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Quality of Life After Collis Gastroplasty for Short Esophagus in Patients With Paraesophageal Hernia

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Abstract

Background—Collis gastroplasty is an important component of laparoscopic giant paraesophageal hernia (GPEH) repair in patients with persistent shortened esophagus after aggressive laparoscopic mobilization. Concerns remain, however, regarding symptomatic outcomes compared with fundoplication alone. This study assessed the impact of Collis gastroplasty on quality of life after laparoscopic GPEH repair.

Methods—We performed 795 nonemergent laparoscopic GPEH repairs with fundoplication (with Collis, $n = 454$; fundoplication alone, $n = 341$). Radiographic follow-up and symptom assessment were obtained a median 22 months and 20 months, respectively, after fundoplication alone and 36 and 33 months, respectively, after Collis ($p < 0.001$). Radiographic recurrence, reoperation for recurrent hernia or intolerable symptoms, overall symptom improvement, and quality of life were examined.

Results—Compared with fundoplication alone, Collis patients had significantly larger GPEH ($p = 0.027$) and fewer comorbidities ($p = 0.002$). Radiographic recurrences were similar ($p = 0.353$). Symptom improvement was significant for both ($p < 0.001$), although Collis was associated with better pain resolution ($p < 0.001$) and less gas bloat ($p = 0.003$). Quality of life was good to excellent in 88% (90% Collis versus 86% fundoplication alone, $p = 0.17$).

Conclusions—Symptomatic outcomes after laparoscopic fundoplication with Collis gastroplasty are excellent and comparable with those of fundoplication alone. These results confirm that utilization of Collis gastroplasty, based on intraoperative assessment for shortened esophagus, is not detrimental to the overall outcome or quality of life associated with the laparoscopic approach to GPEH. Collis gastroplasty is recommended as an important procedure in the surgeon's armamentarium for laparoscopic repair of GPEH.

The importance of “short esophagus” in the management of patients with esophageal disorders has been a long-standing topic of debate. While short esophagus may be suspected in preoperative assessment, the confirmation of short esophagus can be made only when,

after extensive mediastinal dissection, the surgeon is unable to reestablish at least 2 cm of tension-free esophageal length below the level of the diaphragmatic crura. Factors commonly associated with the intraoperative determination of short esophagus include Barrett's esophagus, esophageal stricture, and large, type III paraesophageal hernia (PEH). Failure to recognize and treat short esophagus at the time of antireflux surgery contributes to a high rate of symptom and hernia recurrence due to ongoing axial forces on the crural repair [1].

Esophageal lengthening by Collis gastroplasty, the preferred method for surgical correction of short esophagus at our institution, is a well-established treatment option [2, 3]. Concerns remain, however, that patients requiring Collis gastroplasty may have reduced symptom resolution because the procedure creates an amotile neoesophagus containing functional parietal cells. In some patients, these parietal cells continue to produce gastric acid, which can cause recurrent heartburn and esophagitis. In rare circumstances, when a long Collis segment (>2 cm to 3 cm) is required, the fundoplication wrap does not fully encompass the Collis segment, and a portion of neoesophagus is present above the wrap. A gastric reservoir, which dilates over time, can form, contributing to new or recurrent symptoms of dysphagia.

The aim of this study was to determine whether patients undergoing giant paraesophageal hernia (GPEH) repair with fundoplication and Collis gastroplasty have symptomatic outcomes that are comparable with those of patients treated with fundoplication alone.

Patients and Methods

Patient Selection and Stratification

All patients undergoing nonemergent laparoscopic GPEH repair with fundoplication from January 1, 1997, to December 31, 2009, were included (795 consecutive patients). We previously defined GPEH as herniation of 30% or more of the stomach through the esophageal hiatus into the posterior mediastinum [2, 4]. Patients who underwent emergency repair or who received GPEH repair with gastropexy, Roux-en-Y near-esophagojejunostomy, or gastroesophageal resection were excluded. Patients were stratified into two groups based on the addition of Collis gastroplasty for esophageal lengthening (fundoplication alone, $n = 341$, versus fundoplication with Collis, $n = 454$). Our Institutional Review Board approved this retrospective study.

