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Quality of Life Following Laparoscopic Hiatal Hernia Repair and Anterior 180° Partial Fundoplication for Symptomatic Sliding Hiatal Hernia

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ABSTRACT

Background: Laparoscopic hiatal hernia repair (LHHR) is the treatment of choice for symptomatic sliding hiatal hernia. This study evaluates health-related quality of life (HRQOL) outcomes following LHHR with anterior 180° partial fundoplication.

Methods: Forty consecutive patients underwent LHHR with anterior 180° partial fundoplication between June 2020 and December 2022. Patients were included based on one of the following criteria: persistent symptoms despite optimal medical therapy (55%), preference for a surgical solution over lifelong medication (37.5%), or complications including reflux oesophagitis/Barrett's esophagus (7.5%). HRQOL was assessed using the SF-36 questionnaire preoperatively and at 1, 6, and 12 months postoperatively.

Results: Significant improvements were observed in physical functioning (66.3 ± 24.7 to 95.6 ± 7.7, $p < 0.001$), bodily pain (38.1 ± 28.1 to 79.2 ± 18.6, $p < 0.001$), general health (37.7 ± 16.2 to 66.1 ± 23.6, $p < 0.001$), social function (62.5 ± 23.7 to 85.6 ± 16.1, $p < 0.001$), and mental health (68.2 ± 21.4 to 83.7 ± 12.5, $p < 0.001$) at 12 months. Role limitations due to physical health improved gradually, becoming significant at 12 months (60.0 ± 45.6 to 86.9 ± 16.8, $p < 0.001$). Early improvements in vitality ($p = 0.02$) and role limitations due to emotional health ($p = 0.331$) showed some decline by 12 months. The median hospital stay was 3 days, with no major complications. At 1 year, 72.5% of patients were medication-free, while anatomical recurrence was observed in 7.5%. Patients with recurrence showed lower physical functioning (82.3 vs. 96.8, $p = 0.02$) and bodily pain scores (65.7 vs. 80.5, $p = 0.04$) but still demonstrated significant improvement from baseline. Body mass index, education level, age, and defect area did not influence outcomes (all $p > 0.05$).

Conclusion: LHHR with anterior 180° partial fundoplication significantly improves quality of life across multiple domains, with sustained benefits at 12 months post-surgery, particularly in physical function, pain, and social functioning. Most domains reached or surpassed population norms by 12 months, establishing this approach as an effective treatment for symptomatic sliding hiatal hernia.

1 | Introduction

Sliding hiatal hernia, or type 1 hiatal hernia, occurs when a portion of the gastric cardia herniates through the esophageal hiatus of the diaphragm due to widening of the hiatus and laxity of the phrenoesophageal membrane [1]. It is the most common type of hiatal hernia, accounting for 85%–95% of cases [1], and is strongly associated with gastroesophageal reflux disease (GERD). Surgical repair is recommended for patients experiencing GERD-related symptoms or complications arising from the hernia [2–4].

Laparoscopic hiatal hernia repair (LHHR) is a safe and effective treatment associated with low morbidity and mortality rates, as well as favorable clinical outcomes [5]. The procedure typically involves crural closure to repair the hernia, followed by an antireflux procedure. Recent national data confirm that the laparoscopic approach is the preferred technique for both elective and emergency hiatal hernia repairs, offering advantages over open surgery such as reduced postoperative complications, shorter hospital stays, and lower healthcare cost [6].

Increasing attention has been given to the physical and psychosocial impacts of hiatal hernia [7, 8] and its treatment, highlighting the importance of health-related quality of life (HRQOL) in evaluating surgical success [9, 10]. Patients with GERD often experience impaired HRQOL [11–14], which has been shown to improve following laparoscopic antireflux surgery [9, 13, 15]. However, objective measures of surgical success, such as GERD resolution, do not always correlate with patient-reported outcomes. Some patients remain dissatisfied despite favorable clinical parameters [11]. From the patients' perspective, symptom relief and HRQOL improvement are key determinants of success [9].

This study represents the first prospective investigation specifically focused on QOL outcomes after laparoscopic repair of symptomatic hiatal hernia with anterior 180° partial fundoplication. While previous studies have explored the impact of laparoscopic surgery on HRQOL in paraesophageal or large hiatal hernias [10, 16], the specific QOL impact of sliding hiatal hernia repair remains underreported. This study aims to assess the changes in HRQOL among patients undergoing elective LHHR and anterior 180° partial fundoplication for symptomatic sliding hiatal hernia during the first postoperative year.

2 | Materials and Methods

This prospective study was carried out at a tertiary care center from June 2020 to December 2022. Patients with symptomatic sliding hiatal hernia were considered for surgical intervention. The specific indications for LHHR in our study included: (1) persistent symptoms (heartburn, regurgitation) despite optimal medical therapy with proton pump inhibitors (PPI); (2) symptomatic sliding hiatal hernia requiring long-term PPI therapy in patients who preferred a surgical solution over lifelong medication; (3) symptomatic sliding hiatal hernia with associated complications such as reflux esophagitis or Barrett's esophagus despite medical management; and (4) symptomatic sliding hiatal hernia causing mechanical symptoms including early satiety, postprandial discomfort, or dysphagia. Figure 1 shows the patient selection flowchart for this study. Patients were excluded if they were under 18 years of age, had paraoesophageal hiatal hernia, a history of gastric or esophageal surgery, concurrent gastric or esophageal malignancies, psychiatric disorders, or significant medical conditions (American Society of Anesthesiologists [ASA] grade > III). Informed consent was obtained from all patients.

