

Original Article

Comparative efficacy of laparoscopic Dor and Nissen fundoplication for refractory gastroesophageal reflux disease

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Abstract: Objective: To compare the clinical efficacy of laparoscopic Dor versus Nissen fundoplication in the treatment of refractory gastroesophageal reflux disease (RGERD). Methods: This retrospective study included 102 RGERD patients treated between January 2023 and January 2025. Patients were assigned to either the Dor (n=50) or the Nissen (n=52) groups based on the surgical approach. Outcomes compared included overall clinical efficacy, perioperative indicators (intraoperative blood loss, operative time, and hospital stay), time to symptomatic improvement (reflux, burning epigastric discomfort, and retrosternal pain), esophageal manometry (integrated relaxation pressure [IRP] and lower esophageal sphincter resting pressure [LESP]), esophageal pH monitoring (reflux duration, reflux episodes, and DeMeester score), Gastroesophageal Reflux Disease Questionnaire (GERDQ) score, adverse events during hospitalization and at 1-year follow-up (heartburn, constipation, eructation disorder, acid regurgitation, bloating, and dysphagia), and patient satisfaction. Results: The two surgical techniques demonstrated no marked difference in overall efficacy rates, perioperative parameters, time to symptomatic improvement, incidence of adverse events (8.00% vs. 13.46%), or treatment satisfaction (82.00% vs. 76.92%; all $P>0.05$). Both groups showed significant postoperative increases in IRP and LESP and marked reductions in reflux duration and episodes, as well as DeMeester and GERDQ scores (all $P<0.05$), though no statistical inter-group differences were identified ($P>0.05$). Conclusions: Dor and Nissen fundoplication demonstrated equivalent effectiveness and safety in the treatment of RGERD.

Keywords: Fundoplication, Dor procedure, Nissen procedure, laparoscopy, refractory gastroesophageal reflux disease, clinical efficacy

Introduction

Gastroesophageal reflux disease (GERD) is a common gastrointestinal condition characterized by esophageal and extraesophageal symptoms and/or reflux of gastric contents to the esophagus [1]. Typical clinical presentations include reflux, heartburn, and esophageal chest pain, whereas atypical manifestations may involve chest pain, laryngeal injury, globus sensation, chronic cough, and hoarseness [2, 3]. While proton pump inhibitors (PPIs) provide effective symptom control for most patients, approximately 10-40% of the cases exhibit sub-optimal response, defined as refractory GERD (RGERD), which causes considerable therapeutic challenges and increases healthcare resource use [4, 5]. RGERD is clinically diagnosed

when symptoms persist despite at least eight weeks of standard-dose PPI therapy [6]. For such patients, anti-reflux fundoplication represents the primary therapeutic option. It is considered the surgical gold standard, effectively reducing reflux events while significantly reducing refluxate acidity [7]. However, conventional fundoplication carries the risk of postoperative complications, including dysphagia, flatulence, and recurrent heartburn [8]. Consequently, refining fundoplication carries profound clinical importance for enhancing surgical efficacy and promoting smooth postoperative rehabilitation.

Laparoscopic Nissen fundoplication, a conventional surgical treatment for GERD, involves a 360° gastric wrap and has demonstrated both clinical benefits and drawbacks. Laparoscopic

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Dor fundoplication is a modified procedure featuring an anterior (180°) wrap [9]. Research suggests that this modified technique achieves comparable efficacy to Nissen fundoplication in managing reflux and regurgitation, while reducing the incidence of postoperative dysphagia and gas-bloat syndrome [10-12]. Moreover, the Dor approach has shown therapeutic value in refractory esophagogastric junction outflow obstruction, offering a high-potential alternative to pharmacotherapy [13], and has been applied in type I achalasia to reduce esophageal acid exposure without impairing esophageal drainage [14]. Despite these findings, comparative studies evaluating laparoscopic Dor versus Nissen fundoplication in RGERD remains limited.

This study queries whether there is clinical superiority of the laparoscopic Dor over Nissen fundoplication in RGERD treatment by comprehensively comparing differences in clinical efficacy, perioperative indicators, symptom relief, esophageal manometry, esophageal pH monitoring, Gastroesophageal Reflux Disease Questionnaire (GERDQ) score, adverse events during hospitalization and at 1-year follow-up, and treatment satisfaction between the two procedures, possibly offering a more effective therapeutic alternative.

This research features several innovations. First, it pioneers a comparative analysis of two laparoscopic procedures (Nissen vs. Dor) in RGERD management, delivering evidence-based grounds for personalized surgical technique selection. Second, it compares short- and long-term adverse events (e.g., heartburn, constipation, eructation disorder, acid regurgitation, bloating, and dysphagia). Third, the research carries out an all-round examination of symptom relief dynamics, esophageal manometry tests, esophageal pH monitoring results, GERDQ ratings, and patient satisfaction, contributing to a more thorough understanding of the clinical performance of both therapies.