Operative Technique

Our approach to laparoscopic GPEH repair has recently been described in detail [2]. In our early experience, laparoscopic Collis gastroplasty was accomplished using the end-to-end anastomosis (EEA) technique ($n = 327$) [3, 5], but in more recent cases, the wedge technique has been used ($n = 127$) [6]. Preoperative manometry was available in 26% of patients ($n = 202$), and 24-hour pH in 6% ($n = 47$). We rarely obtain these preoperative tests in patients with GPEH as we have found that they are difficult to perform and have an increased risk of perforation owing to the location of the stomach above the diaphragm, often with associated gastric volvulus. Type of fundoplication was determined by the surgeon based on his or her

preference and preoperative estimates of esophageal motility. Circumferential, floppy two-stitch fundoplication (ie. Nissen 360-degree wrap) was performed in 629 patients (79%) and partial fundoplication (Toupet or Dor) in 166 patients. A 54F bougie was utilized for fundoplication in 81% of fundoplication only patients ($n = 245$) compared with 47% of fundoplication with Collis patients ($n = 207$). A smaller bougie size (usually 50F or 52F) was used in 11% of fundoplication only patients compared with 45% of fundoplication with Collis patients ($n = 201$; $p < 0.001$).

Database and Clinical Follow-Up

Using retrospective chart review, data were abstracted and entered into an outcomes database by trained research personnel using a standardized outcome protocol [2]. As part of our clinical pathway, patients now routinely complete a standardized follow-up symptom assessment and validated questionnaires—the Gastroesophageal Reflux Disease–Health-Related Quality of Life (GERD-HRQoL) measure [7] and the Medical Outcomes Study Short-Form 36 (SF-36) [8]—at every clinic visit to determine disease-specific and overall quality of life during follow-up. Yearly barium esophagram is recommended to all patients. Radiographic recurrence rates were determined in patients with a barium esophagram at least 3 months after initial repair. If a recent barium esophagram was not available, esophagoscopy or chest/abdominal computed tomography scan results were used to determine the presence or absence of recurrence. Radiographic recurrence was defined as at least 10% (or 2 cm) of proximal stomach above the level of the hiatus [9].

Statistical Analysis

Statistical analysis was performed using STATA/SE 10.0 software (StataCorp, College Station, TX). Descriptive statistics were summarized with frequencies and percentages for categorical variables and median with interquartile range (IQR) for continuous variables. The χ^2 test, Fisher's exact test, Student's t tests, and two-sample Wilcoxon rank sum (Mann-Whitney) test were used to describe differences between groups. Analysis of paired variables was performed using McNemar's χ^2 test. Significance was set as $p \leq 0.05$ or less.

Results

Preoperative Characteristics and Postoperative Outcomes

Most preoperative characteristics were similar between the two groups. Patients with Collis gastroplasty had significantly larger PEHs and were less likely to have an age-adjusted Charlson Comorbidity Index score of 3 or more than were patients with fundoplication alone (Table 1). All patients had at least one preoperative symptom complaint, including dysphagia (352 of 783; 45%), heartburn (525 of 780; 67%), regurgitation/vomiting (485 of 786; 62%), epigastric or chest pain (475 of 791; 60%), postprandial bloating (270 of 760; 36%), and shortness of breath (373 of 781; 48%). Anemia was present in 43% of patients (326 of 760), with overt gastrointestinal bleeding in 13% (70 of 540). The proportion of patients with each symptom was similar when Collis gastroplasty patients were compared with patients receiving fundoplication alone (data not shown).

The addition of a Collis gastroplasty increased the median operative time by 40 minutes ($p < 0.001$) and Collis gastroplasty patients were significantly more likely to have mesh-reinforcement of the cruroplasty rather than primary crural closure. Collis gastroplasty did not impact postoperative mortality or length of hospital stay (Table 2). However, 2.7% of Collis gastroplasty patients had postoperative leaks compared with only 0.6% of patients in the fundoplication only group ($p = 0.032$). There were more postoperative leaks in the EEA-Collis group (10 of 327; 3.1%) than in the wedge-Collis group (2 of 127; 1.6%), but that was not statistically significant ($p = 0.523$).

Symptom Resolution and Quality of Life at Most Recent Follow-Up

Clinical follow-up at least 3 months after laparoscopic GPEH repair was available for 76% of patients (606 of 795). Symptom assessment was available for more Collis gastroplasty patients (81%) than for fundoplication alone patients (70%; $p = 0.001$). For most symptoms, the proportion of patients with each symptom decreased significantly after surgery in both groups, except for complaints of postprandial bloating in the fundoplication only group (Table 3).

Symptom resolution and onset of new symptoms were determined by comparing symptoms at most recent assessment to the patient's preoperative complaints. Dysphagia, heartburn, and regurgitation were resolved similarly in both groups. However, Collis gastroplasty patients were more likely to have resolution of epigastric or chest pain, postprandial bloating, and shortness of breath and were less likely to have postprandial bloating as a new postoperative complaint compared with patients with fundoplication alone (Table 4).