Data collected included patient demographics, comorbidities, operative details, intraoperative measurement of hiatal surface area (HSA), and postoperative outcomes. Follow-ups were conducted at 1, 6, and 12 months postoperatively. The short-form 36 (SF-36) questionnaire was administered preoperatively and at each follow-up to assess HRQOL. Sliding hiatal hernia was diagnosed based on the following criteria:

1. Separation of the squamocolumnar junction from the diaphragmatic impression by > 2 cm on endoscopy.
2. Hill's Grade IV flap valves appearance during retroflexed endoscopic assessment [17].
3. Separation > 2 cm between the B ring and diaphragmatic hiatus.
4. Visualization of gastric rugae traversing the diaphragm on barium swallow examination [1].

The hiatal defect was defined using the HSA, measured intraoperatively, and calculated through an arithmetic formula [18].

2.1 | Data Collection and Quality Assurance

All patients were enrolled during preoperative clinic visits after obtaining informed consent. The validated Malaysian version of the SF-36 questionnaire was administered by a trained medical officer not involved in surgical care. Patients attended mandatory follow-up at 1, 6, and 12 months postoperatively, with questionnaires completed during these visits. To ensure data quality and completeness, we implemented telephone appointment reminders, verified questionnaires for completeness, provided immediate clarification for ambiguous responses, and conducted regular database audits. This rigorous approach resulted in 100% follow-up and complete data for all 40 patients throughout the study period.

2.2 | Surgical Technique

All surgeries were performed by an experienced surgeon and involved hiatal repair with anterior 180° partial fundoplication. Patients were placed in a modified lithotomy position, with the surgeon standing between the patient's legs, the camera operator on the patient's right, and the assistant on the patient's left. The scrub nurse and laparoscopic trolley were positioned to the surgeon's right, while the monitor was placed at the top left end of the patient. Pneumoperitoneum was established at 12 mmHg.

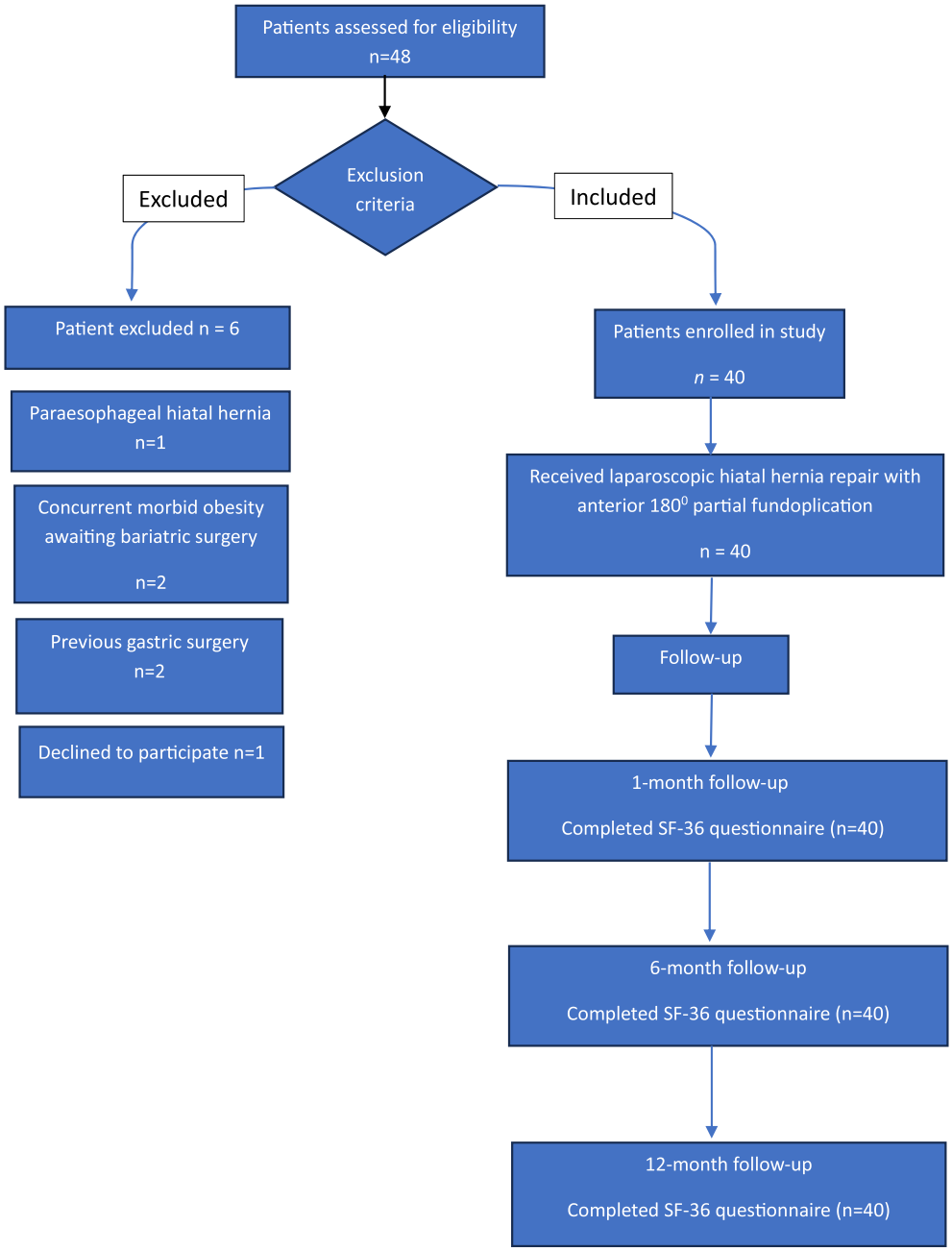

FIGURE 1 | Patient selection flow diagram for laparoscopic hiatal hernia repair with anterior 180° partial fundoplication.

