pie chart

**Table 2** Comparison summary of preoperative clinical data on admission between PESG and LSGs

| Parameters | Group | | p value |
|---|---|---|---|
| | Early (n = 35) | Late (n = 27) | |
| Symptom onset to diagnosis (mean months) * | 16.43 | 43.93 | 0.0001[4] |
| Pain | 35 | 27 | |
| Recurrent pain requiring multiple hospital admissions with intervening asymptomatic period (Yes) | 22(62%) | 15(55.5%) | 0.609[2] |
| Intractable pain (Yes) | 11(31.4%) | 14(51.8%) | 0.12[3] |
| Chronic Preoperative Opioid usage (Yes) | 0** | 12(44.2%) | - |
| Preoperative endo-therapy | 0*** | 7(26%) | - |
| Diabetic (Yes) | 6 (17.1%) | 8 (29.6%) | 0.244[3] |
| Exocrine Insufficiency (Yes) | 3 (8.6%) | 4 (14.8%) | 0.689[2] |
| Alcohol history (Yes) | 30(85.7%) | 20(74.1%) | 0.31[2] |
| Alcohol and Smoking history (Yes) | 17(48.6%) | 12(44.4%) | 0.758[3] |
| Smoking alone (Yes) | 0 | 1 | - |

**Significant at $p < 0.05$, 1: t-test, 2: Fisher's exact test, 3: chi-squared Test, 4: Wilcoxon–Mann–Whitney U test*

*** Acute episodes were managed with short-term opioids for a few days*

**** No step-up approach*

**Table 3** Comparison of Type of surgery done

| Procedure done | Group | | p value (*Chi-Squared Test*) |
|---|---|---|---|
| | Early (n = 35) | Late (n = 27) | |
| Frey's* | 18(53%) | 12(46%) | 0.61 |
| LPJ | 17(47%) | 15(54%) | |
| Whipple's procedure | 0 | 0 | - |
| Distal pancreatectomy | 0 | 0 | - |

**Frey's procedure along with Choledocho-duodenostomy was done in 5 cases in patients with co-existing distal CBD stricture*

median (IQR) of Physical Functioning in the PESG was 90 (87.5–100) and in the LSG was 55 (50–78.75). There was a significant difference between the 2 groups in terms of Physical Functioning (W = 688.500, p = 0.002), with the median Physical Functioning score being highest in the PESG indicating good Physical Functioning in PESG. Strength of association (point-biserial correlation) = 0.44 (large effect size). Distribution of Physical Functioning score in violin plot is shown in Fig. 5.

The mean (SD) of Role Limitations Due to Physical Health in the PESG was 83.57 (32.05) and in LSG was 44.44 (47.20). The median (IQR) of Role Limitations Due to Physical Health in the PESG was 100 (87.5–100) and in the LSG was 25 (0–100). There was a significant difference

**Table 4** Comparison summary of outcomes between PESG and LSGs

| Parameters | Group | | p value |
|---|---|---|---|
| | Early (n = 35) | Late (n = 27) | |
| Pain*** | 78.64 ± 24.87 | 63.98 ± 21.40 | 0.010[4] |
| Physical Functioning*** | 89.14 ± 11.85 | 72.78 ± 22.07 | 0.002[4] |
| Role Limitations Due to Physical Health*** | 83.57 ± 32.05 | 44.44 ± 47.20 | 0.001[4] |
| Role Limitations Due to Emotional Problems*** | 96.19 ± 13.46 | 77.78 ± 32.03 | 0.009[4] |
| Energy/ Fatigue*** | 69.29 ± 21.39 | 52.59 ± 22.55 | 0.005[4] |
| Emotional Well-Being*** | 71.77 ± 15.00 | 57.19 ± 17.32 | 0.001[4] |
| Social Functioning*** | 78.50 ± 22.58 | 63.70 ± 25.85 | 0.012[4] |
| General Health | 59.69 ± 25.70 | 50.22 ± 21.80 | 0.150[4] |