At the most recent clinical follow-up, patient satisfaction with surgical outcome and symptoms was excellent. Most patients (91%) reported satisfaction with no difference between the groups. Good or excellent GERD-HRQoL scores were obtained in 88% of patients and were not significantly different when comparing fundoplication with Collis gastroplasty with fundoplication alone. Finally, overall health, assessed by the SF-36 questionnaire, was slightly better in the Collis gastroplasty group for the physical component score, likely reflecting fewer comorbid diseases in this cohort (Table 5). When comparing outcomes stratified by type of Collis (EEA versus wedge), there were no differences in satisfaction ($p = 0.315$), GERD-HRQoL score ($p = 0.469$), and SF-36 physical component ($p = 0.510$) and mental component score ($p = 0.493$).

Radiographic Recurrence and Reoperation for Recurrent Hernia or Intolerable Symptoms

Radiographic follow-up at least 3 months after laparoscopic GPEH repair was available for 70% of patients (555 of 795). There were no differences in rates of radiographic follow-up between the two groups (71% Collis patients versus 68% fundoplication alone; $p = 0.344$); however, the time to most recent radiographic assessment was significantly longer in Collis gastroplasty patients compared with the patients with fundoplication alone (median 22 versus 36 months; $p < 0.001$). The median time to reoperation (30 months in the Collis gastroplasty patients and 22 months in the fundoplication alone patients) also did not differ ($p = 0.797$) between the two groups. There was no difference in the rate of radiographic recurrence (16.6% in the Collis gastroplasty patients and 19.7% in the fundoplication alone

patients; $p = 0.353$) or reoperation (2.7% in the Collis gastroplasty patients and 5.0% in the fundoplication alone patients; $p = 0.079$). Body mass index (BMI) did not influence radiographic recurrence (16% in patients with BMI <30 versus 20.2% in patients with BMI 30; $p = 0.202$), but was associated with increased rates of reoperation in patients who did not have a Collis gastroplasty (2.8% with BMI <30 versus 8.2% with BMI 30; $p = 0.03$). Among patients with a Collis, there was no association of BMI with reoperation (2.3% versus 3.4%, respectively; $p = 0.523$). Reoperation was more common among patients with mesh repair than among patients without mesh repair (8.6% versus 2.9%; $p = 0.004$).

Comment

Using routine symptom assessment, validated quality of life questionnaires, and radiographic assessment, this study compared outcomes and quality of life in a large series of patients who underwent laparoscopic fundoplication with Collis gastroplasty or fundoplication alone for treatment of GPEH. Symptomatic outcomes after laparoscopic fundoplication with Collis gastroplasty were excellent and comparable with those of fundoplication alone. Although there was better symptom resolution of epigastric and chest pain, regurgitation, and shortness of breath in the Collis gastroplasty group, this finding likely reflects the significantly larger PEH found in the Collis patients, many of whom had completely intrathoracic stomach, compared with the fundoplication alone group. Overall, we found that, when short esophagus was identified after extensive esophageal mobilization, the addition of Collis gastroplasty to the laparoscopic repair of GPEH was not detrimental to the overall outcome or quality of life. Collis gastroplasty is recommended as an important procedure in the surgeon's armamentarium for laparoscopic repair of GPEH.

Symptom Resolution and Physiologic Outcomes

One of the primary concerns regarding the use of Collis gastroplasty is persistent acid secretion within the neoesophagus. Several authors have performed physiologic assessment of the neoesophagus, including objective measures of pH and endoscopic evaluation for esophagitis, and found evidence for ongoing acid-related complications. In 1998, Jobe and associates [10] published an analysis of 15 patients who had undergone fundoplication with Collis. They performed postoperative manometry, endoscopy, 24-hour pH, and endoscopic Congo red staining for acid secretion in the Collis segment. They found that 50% of patients had abnormal pH studies with acid secretion from functional parietal cells in the Collis segment, and 36% had persistent esophagitis. Despite these objective findings, only 14% of patients complained of heartburn in postoperative symptom assessment. They did not find any recurrent herniation 14 months postoperatively and concluded that patients treated with Collis gastroplasty require close objective follow-up and maintenance acid-suppression therapy.