A 5-port technique was utilized. The first port, an 11- or 12-mm port, was inserted under telescopic vision at the junction of the upper two-thirds and lower one-third between the xiphisternum and umbilicus (camera port). A right-hand working port (11- or 12-mm) was placed at the left midclavicular line just below the costal margin. A left-hand working port (5-mm) was inserted at the right midclavicular line below the costal margin. A 5-mm port was placed at the left anterior axillary line just below the costal margin for gastric retraction. Additionally, a 5-mm stab incision was made in the subxiphoid region for the Nathanson liver retractor. Figure 2 illustrates the port placement for the procedure.

The hiatal dissection began with exposure of the gastroesophageal junction, facilitated by retracting the stomach through the left anterior axillary port. The gastrohepatic omentum was divided to expose the caudate lobe and the right crus of the diaphragm. The peritoneal attachment between the right crus and esophagus was dissected using an ultrasonic dissector. The phrenoesophageal membrane was circumferentially divided along the anterior esophagus. Dissection continued along the anterior and left sides of the left crus, with division of peritoneal attachments between the gastric fundus and left crus to fully mobilize the left crus.

Retroesophageal dissection was performed to identify the posterior vagus nerve and connect the previously dissected left crus. A posterior window was created, and a nylon tape was passed around the gastroesophageal junction to facilitate further dissection. Mobilization of the lower esophagus was extended into

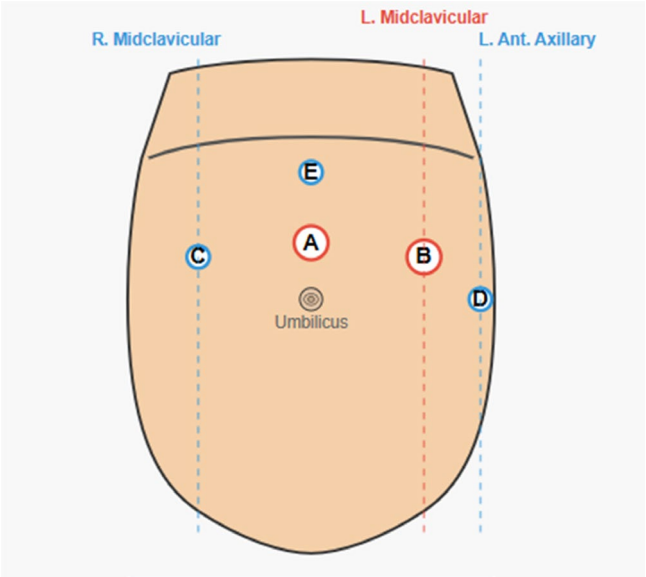

FIGURE 2 | Laparoscopic trocar positions: (A) Supraumbilical 12 mm camera port, (B) left midclavicular 12 mm right-hand working port, (C) right midclavicular 5 mm left-hand working port, (D) left anterior axillary 5 mm stomach retraction port, and (E) right subxiphoid 5 mm left-lobe liver retraction port.

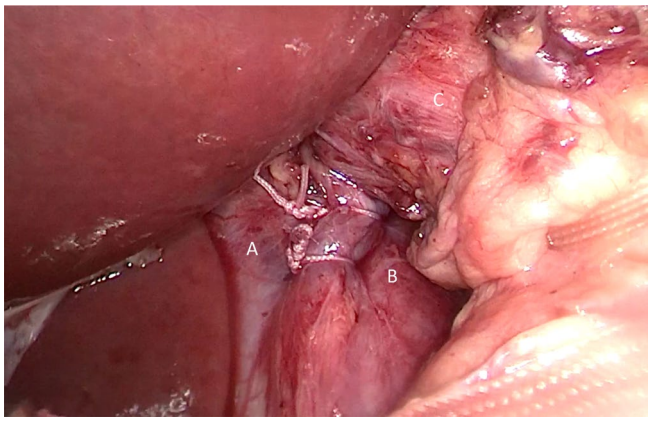

FIGURE 3 | Posterior crural approximation with 2–0 ethibond sutures, securing the right crus (A) and left crus (B) posterior to the esophagus (C).

the mediastinum to achieve at least 3 cm of intraabdominal esophageal length without traction.

The hiatal defect was assessed by measuring the crural length (radius, *R*) from the crural commissure to the edge of the pars flaccida, and the circuit (s) between the crural edges. The HSA was calculated using these measurements.

Posterior crural closure was performed with two or three interrupted 2–0 Ethibond (Ethicon, Cincinnati, USA) sutures (Figure 3). Anterior hiatal closure was added when necessary. The angle of His was accentuated with two 2–0 Ethibond (Ethicon, Cincinnati, USA) sutures: one anchoring the right side of the fundus to the left side of the esophagus, and another securing the fundus to the esophagus and the left hiatal pillar (Figure 4).