Patients and methods

General information

This retrospective study was approved by the Ethics Committee of Xuan Wu Hospital, Capital Medical University. A total of 102 RGERD cases treated between January 2023 and January

2025 were enrolled. According to the treatment methods, 50 cases were assigned to the Dor group and 52 to the Nissen group.

Inclusion and exclusion criteria

Inclusion criteria: meeting the diagnostic criteria of RGERD [15]; aged between 18-80 years; persistent GERD symptoms for ≥ 1 year, including reflux, heartburn, substernal/back pain, subxiphoid distension, cough, wheezing, or pharyngeal globus sensation; GERDQ score > 8 or endoscopic evidence of reflux esophagitis or Barrett's esophagus [16]; availability of complete clinical data.

Exclusion criteria: previous esophageal/gastric surgery or short esophagus; severe cardiovascular/cerebrovascular diseases contraindicating operations; acute digestive tract ulcers or esophageal/gastrointestinal malignancies; failure to complete PPIs or acid-suppressing therapy for at least 6 months; concurrent malignancies; moderate-to-severe ascites due to liver cirrhosis, severe connective tissue disease, or cardiac/renal failure; esophageal achalasia.

Treatment methods

All procedures were carried out by the same surgical team. Patients were positioned in a supine with the head elevated (30°-45°) and the legs separated ("leg-split" position). The chief surgeon stood between the patient's lower limbs, with the first assistant on the left and the laparoscope holder on the right. General anesthesia was administered by endotracheal intubation. A pneumoperitoneum was established with a Veress needle (intra-abdominal pressure: 12 mmHg), and the conventional five-port technique was applied in a diamond-shaped configuration. A 10-mm vertical incision above the umbilicus served as the observation port. Under laparoscopic guidance, 5-mm and 10-mm trocars were inserted at the left and right midclavicular lines beneath the costal margins. A small incision was made below the xiphoid process slightly to the left, through which a 5-mm self-made liver retractor (the "7"-shaped hook) was introduced. A 10-mm trocar was then placed at the left midclavicular line, serving as the main operating port for the insertion of the ultrasonic scalpel. When enhanced exposure was required, a 5-mm tro-

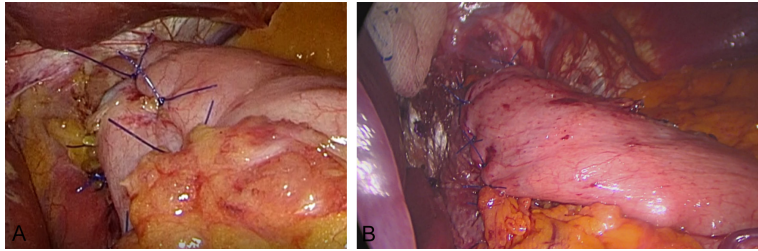


Figure 1. Surgical images captured during the two procedures. A. Laparoscopic Nissen fundoplication procedure. B. Laparoscopic Dor fundoplication technique.

car at the left anterior axillary line was selected as an auxiliary operating port for cooperative instruments. Following adequate exposure of the esophageal hiatus, the ultrasonic scalpel was used to divide the gastro-splenic ligament along the greater curvature, mobilizing the gastric fundus toward the left diaphragmatic crus. Next, the lesser omentum was opened at the upper lesser curvature, and the phreno-esophageal membrane over the lower esophagus was dissected to expose the left and right diaphragmatic crura. Blunt dissection of the posterior esophageal space was then performed using an atraumatic dissector, followed by esophageal suspension with a gauze strip to complete abdominal esophageal mobilization. Finally, several stitches were placed using 2-0 non-traumatic non-absorbable sutures to approximate the diaphragmatic crura, all employing intracorporeal knot-tying techniques, to narrow the hiatal opening to approximately 1.0 cm.

Dor group: Dor fundoplication was performed by pulling the left gastric fundus anteriorly across the esophagus to the right side and wrapping it around the lower esophagus. The fundus was then secured to the diaphragmatic crus with 2-3 stitches, forming a 180° anterior partial wrap. Depending on the intraoperative conditions and the patient's coagulation status, a laparoscopic drain was placed when needed.

Nissen group: Nissen procedure was executed by pulling the posterior gastric fundus behind the esophagus to the right, forming a complete 360° wrap around the distal esophagus. Interrupted non-absorbable sutures were spaced 1-2 cm apart to construct a 2.0-2.5 cm circumferential wrap. To prevent displacement, each stitch included bites of the anterior

esophageal wall. The suturing sequence followed the pattern of fundus-esophagus-fundus, resulting in a full circumferential wrap.