****Significant at p < 0.05, 1: t-test, 2: Fisher's exact test, 3: chi-squared Test, 4: Wilcoxon–Mann–Whitney U test*

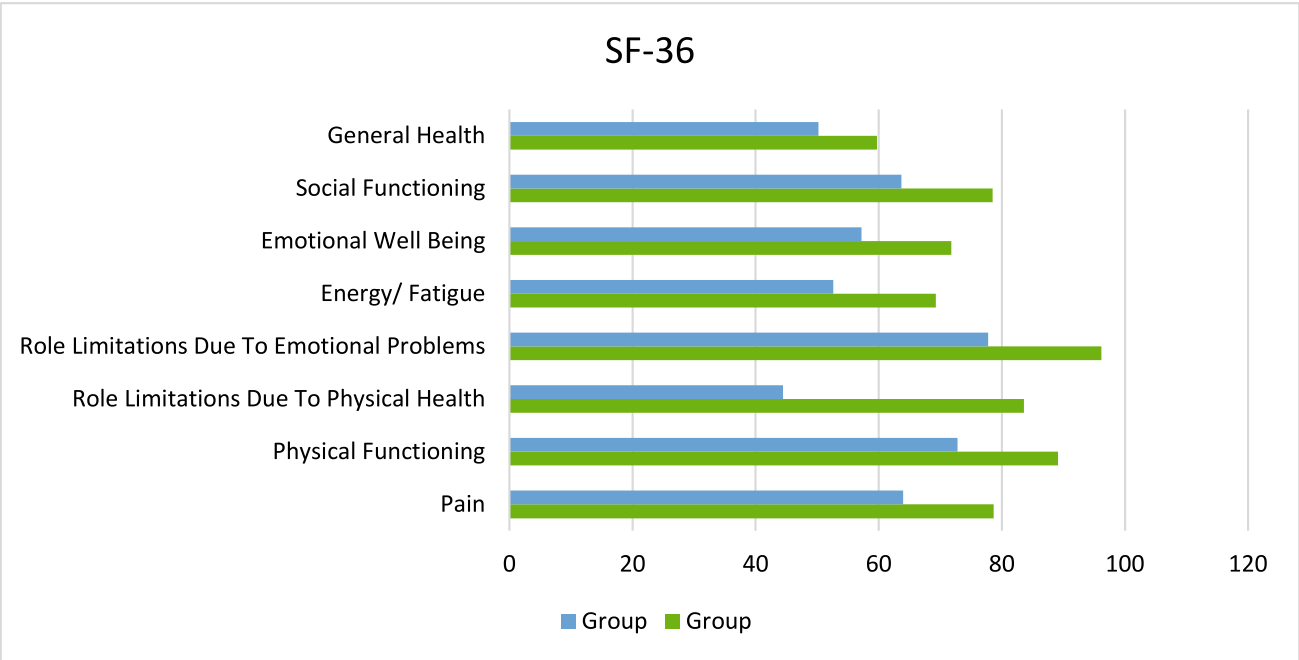


**Fig. 3** Score comparison between the components of SF-36

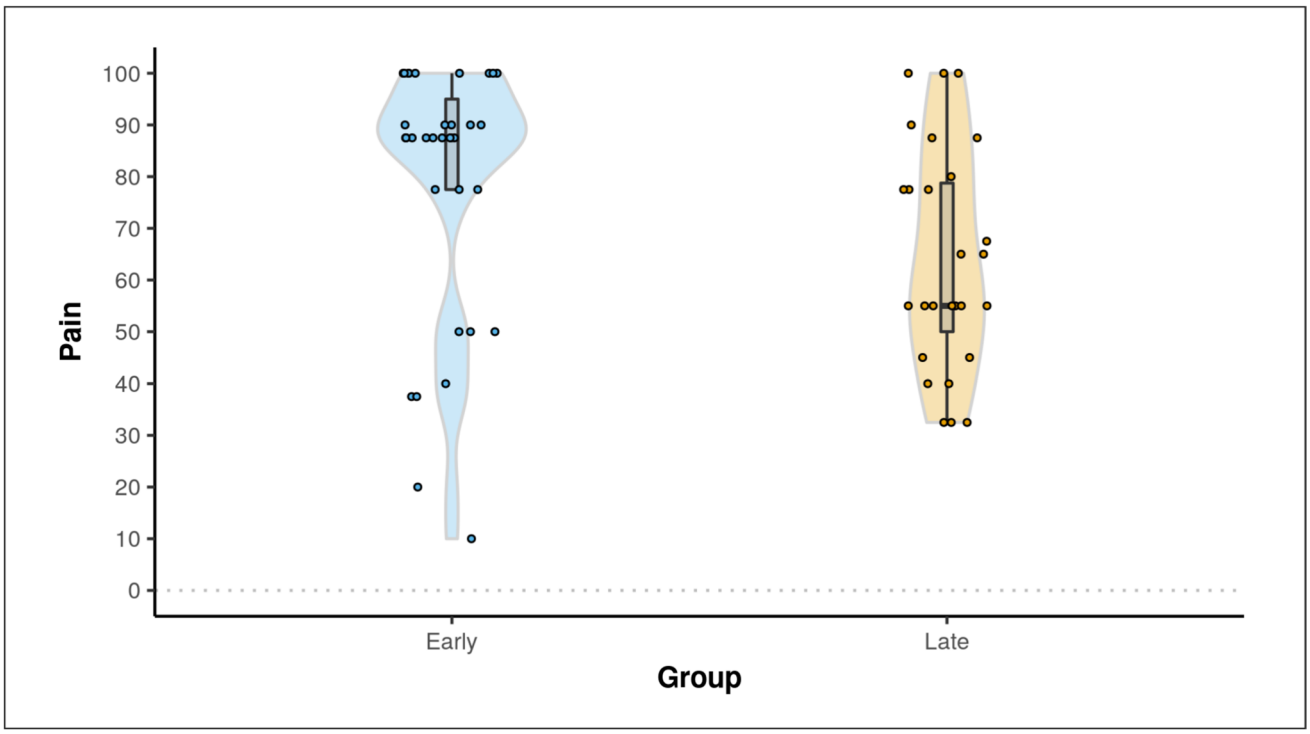


**Fig. 4** Distribution of pain score in violin plot

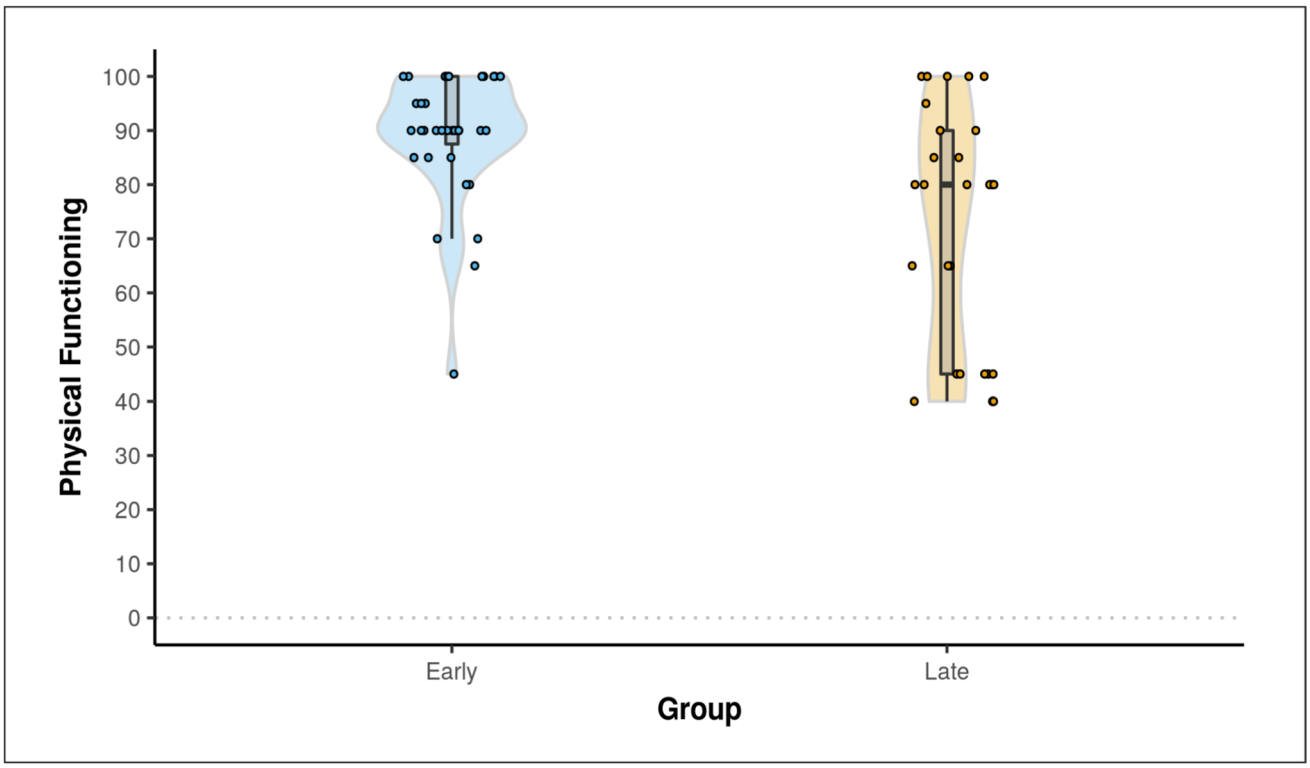


**Fig. 5** Distribution of Physical functioning score in violin plot

between the 2 groups in terms of Role Limitations Due to Physical Health (W = 683.000, p = 0.001), with the median Role Limitations Due to Physical Health score being the highest in the PESG indicating lesser Role Limitations Due to Physical Health in PESG. Strength of association (point-biserial correlation) = 0.45 (large effect size). Distribution of Role limitation to Physical health score is depicted as violin plot in Fig. 6 and score difference in Fig. 7. The summary of primary objectives and comparison between the two groups are given in Table 5.