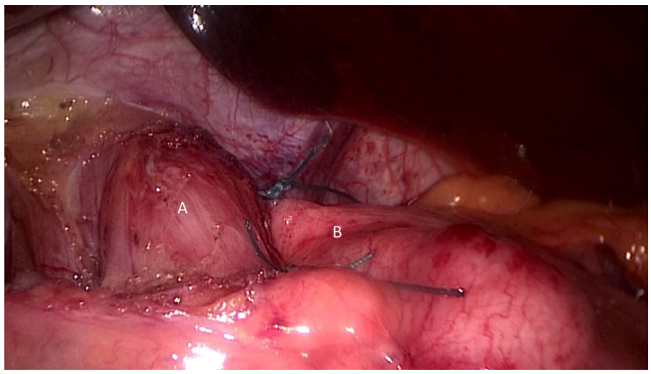

FIGURE 4 | Accentuation of the angle of His by securing the right side of the fundus to the esophagus with two interrupted sutures, one of which incorporates the left hiatal pillar. (A) Esophagus. (B) Fundus).

The anterior fundus was positioned loosely in front of the esophagus using a grasper through the left anterior axillary port. A top suture was placed between the apex of the hiatal rim, the top of the fundus, and the esophagus (Figure 5). The 180° anterior partial fundoplication was completed with two interrupted 2–0 Ethibond sutures, incorporating the fundus, the muscle of the right lateral esophageal wall, and the right crus (Figure 6).

All procedures were performed under general anesthesia. Prophylactic antibiotics (1.2 g Amoxicillin/Clavulanate) were administered preoperatively. A nasogastric tube was routinely placed during surgery and removed at the end of the procedure. Drains were not used. Postoperative fluids were initiated once patients were fully conscious and progressed to a soft diet as tolerated. Pain management included intravenous Parecoxib (40 mg every 12 h) and oral paracetamol.

2.3 | Outcome Measures

The validated Malaysian version of the SF-36 questionnaire was used to assess HRQOL [19]. This tool evaluates both physical and mental health (MH) across eight domains: physical functioning (PF), role-physical (RP), bodily pain (BP), general health (GH), vitality (VT), social functioning (SF), role-emotional (RE), and MH. Each domain is scored on a scale from 0 to 100, with higher scores indicating a better health index.

The SF-36 is a validated and widely used tool for assessing HRQOL, including outcomes following laparoscopic antireflux surgery for GERD [20–22]. Patients completed the questionnaire at four time points: preoperatively, and at 1, 6, and 12 months postoperatively. Data collection occurred during clinic visits for patients who provided informed consent.

2.4 | Data Collection and Analysis

Statistical analyses were performed using IBM SPSS version 26 (IBM Corp., Armonk, NY). Demographic data are presented as frequency counts with percentages for categorical variables and as means with standard deviations (SDs) for continuous variables.

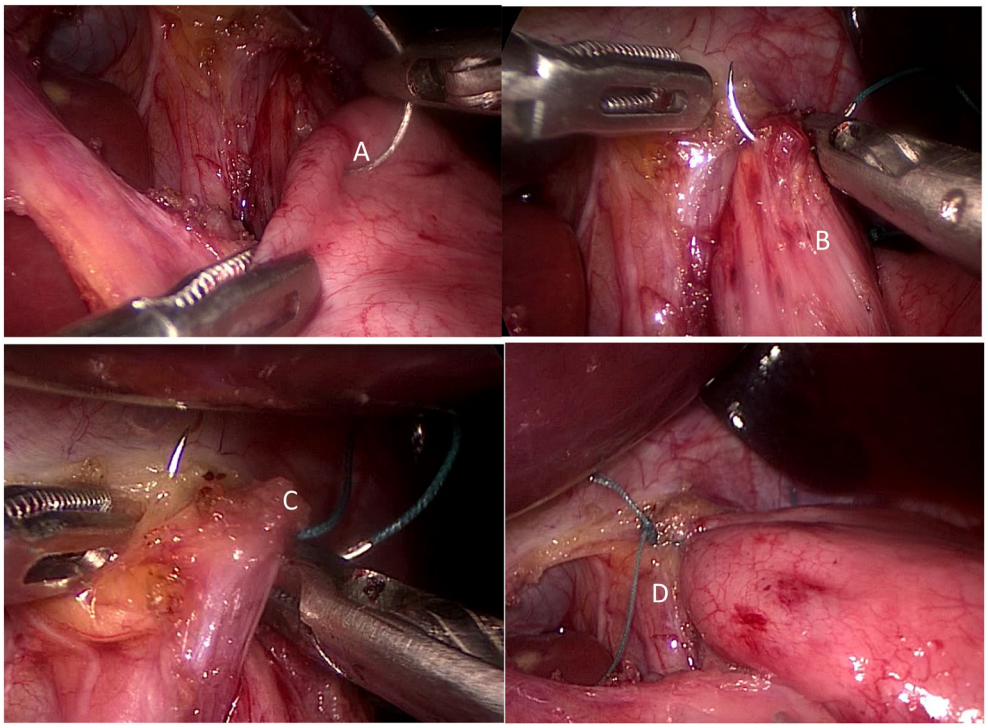

FIGURE 5 | A top suture is placed securing the fundus of the stomach (A) to the esophagus (B) and the apex of the hiatus (C), with the right crus (D) visible for reference.