After surgery, all patients were kept *nil per os* with allowance for moderate water intake at 24 hours. Liquid diet was initiated on postoperative days 2-3. If no complications were observed, the nasogastric

tube could be withdrawn, followed by a gradual shift to semi-liquid meals. One week after surgery, an upper gastrointestinal examination was performed, and patient were discharged if no abnormalities were indicated. During the first post-discharge month, a soft and light diet was recommended, with gradual transition to a normal diet over the subsequent 2-3 months. **Figure 1** displays surgical photographs from both procedures.

Detection indicators

(1) Clinical efficacy [17]. Significant improvement: complete resolution of clinical manifestations (e.g., burning epigastric discomfort, retrosternal pain, regurgitation), and absence of esophageal/gastric congestion, edema, or erosions; Moderate improvement: over 50% symptom alleviation with partial mucosal congestion and edema; No improvement: no symptom relief or symptom aggravation. The total efficacy rate was calculated as: (significant improvement cases + moderate improvement cases)/the total number of cases*100%.

(2) Perioperative indicators [18]. Intraoperative bleeding, operative time, and length of hospital stay were recorded.

(3) Time to symptomatic improvement [19]. The time to symptom relief (e.g., reflux, burning epigastric discomfort, retrosternal pain) was documented for both groups.

(4) Esophageal manometry [20]. Key measures including the integrated relaxation pressure (IRP) and lower esophageal sphincter resting pressure (LESP) were measured.

(5) Esophageal pH monitoring [21]. Reflux duration, number of reflux episodes, and DeMeester

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Table 1. Comparison of baseline data between the Dor and Nissen groups

Indicator	Dor group (n=50)	Nissen group (n=52)	χ^2/t	P
Sex			0.187	0.665
Male	30 (60.00)	29 (55.77)		
Female	20 (40.00)	23 (44.23)		
Age (years)	57.02±13.15	55.69±11.60	0.542	0.589
Body mass index (kg/m ²)	25.88±3.57	26.96±5.50	1.171	0.244
Ethnicity			0.698	0.403
Ethnic minorities	12 (24.00)	9 (17.31)		
Han	38 (76.00)	43 (82.69)		
Reflux esophagitis			3.008	0.083
Without	13 (26.00)	22 (42.31)		
With	37 (74.00)	30 (57.69)		

Table 2. Comparison of treatment efficacy between the Dor and Nissen groups

Indicator	Dor group (n=50)	Nissen group (n=52)	χ^2	P
Significant improvement	23 (46.00)	25 (48.08)		
Moderate improvement	20 (40.00)	22 (42.31)		
Non-improvement	7 (14.00)	5 (9.62)		
Overall efficacy	43 (86.00)	47 (90.38)	0.472	0.492

scores were compared before and after surgery.

(6) GERDQ score. The GERDQ assessed symptom frequency in the past week, covering heartburn, regurgitation, epigastric pain, nausea, sleep disturbances, and over-the-counter (OTC) medication use. Scores range from 0 to 18, with <8 suggesting the absence of GERD and ≥8 supporting a GERD diagnosis [22].

(7) Postoperative complications [23]. Adverse events recorded during hospitalization and at 1-year follow-up included heartburn, constipation, eructation disorder, acid regurgitation, bloating, and dysphagia, with incidence rates calculated.

(8) Treatment satisfaction [24]. Patient satisfaction with the overall surgical outcome, categorized as “very satisfied”, “moderately satisfied”, or “dissatisfied”, was assessed through outpatient visits or telephone follow-ups.

Statistical methods

All data were analyzed using SPSS version 20.0. Figures were generated with the Hiplot

online platform. Enumerated data were presented as frequencies and percentages (n/%), while measured data were reported as means ± standard error of the mean (mean ± SEM). The χ^2 test was utilized for intergroup comparisons of enumeration data. Comparisons between groups for measured data were conducted using independent samples t-tests, whereas paired t-tests were employed for evaluating pre- and post-operative measurements. Statistical significance was determined at $P < 0.05$.

Results

Baseline data

There were no significant differences in terms of baseline characteristics, including sex, age, body mass index (BMI), ethnicity, and reflux esophagitis status, between the two groups (**Table 1**), indicating the comparability between the Dor (n=50) and Nissen groups (n=52) ($P > 0.05$).

Clinical efficacy

As shown in **Table 2**, the Dor group had 23 cases of significant improvement, 20 of moderate improvement, and 7 of no improvement, while the Nissen group had 25, 22, and 5 cases, respectively. Although the Nissen group showed marginally superior overall efficacy, this difference was not statistically significant (90.38% vs. 86.00%; $P > 0.05$).

Perioperative indices

Perioperative parameters, including intraoperative bleeding, operative time, and length of hospital stay, were also similar between the two groups ($P > 0.05$, **Table 3**).