The mean (SD) of Role Limitations Due to Emotional Problems in the PESG was 96.19 (13.46) and in LSG was 77.78 (32.03). The median (IQR) of Role Limitations Due to Emotional Problems in the PESG was 100 (100–100) and in the LSG was 100 (33.33–100). There was a significant difference between the 2 groups in terms of Role Limitations Due to Emotional Problems (W = 598.500, p = 0.009), with the median Role Limitations Due to Emotional Problems score being the highest in the PESG indicating lesser Role Limitations Due to Emotional Problems in PESG. Strength of association (point-biserial correlation) = 0.37 (large effect size).

The mean (SD) Energy/Fatigue score was 69.29 (21.39) in the PESG and 52.59 (22.55) in the LSG. A significant difference was found (W = 668.500, p = 0.005), with higher median scores in the PESG, indicating a positive impact on Energy/Fatigue. The mean (SD) Emotional Well-Being score was 71.77 (15.00) in the PESG and 57.19 (17.32) in the LSG. A significant difference was observed (W = 696.000, p = 0.001), with higher median scores in the PESG, indicating better Emotional Well-Being. The mean (SD) Social Functioning score was 78.50 (22.58) in the PESG and 63.70 (25.85) in the LSG. A significant difference was found (W = 647.000, p = 0.012), with higher median scores in the PESG, indicating better Social Functioning.

The mean (SD) of General Health in the PESG was 59.69 (25.70) and in LSG was 50.22 (21.80). There was no significant difference between the groups in terms of General Health (W = 574.000, p = 0.150).

## Discussion

Primary early surgery (i.e., within 2 years from symptoms onset) in chronic calcific pancreatitis (CCP) has better durable long-term quality of life (QOL) than patients undergoing late surgery (> 2 years from symptom onset) using the SF-36 questionnaire. All the components of the SF-36 except overall general health had a statistically significant difference in the PESG. Primary early surgery had the best impact in ameliorating the role limitations due to physical health and boosts the emotional well-being of the patients. A better impact was seen in improving the physical functioning, energy, and mitigating the role limitations due to emotional