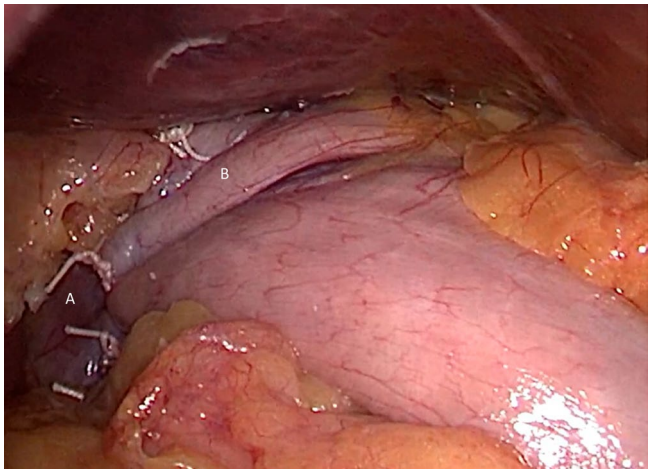

FIGURE 6 | Completion of the 180° anterior partial fundoplication using two interrupted 2–0 Ethibond sutures, securing the fundus to the right crus, with one suture incorporating the muscle of the right lateral esophageal wall. (A) Right crus. (B) Fundus).

Pre- and postoperative quality-of-life scores were compared using paired *t* tests. Comparisons were made between the preoperative baseline and postoperative time points at 1 month, 6 months, and 1 year. $p < 0.05$ was considered statistically significant.

Pearson correlation was employed to evaluate associations between quality-of-life improvements and variables such as age, body mass index (BMI), education level, and hiatal defect area.

2.5 | Ethics Approval and Informed Consent

This study adhered to the principles outlined in the 1989 Declaration of Helsinki and followed the guidelines of Good Clinical Practice. Ethical approval was obtained from the Medical Research Ethics Committee, University of Malaya (ID: 20167-2617) prior to the study.

3 | Results

A total of 40 patients were recruited over a 30-month period for this study. The baseline clinical characteristics and operative details are summarized in Table 1. The mean age of the patients was 43.4 ± 12.6 years, with a female predominance (65%), and the mean BMI was 27.8 ± 4.3 kg/m^2. The majority of patients (77.5%) had an ASA score of I or II. Comorbidities were present in 25 patients (62.5%), with the most common being hypertension (32.5%), diabetes mellitus (22.5%), dyslipidaemia (17.5%), and pulmonary diseases (15%). A total of 15 patients (37.5%) had no medical comorbidities. The median duration of symptoms was 18 months (range 3–96 months), and 11 patients (27.5%) had a history of prior abdominal surgery.

All patients had symptomatic sliding hiatal hernia as the primary indication for surgical intervention. The majority ($n = 38$, 95.0%) had small-to-medium sized hernias, while 2 patients (5.0%) presented with large hernias (> 5 cm^2). The specific indications for surgery were persistent symptoms despite optimal medical therapy ($n = 22$, 55%), symptomatic sliding hiatal hernia requiring long-term PPI therapy with preference for a surgical solution ($n = 15$, 37.5%), and symptomatic sliding hiatal hernia with associated

TABLE 1 | Baseline clinical characteristics and operative details.

Variable	*N* (%)
Number of patients	40
Age (years), (mean ± SD)	43.4 ± 12.6
Sex ratio (M:F)	18:22
BMI (kg/m^2), (mean ± SD)	27.8 ± 4.3
Level of education	
Secondary	14 (35%)
Tertiary	26 (65%)
ASA score	
I + II	31 (77.5%)
III	9 (22.5%)
Comorbidities	
No medical comorbidities	15 (37.5%)
Hypertension	13 (32.5%)
Diabetes Mellitus	9 (22.5%)
Dyslipidemia	7 (17.5%)
Pulmonary diseases	6 (15%)
Cerebrovascular accident	1 (2.5%)
Renal impairment	1 (2.5%)
Others (e.g., thyroid disease, TB)	3 (7.5%)
Duration of symptoms (months) (median, range)	18 (3–96)
Previous abdominal surgery	11 (27.5%)
Operative time (min) (median, range)	115 (105–135)
Conversion to laparotomy	0 (0%)
Reoperation	0 (0%)
Complications	
Intraoperative	1 (2.5%)
Superficial liver laceration	
Postoperative	1 (2.5%)
Excessive abdominal pain	
30-Day mortality	0 (0%)
Hospital stays (days) (median, range)	3 (2–4)

Abbreviations: ASA, American Society of Anesthesiology; BMI, body mass index; F, female; M, male; SD, standard deviation.

complications such as reflux esophagitis or Barrett's esophagus ($n = 3$, 7.5%). The two patients with large hernias also presented with mechanical symptoms including early satiety, postprandial discomfort, and dysphagia in addition to reflux symptoms.

The median operative time was 115 min (range 105–135 min). There was no conversion to laparotomy. Intraoperative complications were rare, with only one case of superficial liver laceration during the insertion of the Nathanson liver retractor, which was managed conservatively. Postoperative complications were limited to one case of excessive abdominal pain requiring additional analgesia. No 30-day mortality was observed in this cohort. The median hospital stay was 3 days (range 2–4 days), indicating a short recovery period following the procedure. There was no readmission within 30 days after surgery.

3.1 | Health-Related Quality of Life and Its Subscales

All patients completed both preoperative and postoperative SF-36v2 forms up to 1 year. Table 2 shows the mean ± SD scores for the presurgery, 1-month, 6-month, and 12-month periods after surgery.