Time to symptomatic improvement

As shown in **Table 4**, the time to relief of reflux, burning epigastric discomfort, and retrosternal

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Table 3. Comparison of perioperative indicators between the Dor and Nissen groups

Indicator	Dor group (n=50)	Nissen group (n=52)	t	P
Intraoperative bleeding (mL)	53.20±22.69	50.23±21.66	0.676	0.500
Operative time (min)	105.46±38.53	107.67±37.52	0.293	0.770
Hospital stay (d)	4.38±1.86	4.58±1.99	0.524	0.602

Table 4. Comparison of time to symptomatic improvement between the Dor and Nissen groups

Symptom relief time	Dor group (n=50)	Nissen group (n=52)	t	P
Reflux	8.00±1.96	8.46±2.47	1.039	0.301
Burning epigastric discomfort	7.68±1.74	8.10±2.73	0.922	0.359
Retrosternal pain	9.74±2.57	9.54±3.20	0.347	0.729

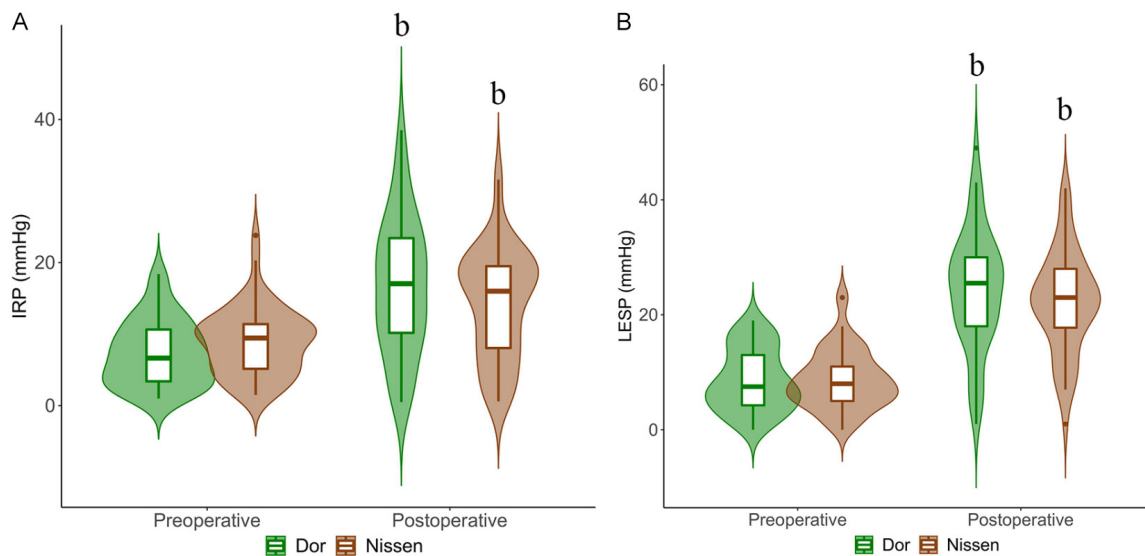


Figure 2. Comparison of esophageal manometry measurements between the two groups before and after treatment. A. IRP; B. LESP. Note: IRP, integrated relaxation pressure; LESP, lower esophageal sphincter resting pressure. b $P < 0.01$, compared to preoperative value.

pain did not differ significantly between the two groups ($P > 0.05$).

Esophageal manometry measurements

Pre- and postoperative esophageal manometry (IRP and LESP) findings are shown in **Figure 2**. Baseline values were comparable between groups ($P > 0.05$). Post-surgery, both groups demonstrated marked increases in IRP and LESP ($P < 0.01$), though intergroup differences remained insignificant ($P > 0.05$).

Esophageal pH and GERDQ scores

As shown in **Figure 3**, both groups exhibited significant postoperative reductions in reflux episodes, DeMeester scores, and GERDQ scores

compared to baseline (all $P < 0.01$). No significant intergroup variations were observed before and after surgery ($P > 0.05$).

In-hospital adverse events

Adverse events during hospitalization mainly included heartburn, constipation, eructation disorder, acid regurgitation, bloating, and dysphagia. The overall incidence of complications was comparable between the two groups ($P > 0.05$; **Table 5**).

One-year postoperative adverse events

At the 1-year follow-up, adverse events were recorded as shown in **Table 6**. Similarly, the overall incidence showed no significant intergroup differences ($P > 0.05$).