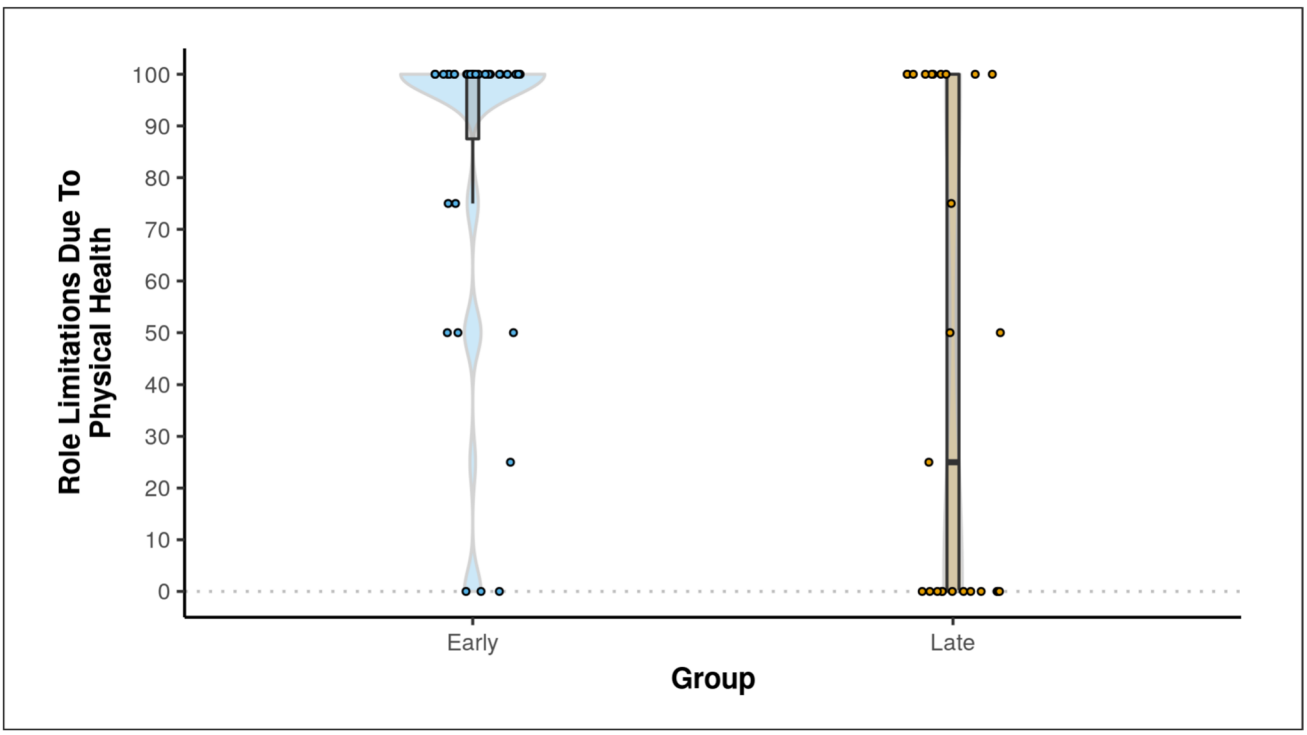


**Fig. 6** Distribution of Role limitation to Physical health score in violin plot

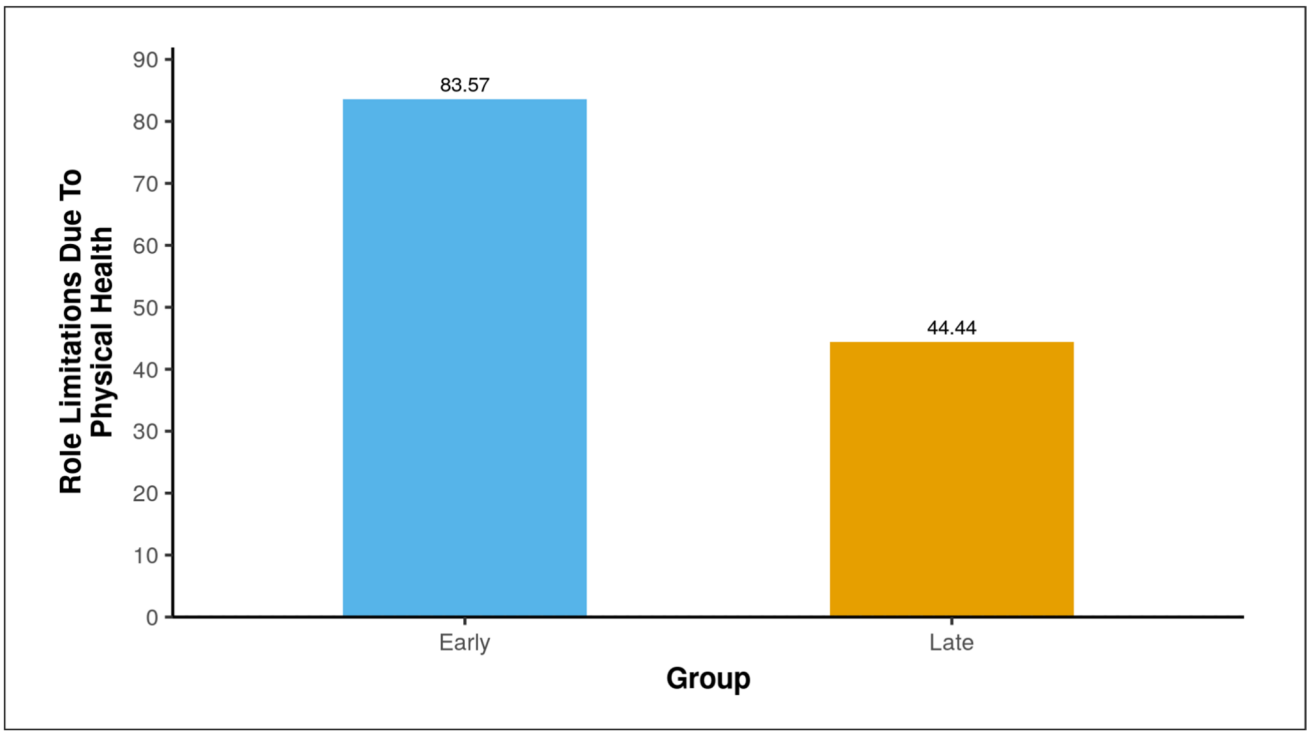


**Fig. 7** Scores of Role limitations due to Physical health

**Table 5** Primary objectives and their comparisons

| Pain | Group | | Wilcoxon-Mann–Whitney U Test | |
|---|---|---|---|---|
| | Early | Late | W | p value |
| Mean (SD) | 78.64 (24.87) | 63.98 (21.40) | 653.500 | 0.010 |
| Median (IQR) | 87.5 (77.5–95) | 55 (50–78.75) | | |
| Min—Max | 10—100 | 32.5—100 | | |
| Physical Functioning | Group | | Wilcoxon-Mann–Whitney U Test | |
| | Early | Late | W | p value |
| Mean (SD) | 89.14 (11.85) | 72.78 (22.07) | 688.500 | 0.002 |
| Median (IQR) | 90 (87.5–100) | 80 (45–90) | | |
| Min—Max | 45—100 | 40—100 | | |
| Role Limitations Due to Physical Health | Group | | Wilcoxon-Mann–Whitney U Test | |
| | Early | Late | W | p value |
| Mean (SD) | 83.57 (32.05) | 44.44 (47.20) | 683.000 | 0.001 |
| Median (IQR) | 100 (87.5–100) | 25 (0–100) | | |
| Min—Max | 0—100 | 0—100 | | |

problems in the PESG. Primary early surgery had a good impact in terms of pain relief and social functioning.

There are about 41 instruments for QOL assessment, with only 10 that are abdomen specific. Among all instruments, SF-36 ranks second in place with usage in17.2% studies next to EORTC QLQ-30 questionnaire. No instrument had all eight psychometric properties evaluated; however, GIQLI, PAN-PROMISE, and SF-36 were the only tools in which seven properties were assessed [10]. The SF-36 is a multi-dimensional and holistic measure of health. It encompasses

all the three dimensions of health namely physical, mental, and social well-being. The eight components are interdependent and contribute to the measurement of all the three inter-twined dimensions of health in varying proportions.

In our analysis, among the SF-36 components, highest score difference was seen in Role Limitations Due to Physical Health (p value < 0.001), probably as a result of their improvement in physical functioning (p value = 0.002) as these components of the SF-36 are interlinked and physiometric. The next highest improvement was seen in terms of Emotional Well-Being (p value = 0.001) which was perhaps as a result of diminution of role limitations due to their emotional problems (p value = 0.009); as both these components are psychometric. There was a significant improvement in pain relief(p = 0.010) and energy/fatigue (p value = 0.005) which had a positive impact on both physical and emotional well-being. As a