3.1.1 | Preoperative

Patients demonstrated poor baseline scores across most domains. Physical components were particularly affected, with BP (38.1 ± 28.1) and GH (37.7 ± 16.2) showing the lowest scores. Role limitations due to physical and emotional problems showed the highest variability (SD = 45.6 and 39.9, respectively), indicating diverse preoperative functional status among patients. MH was notably better than other components (68.2 ± 21.4), suggesting that psychological well-being was relatively preserved despite physical limitations.

3.1.2 | PF

Patients showed significant improvement from baseline (66.3) to 1 month (92.1, $p < 0.001$), with sustained improvement at 6 months (94.4, $p < 0.001$) and 1 year (95.6, $p < 0.001$).

3.1.3 | Role Limitation due to Physical Problems

Patients showed non-significant improvement at 1 month (75.0, $p = 0.151$), but increasingly significant improvements at 6 months (83.1, $p = 0.005$) and 1 year (86.9, $p < 0.001$).

3.1.4 | BP

Patients showed highly significant improvement at 1 month (71.8, $p < 0.001$), with maintained improvement at 6 months (76.0, $p < 0.001$) and 1 year (79.2, $p < 0.001$).

3.1.5 | GH Perception

Patients showed significant improvement at 1 month (71.3, $p < 0.001$), with sustained improvement at 6 months (66.3, $p < 0.001$) and 1 year (66.1, $p < 0.001$).

3.1.6 | VT

Patients showed significant improvement at 1 month (79.0, $p < 0.001$), had less pronounced but still notable improvement at 6 months (68.4, $p = 0.005$) and at 1 year (68.8, $p = 0.002$).

3.1.7 | SF

Patients showed significant improvements at 1 month (80.6, $p < 0.001$), 6 months (84.7, $p < 0.001$), and 1 year (85.6, $p < 0.001$), with progressive improvement throughout the follow-up period.

3.1.8 | Role Limitations due to Emotional Problems

Patients showed mild improvement at 1 month (94.2, $p = 0.015$), but statistical significance was lost at 6 months (86.9, $p = 0.331$) and 1 year (86.0, $p = 0.331$).

3.1.9 | MH

Patients showed significant improvement at 1 month (83.1, $p < 0.001$), 6 months (83.1, $p < 0.001$), and 1 year (83.7, $p < 0.001$), maintaining stable improvement throughout the follow-up period.

3.2 | Correlation Analysis

Table 3 presents the correlation analysis, indicating no significant associations between demographics or anatomical variables (age, BMI, ASA score, education level, or defect area) and quality-of-life improvements. Notably, hiatal defect area showed no correlation with improvements in any SF-36 domain (all $p > 0.05$), suggesting that patients may derive similar benefits regardless of anatomical defect size. This highlights the broad applicability of LHHR across diverse patient profiles.

3.3 | Postoperative Medication Use and Anatomical Recurrence

All patients were prescribed a one-month course of PPI therapy following surgery to facilitate healing and minimize suture line irritation. Metoclopramide was routinely prescribed for 1 week postoperatively to reduce the risk of postoperative nausea, promote gastric emptying, and minimize pressure on the repair site. At 12 months postoperatively, seven patients (17.5%) were using PPIs for recurrent symptoms. Upper gastrointestinal endoscopy performed at 12 months revealed anatomical recurrence (defined as ≥ 2 cm separation between the squamocolumnar junction and diaphragmatic impression) in three of these patients. Additionally, four patients (10%) required prokinetic therapy for recurrent symptoms of postprandial bloating and dyspepsia. Overall, 29 patients (72.5%) were

TABLE 2 | SF-36 scores before and after surgery. All values are presented as means ± standard deviation. Score ranges from 0 to 100, with higher scores indicating better quality of life. *p* values are calculated comparing each follow-up time point to preoperative baseline values. Significant *p* values are in bold.

SF-36 category	Pre-op	1 Month (*p*)	6 Months (*p*)	1 Year (*p*)
Physical functioning	66.3 ± 24.7	92.1 ± 10.7 **(< 0.001)**	94.4 ± 8.9 **(< 0.001)**	95.6 ± 7.7 **(< 0.001)**
Role limitations (physical)	60.0 ± 45.6	75.0 ± 25.3 (0.151)	83.1 ± 18.9 (=0.005)	86.9 ± 16.8 **(< 0.001)**
Bodily pain	38.1 ± 28.1	71.8 ± 18.4 **(< 0.001)**	76.0 ± 19.6 **(< 0.001)**	79.2 ± 18.6 **(< 0.001)**
General health	37.7 ± 16.2	71.3 ± 10.0 **(< 0.001)**	66.3 ± 21.8 **(< 0.001)**	66.1 ± 23.6 **(< 0.001)**
Vitality	55.3 ± 15.2	79.0 ± 11.0 **(< 0.001)**	68.4 ± 19.5 (0.005)	68.8 ± 19.9 **(0.02)**
Social functioning	62.5 ± 23.7	80.6 ± 9.8 **(< 0.001)**	84.7 ± 15.4 **(< 0.001)**	85.6 ± 16.1 **(< 0.001)**
Role limitations (emotional)	75.8 ± 39.9	94.2 ± 12.8 **(0.015)**	86.9 ± 20.7 (0.331)	86.0 ± 20.9 (0.331)
Mental health	68.2 ± 21.4	83.1 ± 9.3 **(< 0.001)**	83.1 ± 9.3 **(< 0.001)**	83.7 ± 12.5 **(< 0.001)**

TABLE 3 | Correlation analysis of quality of life improvements.