Lin and colleagues [11] performed a similar study in 2004 to determine the physiologic and symptomatic outcomes after Collis gastroplasty. Upper endoscopy and esophageal acid monitoring were performed in 68 patients who had previously undergone Collis gastroplasty. In their study, the indication for Collis gastroplasty was failed antireflux surgery in 30% of patients and large PEH in 40%. In patients willing to undergo physiologic follow-up (37%), they found 17% with recurrent hernia and 80% with evidence of

esophagitis and abnormal pH. They concluded that distal esophageal injury can persist after Collis gastroplasty and questioned the liberal application of esophageal lengthening in antireflux surgery.

The findings of both papers raise important concerns regarding widespread application of Collis gastroplasty as a component of antireflux surgery. It is important to note, however, that neither paper analyzed patients with fundoplication alone. Hence, they could not comment on whether the findings of persistent esophagitis and abnormal pH were more prevalent in patients with Collis gastroplasty than in a comparison group treated with fundoplication alone. Chen and colleagues [12] addressed this question in 2005. They performed extensive preoperative and postoperative objective testing, including esophagram, radionuclide emptying studies, manometry, 24-hour pH, and endoscopy, in 33 patients undergoing Nissen fundoplication and 51 patients who received Collis-Nissen. Median follow-up was quite long (8 years for the Nissen group and 6.5 years for the Collis-Nissen group). They found evidence for esophagitis and mucosal erosions after Collis-Nissen. However, the prevalence of these abnormal findings in the Collis-Nissen group was significantly less than in the Nissen alone group. Rather than concluding that Collis-Nissen was associated with a high rate of acid-related complications, they found that the procedure was associated with much better reflux protection than a standard Nissen repair and lowered the risk of fundoplication failure.

A major strength of our study is the large number of patients in each group, which allows robust comparison of symptomatic outcomes. However, because it is retrospective and objective testing has not been recommended in routine clinical postoperative assessment, we cannot correlate symptoms with objective physiologic measures. However, our symptom and quality of life outcomes are consistent with other reports. Several series have reported similarly good symptom outcomes after fundoplication with Collis gastroplasty [13–17]. Garg and colleagues [13] reported complete resolution of heart-burn and regurgitation in 52% and 54% of patients undergoing Collis gastroplasty during surgery for treatment of gastroesophageal reflux disease. High satisfaction with surgical outcome was identified in 77% of patients. In their series, however, chest pain and dysphagia persisted in 78% and 71%, respectively [13]. This difference in symptom outcome compared with our study likely reflects differences in the underlying patient population. In our study, reoperations were excluded. In the study by Garg and coworkers [13], 25% of patients had at least one prior antireflux operation; reoperation for failed antireflux surgery is associated with worse symptomatic outcomes than primary repair [18, 19].

Patient Factors Influencing Surgeon Utilization of Collis Gastroplasty

Because the Collis gastroplasty procedure introduces the potential for added morbidity, the patient's age, comorbid diseases, intraoperative stability, condition of the stomach after hernia reduction, and ability to heal or tolerate postoperative complications must be taken into account. It is not surprising, therefore, that the Collis gastroplasty group was significantly less likely to have an age-adjusted Charlson Comorbidity Index score of 3 or more compared with the fundoplication alone group. That is not because patients with more comorbid diseases are less likely to have short esophagus at the time of surgery; rather, it

reflects the complexity of the intraoperative management of these patients. Over the past decade, our practice has shifted so that if the surgeon has concerns regarding any of these patient-related factors, Collis gastroplasty is not performed. Many of these patients are treated with a salvage operation consisting of sac reduction, esophageal mobilization, and crural closure, with an extended gastropexy to prevent large postoperative recurrence.

Study Limitations

This study has several strengths and weaknesses. We present a large number of patients with primary GPEH repair. Thus, we eliminate the heterogeneity introduced by reoperative surgery, surgery indicated for symptoms without significant hiatal hernia, and surgery for underlying esophageal disorders (eg, scleroderma). The study population was relatively homogeneous with regard to preoperative symptom complaints, enabling direct comparison between the two operative approaches. Because the data for this study were obtained retrospectively, this analysis is limited somewhat by variability in preoperative symptom assessment in the first 8 years of the experience. More recently, we have instituted clinical pathways that include standard symptom assessment at each clinical encounter, significantly improving the accuracy and completeness of symptom assessment. Finally, the ideal discussion of Collis gastroplasty would include intraoperative details, such as the length of intraabdominal esophagus after maximal esophageal mobilization, the extent of esophageal mobilization, and specific details regarding the surgeon's decision of whether to perform an esophageal lengthening procedure. Because of the retrospective nature of this study, these details were not available.