result of improvement in all the above components in the PESG, Social Functioning(p = 0.012) was good. The only component that had very low score difference of 9.4 is General health which is not statistically significant. This can probably be attributed to extrinsic and other multifactorial causes not related to the disease. Thus, in our analysis, primary early surgery has a major positive impact on both the physical and psychological components of the patients.

In a study assessing QOL in early surgery using the SF-36 questionnaire, early surgery cohort (within 3 years of symptom onset) showed higher scores across all scales except Physical Functioning. In the same study, analysis with the EORTC QLQ-30 revealed that the early surgery had superior average scores on all functional scales compared to late surgery, except for cognitive functioning [11]. Across the existing literature, QOL—encompassing emotional well-being, the effect of pain on daily activities, social functioning, physical health, and mental health—have not been thoroughly evaluated following early surgery. In this study, however, nearly all components of QOL were assessed, providing stronger evidence that primary early surgery exerts a significant long-term positive impact on patients' overall well-being. It is established in the ESCAPE trial that early surgery rather than initial endoscopic management had a better pain response in the short-term. Although the early surgery group reported lower pain scores during follow-up, there was no significant difference in overall QOL when compared with the late surgery group [12]. Two randomized controlled trials in patients with painful obstructive chronic pancreatitis compared step-up approach with surgical intervention. In both studies, surgery demonstrated clear and durable superiority, providing more effective long-term pain relief, better QOL outcomes, and improved results across multiple clinical endpoints [13].

In 2025 ESCOPA study, QOL following surgery for CP was evaluated using the Pancreatitis QOL Instrument (PANQOLI) and the 12-Item Short-Form Survey (SF-12). The SF-12 further provided two summary measures—the Physical Component Summary (PCS) score and the Mental Component Summary (MCS) score—allowing assessment of both physical and mental health outcomes after surgery [14]. Patients undergoing pancreatic duct drainage procedures typically report better postoperative QOL than those treated with resection surgeries, as drainage effectively relieves symptoms while preserving pancreatic tissue and function [15].