Parameter	Physical function (*p*)	Role physical (*p*)	Bodily pain (*p*)	General health (*p*)	Vitality (*p*)	Emotional role (*p*)	Social function (*p*)	Mental health (*p*)
BMI	0.970	0.834	0.746	0.646	0.933	0.811	0.323	0.849
Defect area	0.588	0.673	0.809	0.121	0.249	0.498	0.420	0.457
Education level	0.938	0.892	0.454	0.317	0.766	0.903	0.368	0.412
Age	0.947	0.755	0.680	0.252	0.618	0.489	0.649	0.874

Abbreviation: BMI, body mass index.

completely medication-free at 1 year. Patients with anatomical recurrence had significantly lower SF-36 scores in PF (mean 82.3 vs. 96.8, $p = 0.02$) and BP (mean 65.7 vs. 80.5, $p = 0.04$) compared to those without recurrence. However, these patients still demonstrated significant improvement from their preoperative baseline scores. No significant differences were observed in other SF-36 domains between patients with and without recurrence.

4 | Discussion

Our findings demonstrate that LHHR with anterior partial 180° fundoplication significantly improves HRQOL for patients with symptomatic sliding hiatal hernia. The most pronounced improvements were observed in PF, role limitations due to physical problems, and BP domains at 12 months. While MH showed steady improvements, the emotional role domain demonstrated an interesting pattern with early improvement that was not sustained.

The marked preoperative impairment in BP (38.1 ± 28.1) and GH (37.7 ± 16.2) reflects the profound impact of symptomatic sliding hiatal hernia on patients' daily lives. These domains showed substantial postoperative improvements, with BP improving to 79.2 ± 18.6 ($p < 0.001$) and GH to 66.1 ± 23.6 ($p < 0.001$) at 1 year. Notably, even patients with anatomical recurrence identified at 12 months demonstrated significant improvement from baseline, though their PF (82.3 vs. 96.8, $p = 0.02$) and BP scores (65.7 vs. 80.5, $p = 0.04$) were lower than those without recurrence. This suggests that while anatomical success contributes to optimal outcomes, the procedure provides meaningful QOL benefits regardless of recurrence status. The high variability in preoperative physical role (SD = 45.6) and emotional role (SD = 39.9) scores suggests diverse preoperative functional status among our 40 patients.

An interesting finding in our study was the pattern of improvement in role limitations due to physical problems. Unlike other domains that showed significant immediate improvement at 1 month, the RP domain demonstrated non-significant improvement at 1 month (60.0 ± 45.6 to 75.0 ± 25.3, $p = 0.151$), before achieving statistical significance at 6 months (83.1 ± 18.9, $p = 0.005$) and 1 year (86.9 ± 16.8, $p < 0.001$). This delayed improvement likely reflects the early postoperative recovery period during which patients face temporary activity restrictions (lifting limitations, avoidance of strenuous activities), experience wound-related discomfort affecting certain physical tasks, and are adapting to post-fundoplication eating patterns. The gradual improvement becoming significant by 6 months corresponds to the completion of tissue healing and adaptation to the new anatomical configuration, allowing patients to resume normal physical activities and responsibilities. This finding highlights the importance of setting appropriate expectations for recovery timelines when counseling patients preoperatively.

The emotional role domain showed an interesting pattern—significant improvement at 1 month (94.2 ± 12.8, $p = 0.015$) but loss of statistical significance at 6 months (86.9 ± 20,7, $p = 0.331$) and 12 months (86.0 ± 20.9, $p = 0.331$). This pattern likely reflects the psychological journey following surgery: initial relief and optimism when major symptoms resolve, followed by a gradual recalibration of expectations as patients adapt to their new normal. As recovery progresses, minor residual symptoms or new sensations such as increased bloating or early satiety may become more psychologically prominent with time. Additionally, as patients return to normal life challenges, their focus may shift from surgical recovery to everyday stressors. Similarly, VT showed early improvement at 1 month (79.0 ± 11.0, $p < 0.001$) with some decline by 12 months (68.8 ± 19.9, $p = 0.02$). These findings suggest that psychological recovery follows a different timeline than physical recovery and highlight the importance of continued emotional support throughout the recovery process, especially as patients recalibrate their expectations and adjust to both the benefits and limitations of their post-surgical state.

To better contextualize our findings, we compared postoperative SF-36 scores with Malaysian population norms established by Azman et al. [23] At 12 months postsurgery, our patients not only achieved but exceeded population norms in several key domains. PF showed remarkable improvement, reaching 95.6 compared to the population norm of 85.98, demonstrating excellent surgical outcomes. BP scores improved substantially from a preoperative score of 38.1 to 79.2, surpassing the population norm of 69.96. This suggests particularly effective pain relief following the procedure. SF also exceeded population norms (85.6 vs. 83.73), while GH and VT achieved levels comparable to the general population (66.1 vs. 66.74 and 68.8 vs. 66.79, respectively). Role PF improved to slightly above population norms (86.9 vs. 82.03). These comparisons are particularly meaningful given that our patients started with significantly impaired baseline scores across all domains. The achievement of or exceeding population norms across multiple domains provides strong evidence for the effectiveness of LHHR with anterior 180° partial fundoplication in restoring normal quality of life.