In conclusion, after laparoscopic fundoplication with Collis gastroplasty, symptomatic outcomes and quality of life are excellent and comparable to those of fundoplication alone in the treatment of GPEH. These data provide reassurance to the esophageal surgeon that, if short esophagus persists after extensive esophageal mobilization, the utilization of Collis gastroplasty will not be detrimental to the patient's overall outcome or quality of life.

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Table 1

Preoperative Characteristics

Preoperative Characteristics	All Patients (n)	Fundoplication Alone (n)	Fundoplication With Collis (n)	p Value
All patients	795	341	454	
Age				
<70 years	392	170	222	0.79
70 years	403	171	232	
Sex				
Female	598	264	334	0.213
Male	197	77	120	
Body mass index				
<30	454	191	263	0.789
30	323	139	184	
Age-adjusted Charlson Comorbidity Index				
<3	384	143	241	0.002
3	411	198	213	
Type of paraesophageal hernia				
Type II	61	50	11	<0.001
Type III	638	240	398	
Type IV	88	44	44	
Size of paraesophageal hernia ^a				
30% to 49%	146	73	73	0.027
50% to 75%	289	133	156	
75% to 99%	176	70	106	
Completely intrathoracic stomach	184	65	119	

^aIndicates the percentage of stomach herniated through the hiatus into the posterior mediastinum by preoperative barium esophagram, computed tomography scan, or surgeon's estimation on intraoperative assessment.

Table 2

Operative Details, Postoperative Events, and Differences in Outcome by Approach to Collis Gastroplasty

Operative Details and Postoperative Events	All Patients	Fundoplication Alone	Fundoplication With Collis	pValue	EEA (n = 327)	Type of Collis	
						Wedge (n = 127)	pValue
Time required for operation, minutes, median (IQR)	229 (189, 265)	189 (139, 243)	229 (189, 265)	<0.001	233 (193.5, 271)	218 (184, 255)	0.165
Crural reinforcement with mesh, n (%)	106 (13)	31 (9.1)	75 (17)	0.002	61 (19)	15 (12)	0.08
Converted to open repair, n (%)	13 (1.6)	10 (2.9)	3 (0.7)	0.020	2 (0.6)	1 (0.8)	>0.999
In-hospital or 30-day mortality, n (%)	14 (1.8)	7(2.1)	7(1.5)	0.572	4 (1.2)	3 (2.4)	0.405
Major postoperative adverse event, ^a n (%)	156 (20)	67 (20)	89 (20)	0.988	66 (20)	24 (19)	0.795
Postoperative gastric or esophageal leak	14	2	12	0.032	10	2	0.525
Pneumonia	40	15	25	0.623	21	4	0.251
Sepsis	11	5	6	0.863	4	2	0.674
Hernia recurrence within 30 days	6	3	3	0.704	3	0	0.563
Length of hospital stay after repair, median (IQR)	3(2,5)	3(2,5)	3(2,5)	0.261	3(2,5)	3(2,5)	0.355
Readmission in <30 days, n (%)	71 (9)	37 (11)	34 (7.5)	0.102	26 (8)	9 (7.1)	0.846
Reoperation in-hospital or <30 days, n (%)	40 (5.1)	11 (3.3)	29 (6.4)	0.047	21 (6.5)	8 (6.4)	0.981

EEA = end-to-end anastomosis; IQR = interquartile range.

^a Patient experiencing at least one major postoperative adverse event as defined by The Society of Thoracic Surgeons. Events considered "major" include pneumonia, need for tracheostomy, congestive heart failure, postoperative gastric or esophageal leak, pulmonary embolism, hernia recurrence within 90 days after repair, reintubation, acute renal failure, stroke, myocardial infarction, sepsis, need for hospital readmission within 30 days, or need for reoperation within 30 days or during the same hospital stay.

Table 3

Paired Analysis Comparing Proportion of Patients With Preoperative Complaints to Proportion Within Each Group Reporting Symptoms at Most Recent Clinical Follow-Up

Symptom at Most Recent Clinical Follow-Up ^a	Fundoplication With Collis			Fundoplication Alone		
	Difference in Proportion	p Value	95% CI	Difference in Proportion	p Value	95% CI
Proton pump inhibitor use	37%	<0.001	(30%, 43%)	34%	<0.001	(26%, 42%)
Shortness of breath	33%	<0.001	(26%, 40%)	29%	<0.001	(21%, 36%)
Regurgitation	52%	<0.001	(46%, 59%)	48%	<0.001	(39%, 56%)
Postprandial bloating	7%	0.035	(0%, 15%)	−10%	0.018	(−1%, −19%)
Epigastric pain	39%	<0.001	(31%, 48%)	35%	<0.001	(27%, 43%)
Dysphagia	19%	< 0.001	(13%, 25%)	26%	<0.001	(18%, 34%)
Heartburn	43%	<0.001	(37%, 49%)	44%	<0.001	(36%, 51%)

^aIncludes only patients with both preoperative and postoperative symptom assessment. CI = confidence interval.