Chronic pancreatitis (CP) is a progressive inflammatory disorder with multiple causes, most often linked to alcohol use. The exact pathophysiology remains uncertain. It generally begins with acinar cell injury triggering the inflammation. While some cases resolve with repair, others progress to persistent inflammation due to persisting or intermittent exposure to noxious stimuli, leading to activation of pancreatic stellate cells. These cells drive fibrosis and irreversible structural changes, forming the hallmark of CP[16]. Chronic pancreatitis (CP) is now understood as a multifactorial disease shaped by genetic predisposition and modifying factors. Variants in PRSS1, SPINK1, and CFTR show the strongest associations, while CTRC and CASR contribute more modestly. These genetic influences highlight the role of inherited susceptibility in disease onset, progression, and variability among patients [17]. Hereditary pancreatitis (HP) presents in childhood or adolescence, progresses rapidly to end-stage chronic pancreatitis with exocrine and endocrine failure, and carries a substantially increased lifetime risk of pancreatic adenocarcinoma [17]. Hepatolithiasis [18] and anomalous pancreaticobiliary mal-junction [19] are the other etiologies where recurrent acute pancreatitis can progress to CP.

Alcohol [20] plays major role in Indian patients. In our study, alcohol was identified as the predominant etiological factor, accounting for three-fourth of patients in the both the groups, while the remaining were attributed to idiopathic causes, often presenting with early onset during adolescence. Smoking is a notable risk factor for activation of pancreatic stellate cells. Smoking is an independent predictor of chronic pain in CP [21]. Continued smoking enhances the risk for CP as compared to those who quit smoking. In our study, nearly forty and odd percentage of patients had both alcohol use and smoking in both the groups which did not achieve statistical significance.

In a recent study, the age distribution of patients ranged from 40 to 62 years. The Indian cohort demonstrated the youngest mean age and showed no significant overall difference in age between eastern and western populations [22]. In our study, the mean age was 44.26 years in the PESG and 40.63 years in the LSG. The LSG cohort had more patients in the 21–30, 31–40, and 51–60-year ranges, while the PESG was concentrated in the 41–50-year range, showing a statistically significant age distribution

difference. A higher proportion of younger patients in the LSG suggests their symptoms began in adolescence but were mild, overlooked, or untreated, leading to delayed presentation beyond two years. By then, the pancreas had often progressed to an atrophic state, reducing the benefits of surgery. As a result, their postoperative QOL was less favorable compared with the PESG, who underwent intervention before extensive pancreatic damage developed. Despite the predominance of a younger population in the LSG, it did not translate into a better QOL. The gender distribution between the two groups is also comparable.

Surgical intervention is generally indicated for patients with intractable pain. However, in our study, we also included patients with recurrent pain episodes, who despite not experiencing constant or intractable pain, had a significantly impaired quality of life due to recurrent hospitalization. Patients who required at least two hospital admissions within a six-month period with pain-free intervals between episodes, as well as those requiring intermittent or long-term opioid therapy, were also found to have a reduced quality of life. Thus, we advocate primary early surgical management in large-duct CP(LDCP) irrespective of the intractability of pain.

The reason why some patients present as large-duct CP (LDCP) and others as small-duct CP (SDCP) during their index presentation is not known. But early presentation as LDCP is probably a favorable patho-morphology as it prompts timely intervention. In LDCP, surgery effectively relieves intraductal and probably intraparenchymal hypertension. As the head of the pancreas is considered a pace-maker of pain, head-coring procedures effectively provides durable results. It is our institutional practice to do head-coring even in nonhead mass CP. As for acute pancreatitis, a step-up approach is advocated for CP in the existing literature. But evolving evidence goes in favor of primary early surgery in CP.

Current evidence indicates that surgery generally offers superior outcomes compared to interventional endoscopy. However, endoscopy remains a valuable option for selected patients, particularly those who may benefit from its less invasive nature or as a bridging or alternative therapy when surgery is not feasible [23]. Moreover, endotherapy is not feasible in all cases and increases the chances of postoperative infectious complications. In our study, approximately 44% of patients in the LSG had already undergone a step-up approach elsewhere, with surgery ultimately performed in our institution as a salvage treatment option.