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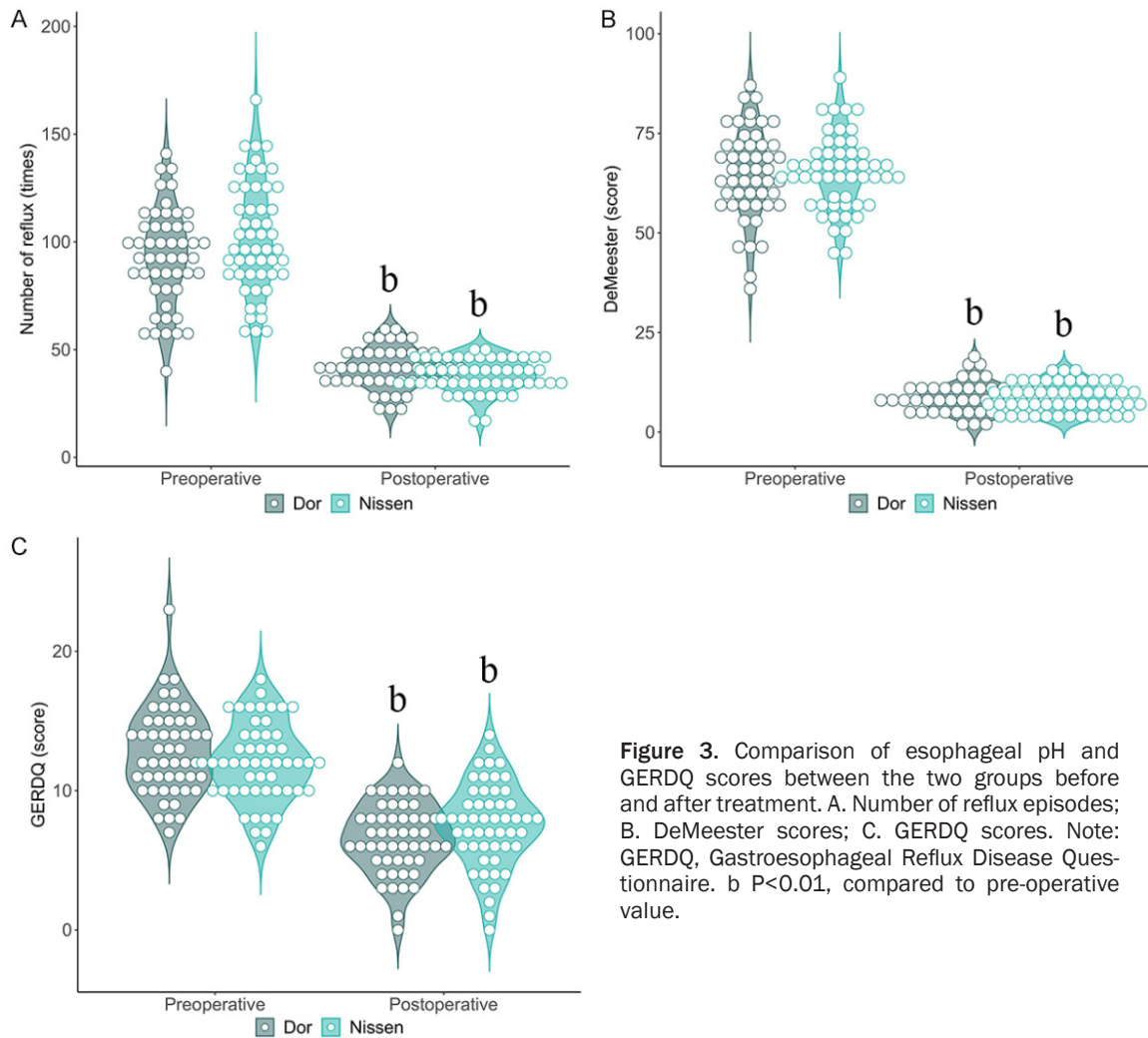


Figure 3. Comparison of esophageal pH and GERDQ scores between the two groups before and after treatment. A. Number of reflux episodes; B. DeMeester scores; C. GERDQ scores. Note: GERDQ, Gastroesophageal Reflux Disease Questionnaire. b P<0.01, compared to pre-operative value.

Table 5. Comparison of in-hospital adverse events between the Dor and Nissen groups

Indicator	Dor group (n=50)	Nissen group (n=52)	χ^2	P
Heartburn	1 (2.00)	1 (1.92)		
Constipation	0 (0.00)	1 (1.92)		
Eructation disorder	1 (2.00)	2 (3.85)		
Acid regurgitation	1 (2.00)	2 (3.85)		
Bloating	1 (2.00)	2 (3.85)		
Dysphagia	8 (16.00)	10 (19.23)		
Total	12 (24.00)	18 (34.62)	1.384	0.240

Patient satisfaction with treatment

The patient satisfaction on overall efficacy are shown in **Table 7**. In the Dor group, 82% (41/50) of patients reported satisfaction (16 very satisfied, 25 moderately satisfied). In the Nissen group, 76.92% (40/52) reported satisfaction

(17 very satisfied, 23 moderately satisfied). Satisfaction rates were comparable between groups (P>0.05).