Table 4

Symptom Outcomes at Most Recent Clinical Follow-Up

Symptom Outcomes	Total, n (%)	Fundoplication Alone, n (%)	Fundoplication With Collis, n (%)	<i>p</i> Value
Time to clinical follow-up, months, median (IQR)	26 (12,50)	20 (9, 36)	33 (16,60)	<0.001
Dysphagia ^a				
Assessed	614	233	381	
Resolved	188 (67)	76 (72)	112 (63)	0.117
Persistent	94 (33)	29 (28)	65 (37)	
New postoperatively	55 (17)	15 (12)	40 (20)	0.06
Heartburn ^a				
Assessed	642	259	383	
Resolved	315 (71)	127 (70)	188 (72)	0.624
Persistent	126 (29)	54 (30)	72 (28)	
New postoperatively	37 (18)	14 (18)	23 (19)	0.894
Regurgitation ^a				
Assessed	547	202	345	
Resolved	296 (89)	104 (88)	192 (89)	0.746
Persistent	37 (11)	14 (12)	23 (11)	
New postoperatively	19 (9)	8 (10)	11 (8)	0.79
Epigastric or chest pain ^a				
Assessed	598	244	354	
Resolved	291 (80)	104 (69)	187 (87)	<0.001
Persistent	75 (20)	47 (31)	28 (13)	
New postoperatively	41 (16)	15 (16)	26 (19)	0.614
Postprandial bloating ^a				
Assessed	580	231	349	
Resolved	128 (61)	39 (48)	89 (69)	0.003
Persistent	82 (39)	42 (52)	40 (31)	
New postoperatively	126 (34)	63 (42)	63 (29)	0.008
Shortness of breath ^a				
Assessed	574	230	344	
Resolved	218 (78)	79 (70)	139 (83)	0.011
Persistent	63 (22)	34 (30)	29 (17)	
New postoperatively	38 (13)	13 (11)	25 (14)	0.44
Proton pump inhibitor use ^a				
Assessed	612	235	377	
Resolved	257 (55)	94 (51)	163 (57)	0.297
Persistent	214 (45)	89 (49)	125 (43)	
New postoperatively	39 (28)	14 (27)	25 (28)	>0.999

^aIncludes only patients with both preoperative and postoperative symptom assessment. When preoperative symptoms were present, analysis compares proportion of patients in each group with persistent versus resolved symptoms. When symptoms were absent preoperatively, analysis compares proportion of patients in each group with new symptoms. IQR = interquartile range.

Table 5

Impact of Collis Gastroplasty on Gastroesophageal Reflux Disease-Related and Overall Patient Health Status at Most Recent Clinical Follow-Up

Quality of Life Measure	All Patients	Fundoplication Alone	Fundoplication With Collis	<i>p</i> Value
Satisfied with surgery and current symptoms, n (%)	n = 502	n = 206	n = 296	
Yes	457 (91)	182 (88)	275 (93)	0.079
No	45 (9)	24 (12)	21 (7)	
Validated GERD-HRQoL, median (IQR)	n = 590	n = 241	n = 349	
Composite score	1(0,5)	2(0,5)	1 (0, 4)	0.0146
Excellent to good ^a	522(88)	208 (86)	314 (90)	0.171
Fair to poor ^a	68 (12)	33 (14)	35 (10)	
Short-Form 36 Health Survey, median (IQR)	n = 560	n = 230	n = 330	
Physical component summary	49 (38, 57)	46 (36, 55)	52 (39, 57)	0.002
Mental component summary	53 (46, 57)	52 (44, 57)	53 (49, 57)	0.059

GERD-HRQoL = Gastroesophageal Reflux Disease-Health-Related Quality of Life; IQR = interquartile range.

^aGastroesophageal Reflux Disease-Health-Related Quality of Life (GERD-HRQoL) scoring scale: excellent = 0 to 5, good = 6 to 10, fair = 11 to 15, poor = greater than 15.