Cahen et al. demonstrated that surgery offers superior long-term pain relief in chronic pancreatitis, with 75% of surgical patients reporting relief at midterm versus 32% with endoscopy, and 80% versus 38% at long-term follow-up, establishing it as the stronger therapeutic option [24, 25]. Ali et al. showed that early surgery offers better outcomes, with three independent predictors of improved postoperative pain relief: pain duration of three years or less ($P=0.03$), no preoperative opioid use ($P=0.006$), and five or fewer endoscopic procedures before surgery ($P=0.04$). These findings emphasize the value of timely surgical intervention, avoiding opioid use and repeated endoscopic treatments to optimize long-term results in chronic pancreatitis [26]. We selectively practice the step-up approach only for very high-risk surgical patients and those not willing for surgery.

In long-standing disease, neuroplastic changes in the central nervous system leads to somatic hyperalgesia and limits the benefit of surgery or endotherapy [27]. Prior opioid exposure and repeated endoscopic procedures before surgery were linked to reduced pain relief, whereas patients who underwent surgical intervention earlier in the course of the disease experienced more favorable outcomes [28]. An experimental study in piglets showed that early surgical drainage preserved pancreatic histology and function better than delayed surgery, supporting intervention before irreversible damage occurs [29]. Early surgery helps to relieve chronic intraductal and intraparenchymal hypertension and preserves the remaining parenchyma from further damage. Ke et al. conducted a retrospective analysis comparing pain scores and pancreatic function in patients who underwent either early surgery ($<3$ years from diagnosis) or late surgery ($\geq 3$ years from diagnosis). The study concluded that early surgical intervention was associated with significantly higher rates of pain relief and better preservation of pancreatic function compared with delayed surgery. Among the different surgical techniques, the Frey and Berne procedures demonstrated superior outcomes compared with other operative approaches [30]. In the above study, among the early and late surgery groups, 23% and 30% have undergone Frey's procedure, respectively.

A meta-analysis of eight randomized controlled trials ranked the Frey procedure as the most effective surgical option for chronic pancreatitis, demonstrating superior outcomes in terms of postoperative QOL, lower readmission rates, and reduced incidence of exocrine insufficiency compared with other surgical techniques [31]. Previous studies in the literature have shown that purely drainage procedures might have a worse outcome than the hybrid Frey's procedure [32]. But in an atrophic head of pancreas, head coring may not be feasible for making LPJ as the only viable option. In our study, the distribution of the type of procedure is comparable between the two groups, with the standard Frey's procedure done in 18/35 (53%) and 12/27(46%) of cases in PESG and LSG, respectively. LPJ was done in the remaining cases due to the atrophic head negating a Frey's procedure. No resection procedures were done. This eliminates the type of procedure as a confounding factor and strengthens the results of our study.

However, our results have to be taken up with a pinch of salt given the nonrandomized study design. Though a randomized study design will help to eliminate selection bias, recruitment and follow-up are the Herculean tasks. The enrolled percentage of patients can be a probable bias in skewing our results. But as the initial results were encouraging, there was a paradigm shift in our approach to primary early surgery in the subsequent years, thereby decreasing patients in the LSG. Attrition of sample size due to loss of follow-up was also a drawback, despite our meticulous follow-up protocol. A component of recall bias during long-term follow-up is also there.

As a compendious summary of our study, pain is an inextricable component of CP having a significant negative impact on QOL. The strength of our observation is dependable and reliable given the stringent and strenuous long-term follow-up we have done. The information in Tables 2 and 3 is a succinct account of the distribution of probably confounding variables between the two groups. Alcohol use and smoking history in both the groups were comparable. Though the LSG had a predominance of younger patients, it did not translate into a better QOL outcome due to delayed surgery. The type of surgical procedure as a confounding factor is also eliminated. Hence, the results of our study are credible and tenable.

## Conclusion

Our study emphasizes the concept of primary early surgery in CP irrespective of the intractability of pain. Primary early surgery for LDCP at the index presentation yields better long-term QOL as compared to the traditional step-up approach. There is better QOL in terms of Pain control, Role Limitations Due to Physical Health and emotional problems in the PESG. Though the outcome of our study is encouraging and promising, it has a limitation in not being a randomized controlled trial (RCT), which restricts the strength of inferences. Further, future multicenter RCTs with a larger sample size will help to validate the results of our study.

**Author Contribution** P. Data collection, compilation, statistical analysis and manuscript drafting So. Analyzing results, Manuscript editing and revisions K.J. and Sw. Manuscript revision and supervision Si. Finalizing Manuscript and Guiding the research.

**Data Availability** No datasets were generated or analyzed during the current study.

## Declarations

**Conflict of interest** The authors declare no competing interests.

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