Discussion

Multiple treatment approaches have been investigated for RGERD. Sumi et al. [25] demonstrated that anti-reflux mucosal resection provided benefits in RGERD patients and was also effective in reflux hypersensitivity. Harper et al. [26] suggested that Swiss RefluxStop was more cost-effective than both Nissen fundoplication and magnetic sphincter augmentation. Lee et al. [27] also showed that Stretta radiofrequency had significant clinical superiority in facilitating PPI withdrawal and lowering complications in RGERD

Table 6. Comparison of 1-year postoperative adverse events between the Dor and Nissen groups

Indicator	Dor group (n=50)	Nissen group (n=52)	χ^2	P
Heartburn	1 (2.00)	2 (3.85)		
Constipation	1 (2.00)	1 (1.92)		
Eructation disorder	1 (2.00)	0 (0.00)		
Acid regurgitation	0 (0.00)	1 (1.92)		
Bloating	0 (0.00)	1 (1.92)		
Dysphagia	1 (2.00)	2 (3.85)		
Total	4 (8.00)	7 (13.46)	0.790	0.374

Table 7. Comparison of treatment satisfaction between the Dor and Nissen groups

Indicator	Dor group (n=50)	Nissen group (n=52)	χ^2	P
Very satisfied	16 (32.00)	17 (32.69)		
Moderately satisfied	25 (50.00)	23 (44.23)		
Dissatisfied	9 (18.00)	12 (23.08)		
Total satisfaction	41 (82.00)	40 (76.92)	0.402	0.526

patients, while anti-reflux ablation therapy improved Hill's grading and Barrett's esophagus. The current study focuses on comparing the clinical effects of laparoscopic Dor versus Nissen fundoplication in the treatment of RGERD, addressing the scarcity of direct comparative data and aiming to provide new evidence to optimize surgical strategies.

In this study, overall efficacy rates of laparoscopic Dor and Nissen fundoplication techniques were comparable (86.00% vs. 90.38%). Consistently, a network meta-analysis of randomized controlled trials also revealed no significant differences in long-term outcomes between these two laparoscopic techniques, supporting their equal therapeutic effectiveness [28]. The two procedures also showed no marked differences in perioperative indicators (intraoperative bleeding, operative time, and hospital stay) or the time to symptomatic improvement (reflux, burning epigastric discomfort, and retrosternal pain). This suggests equivalent clinical benefits in RGERD. These findings align with the observations of Schwameis et al. [29], who demonstrated that Nissen fundoplication effectively relieved PPI-refractory heartburn with high patient satisfaction.

The subsequent analysis of esophageal manometry and esophageal pH monitoring dem-

onstrated that both techniques significantly increased IRP and LESP, while decreasing reflux episodes, DeMeester scores, and GERDQ scores. These findings suggest that both procedures exert comparable efficacy in improving esophageal function, relieving esophageal reflux symptoms, and enhancing quality of life. Additionally, no statistical differences were observed between the two groups in terms of in-hospital and 1-year postoperative adverse events such as heartburn, constipation, eructation disorder, acid regurgitation, bloating, and dysphagia, suggesting equivalent short- and long-term clinical safety in RGERD patients. Consistent with our results, Broeders et

al. [30] reported no notable short-term differences between Dor and Nissen fundoplication in esophagitis prevalence, reflux control, or perioperative outcomes. In terms of treatment satisfaction, the two were also comparable (82.00% in the Dor group vs. 76.92% in the Nissen group). Similarly, Gunter RL et al. [31] reported equivalent long-term quality-of-life improvements following Nissen and Toupet fundoplication, further supporting our conclusions.

Based on our observations and clinical experience, laparoscopic Dor fundoplication offers several clinical advantages. It better preserves vagal nerve branches, thereby reducing the risk of postoperative gastroparesis and facilitating faster recovery of gastrointestinal function. Furthermore, this technique maintains physiologic vomiting and belching reflexes while offering broader clinical applicability and reversibility compared to complete fundoplication techniques [32, 33].

This study has several limitations that warrant further investigation. First, the relatively small cohort (102 cases) may have reduced the precision and generalizability of the findings. Second, the economic effects of the two procedures, including treatment costs and cost-effectiveness, were not assessed; future analyses incorporating such economic evaluations

could better clarify their value in healthcare resource allocation. Lastly, long-term prognostic comparisons were not performed; extended follow-up is required to assess the sustained efficacy and safety of both procedures.

Conclusion

Laparoscopic Dor fundoplication and Nissen fundoplication demonstrated similar efficacy in RGERD treatment. Both procedures exhibited equivalent performance in terms of surgical outcomes, symptomatic relief, esophageal function improvement, quality-of-life enhancement, and safety profiles during hospitalization and at 1-year follow-up, with comparable patient satisfaction rates. Dor technique may serve as a clinically valid alternative to conventional Nissen fundoplication for RGERD.

Disclosure of conflict of interest

None.