The relationship between postoperative medication use, anatomical recurrence, and quality of life outcomes merits consideration. While the majority of patients (72.5%) were medication-free at 1 year, suggesting successful symptom control through surgery alone, a subset required continued PPI therapy (17.5%) or prokinetic agents (10%). Interestingly, patients with anatomical recurrence demonstrated significantly lower scores in PF and BP domains compared to those without recurrence, despite still showing meaningful improvement from baseline. This suggests that while anatomical success contributes to optimal outcomes, even patients with some degree of anatomical recurrence derive substantial benefits from the procedure.

The impact of hiatal hernia on QOL operates through several interconnected mechanisms. Anatomically, the size of the hiatal hernia affects lower esophageal sphincter (LES) function, and the protective role of the diaphragmatic crura as an "extrinsic sphincter" is lost [24]. This leads to increased esophageal acid exposure and mucosal injury, exacerbated by reduced LES resting pressure, shortened LES length, and prolonged acid clearance [24, 25]. These pathophysiology changes manifest clinically as profound effects across physical, mental, and social domains [12, 14, 26]. Physically, patients experience pain, discomfort, and activity avoidance, leading to a more sedentary lifestyle. Mentally, the condition contributes to anxiety, depression, and reduced daily functioning [12, 14]. Socially, patients

often avoid meals and social interactions due to embarrassment from symptoms, while work productivity decreases due to sleep disturbances and persistent symptoms [12]. Surgical correction addresses these issues by restoring the antireflux barrier and enhancing acid clearance. This enhanced clearance occurs by eliminating the "two-compartment" effect where acid pools in the hernia sac and re-refluxes during swallow-induced LES relaxations, restoring the anatomical relationship between the LES and diaphragmatic crura as a composite sphincter and recreating the angle of His, which collectively optimize the geometry for efficient esophageal emptying and prevent reflux during increased intra-abdominal pressure [24, 25].

Our correlation analysis revealed that age, BMI, ASA score, education level, and hiatal defect area did not predict postoperative QOL improvements (all $p > 0.005$ across all domains), demonstrating that LHHR benefits a broad range of patients regardless of demographic or anatomic factors. Patient selection should focus on symptom severity and its impact on quality of life rather than these variables.

In our study, all patients had been on PPIs prior to surgery, with varying degrees of symptom control. The median duration of symptoms was 18 months (range 3–96 months) prior to surgery. Despite this, LHHR significantly improved QOL scores in most SF-36 domains at 1, 6, and 12 months postoperatively. This suggests that surgery may be more effective than medical therapy in improving QOL for patients with hiatal hernia-associated GERD, likely due to better symptom control. The favorable safety profile in our series, with no conversions to open surgery, no reoperations, and only one minor intraoperative complication (superficial liver laceration), further supports the role of surgical intervention in this cohort.

Several studies have demonstrated the value of patient-reported outcomes in evaluating hiatal hernia surgery, with the SF-36 proving to be a robust tool for assessing both general well-being and functional status [10, 15, 22]. Its validation across different countries, including Malaysia, enhances the relevance of our findings [10, 19]. Our department's standard approach of laparoscopic anterior 180° partial fundoplication is supported by robust evidence from a meta-analysis of five randomized controlled trials (458 patients) showing that 180° anterior fundoplication achieves better postoperative QOL outcomes compared to Nissen fundoplication, particularly in reducing dysphagia and gas-related symptoms, while maintaining comparable reflux control and patient satisfaction at both 1 and 5 years [27]. The meta-analysis reported reoperation rates of 9.5% versus 6.2% at 5 years ($p = 0.26$), confirming the long-term durability of both approaches [27]. The sustained benefits observed in our series align with studies linking successful repair to improved outcomes [10].

Recent years have seen the emergence of endoscopic approaches for treating GERD and hiatal hernia, including antireflux mucosectomy (ARM) and transoral incisionless fundoplication [28, 29]. These minimally invasive techniques offer potential advantages, including reduced invasiveness and shorter recovery times. However, their application remains limited for symptomatic sliding hiatal hernias, particularly larger ones, and long-term outcomes data are still evolving. Our study demonstrates that laparoscopic repair with anterior 180° partial fundoplication achieves robust, sustained QOL improvements across multiple domains, establishing a benchmark against which these newer techniques should be measured. As endoscopic approaches continue to develop, careful patient selection based on hernia characteristics and symptom profiles will be essential to determine the optimal treatment algorithm.

Our study's strengths include its prospective design, use of a validated instrument, and sequential QOL measurements over time. All 40 patients completed follow-up questionnaires, providing comprehensive data. The comparison with age-matched population norms allows us to demonstrate that patients achieved QOL scores comparable to or exceeding the general population in most domains. Limitations include the generic nature of the SF-36, which may lack sensitivity for disease-specific changes. Future research should consider combining generic and disease-specific instruments for comprehensive assessment [14] and follow-up beyond 1 year to evaluate the long-term durability of improvements.

In conclusion, LHHR with anterior partial 180° fundoplication significantly and sustainably improves quality of life for patients with symptomatic sliding hiatal hernia, with most domains reaching or surpassing population norms by 12 months. Combined with its favorable safety profile, these findings support its role as a primary therapeutic option for this condition. Future research should explore strategies to enhance emotional well-being during recovery and identify factors that predict optimal outcomes.

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Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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