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References

- [1] Koloski N, Shah A, Kaan I, Ben Jacob R, Talley NJ, Jones MP and Holtmann G. Healthcare utilization patterns: irritable bowel syndrome, inflammatory bowel disease, and gastroesophageal reflux disease. *Dig Dis Sci* 2024; 69: 1626-1635.
- [2] Rettura F, Bronzini F, Campigotto M, Lambiase C, Pancetti A, Berti G, Marchi S, de Bortoli N, Zerbib F, Savarino E and Bellini M. Refractory gastroesophageal reflux disease: a management update. *Front Med (Lausanne)* 2021; 8: 765061.
- [3] Davis TA and Gyawali CP. Refractory gastroesophageal reflux disease: diagnosis and management. *J Neurogastroenterol Motil* 2024; 30: 17-28.
- [4] Gong EJ, Park CH, Jung DH, Kang SH, Lee JY, Lim H and Kim DH; Endoscopic Therapy and Instrument Research Group Under The Korean Society Of Neurogastroenterology and Motility. Efficacy of endoscopic and surgical treatments for gastroesophageal reflux disease: a systematic review and network meta-analysis. *J Pers Med* 2022; 12: 621.
- [5] Danis N and Bor S. The effects of advanced diagnostic methods and disease phenotypes on the response to PPI in patients with gastroesophageal reflux disease. *J Gastrointest Liver Dis* 2025; 34: 17-22.
- [6] Gyawali CP, Yadlapati R, Fass R, Katzka D, Pandolfino J, Savarino E, Sifrim D, Spechler S, Zerbib F, Fox MR, Bhatia S, de Bortoli N, Cho YK, Cisternas D, Chen CL, Cock C, Hani A, Remes Troche JM, Xiao Y, Vaezi MF and Roman S. Updates to the modern diagnosis of GERD: Lyon consensus 2.0. *Gut* 2024; 73: 361-371.
- [7] Chandan S, Mohan BP, Khan SR, Jha LK, Dhaliwal AJ, Bilal M, Aziz M, Canakis A, Arora S, Malik S, Kassab LL, Ponnada S, Bhat I, Hewlett AT, Sharma N, McDonough S and Adler DG. Clinical efficacy and safety of magnetic sphincter augmentation (MSA) and transoral incisionless fundoplication (TIF2) in refractory gastroesophageal reflux disease (GERD): a systematic review and meta-analysis. *Endosc Int Open* 2021; 9: E583-E598.
- [8] Haseeb M, Brown JRG, Hayat U, Bay C, Bain PA, Jirapinyo P and Thompson CC. Impact of second-generation transoral incisionless fundoplication on atypical GERD symptoms: a systematic review and meta-analysis. *Gastrointest Endosc* 2023; 97: 394-406, e2.
- [9] Frazzoni M, Piccoli M, Conigliaro R, Frazzoni L and Melotti G. Laparoscopic fundoplication for gastroesophageal reflux disease. *World J Gastroenterol* 2014; 20: 14272-14279.
- [10] Cao Z, Cai W, Qin M, Zhao H, Yue P and Li Y. Randomized clinical trial of laparoscopic anterior 180 degrees partial versus 360 degrees Nissen fundoplication: 5-year results. *Dis Esophagus* 2012; 25: 114-120.
- [11] Broeders JA, Broeders EA, Watson DI, Devitt PG, Holloway RH and Jamieson GG. Objective outcomes 14 years after laparoscopic anterior 180-degree partial versus nissen fundoplication: results from a randomized trial. *Ann Surg* 2013; 258: 233-239.
- [12] Broeders JA, Roks DJ, Ahmed Ali U, Watson DI, Baigrie RJ, Cao Z, Hartmann J and Maddern GJ. Laparoscopic anterior 180-degree versus nissen fundoplication for gastroesophageal reflux disease: systematic review and meta-analysis of randomized clinical trials. *Ann Surg* 2013; 257: 850-859.
- [13] Pereira PF, Rosa AR, Mesquita LA, Anzolch MJ, Branchi RN, Giongo AL, Paixao FC, Chedid MF and Krueel CD. Esophagogastric junction outflow obstruction successfully treated with laparoscopic Heller myotomy and Dor fundoplication: First case report in the literature. *World J Gastrointest Surg* 2019; 11: 112-116.
- [14] Barron JO, Tasnim S, Toth AJ, Sudarshan M, Sanaka M, Ramji S, Adhikari S, Murthy SC, Blackstone EH and Raja S; Cleveland Clinic Esophageal Research Group. The value of fundoplication in the treatment of type I achalasia. *Ann Thorac Surg* 2024; 117: 594-601.

- [15] Patel A and Yadlapati R. Diagnosis and management of refractory gastroesophageal reflux disease. *Gastroenterol Hepatol (N Y)* 2021; 17: 305-315.
- [16] Sisik A, Dalkilic MS, Gencturk M, Yilmaz M, Erdem H and Nguyen NT. Correlation of the endoscopic esophagogastric junction integrity with symptomatic GERD in patients undergoing work-up for metabolic and bariatric surgery. *Obes Surg* 2025; 35: 122-130.
- [17] Garg R, Mohammed A, Singh A, Schleicher M, Thota PN, Rustagi T and Sanaka MR. Anti-reflux mucosectomy for refractory gastroesophageal reflux disease: a systematic review and meta-analysis. *Endosc Int Open* 2022; 10: E854-E864.
- [18] Morales MP, Wheeler AA, Ramaswamy A, Scott JS and de la Torre RA. Laparoscopic revisional surgery after Roux-en-Y gastric bypass and sleeve gastrectomy. *Surg Obes Relat Dis* 2010; 6: 485-490.
- [19] Zerbib F, Bredenoord AJ, Fass R, Kahrilas PJ, Roman S, Savarino E, Sifrim D, Vaezi M, Yadlapati R and Gyawali CP. ESNM/ANMS consensus paper: diagnosis and management of refractory gastro-esophageal reflux disease. *Neurogastroenterol Motil* 2021; 33: e14075.
- [20] Zhang Y, Chen Q, Yang L, Zhou Z and Liu X. A study on the esophageal dynamics in patients with gastroesophageal reflux disease and with refractory cough undergoing esophageal high-resolution manometry. *Am J Transl Res* 2021; 13: 9546-9553.
- [21] Gharib A, Forootan M, Sharifzadeh M, Abdi S, Darvishi M and Eghbali A. Diagnostic efficacy of 24-hr esophageal pH monitoring in patients with refractory gastroesophageal reflux disease. *Open Access Maced J Med Sci* 2018; 6: 1235-1238.
- [22] Li P, Tang Y, Liu L, Yang L, Yang L, Sun Z and Gong Y. The diagnostic criteria for psychosomatic research-revised (DCPR-R) in a National China multicenter cohort of patients with irritable bowel syndrome and overlapping gastroesophageal reflux disease. *BMC Gastroenterol* 2025; 25: 136.
- [23] Vaezi MF, Fass R, Vakil N, Reasner DS, Mittleman RS, Hall M, Shao JZ, Chen Y, Lane L, Gates AM and Currie MG. IW-3718 Reduces heartburn severity in patients with refractory gastroesophageal reflux disease in a randomized trial. *Gastroenterology* 2020; 158: 2093-2103.
- [24] Wang Y, Lv M, Lin L and Jiang L. Randomized controlled trial of anti-reflux mucosectomy versus radiofrequency energy delivery for proton pump inhibitor-refractory gastroesophageal reflux disease. *J Neurogastroenterol Motil* 2023; 29: 306-313.
- [25] Sumi K, Inoue H, Ando R, Fujiyoshi MRA, Fujiyoshi Y, Tanabe M, Shimamura Y and Onimaru M. Long-term efficacy of antireflux mucosectomy in patients with refractory gastroesophageal reflux disease. *Dig Endosc* 2024; 36: 305-313.
- [26] Harper S, Kartha M, Mealing S, Borbely YM and Zehetner J. Cost-effectiveness of the Re-fluxStop device for management of refractory gastroesophageal reflux disease in Switzerland. *J Med Econ* 2024; 27: 805-815.
- [27] Lee AY, Kim SH and Cho JY. Comparing the feasibility, safety, and efficacy of Stretta radiofrequency and antireflux ablation therapy for treating patients with refractory gastroesophageal reflux disease: a retrospective, single-center cohort study. *Gastrointest Endosc* 2025; [Epub ahead of print].
- [28] Lee Y, Tahir U, Tessier L, Yang K, Hassan T, Dang J, Kroh M and Hong D. Long-term outcomes following Dor, Toupet, and Nissen fundoplication: a network meta-analysis of randomized controlled trials. *Surg Endosc* 2023; 37: 5052-5064.
- [29] Schwameis K, Oh D, Green KM, Lin B, Zehetner J, Lipham JC, Hagen JA and DeMeester SR. Clinical outcome after laparoscopic Nissen fundoplication in patients with GERD and PPI refractory heartburn. *Dis Esophagus* 2020; 33: doz099.
- [30] Broeders JA, Roks DJ, Ahmed Ali U, Draaisma WA, Smout AJ and Hazebroek EJ. Laparoscopic anterior versus posterior fundoplication for gastroesophageal reflux disease: systematic review and meta-analysis of randomized clinical trials. *Ann Surg* 2011; 254: 39-47.
- [31] Gunter RL, Shada AL, Funk LM, Wang X, Greenberg JA and Lidor AO. Long-term quality of life outcomes following nissen versus toupet fundoplication in patients with gastroesophageal reflux disease. *J Laparoendosc Adv Surg Tech A* 2017; 27: 931-936.
- [32] Memon MA, Subramanya MS, Hossain MB, Yunus RM, Khan S and Memon B. Laparoscopic anterior versus posterior fundoplication for gastro-esophageal reflux disease: a meta-analysis and systematic review. *World J Surg* 2015; 39: 981-996.
- [33] Chrysos E, Athanasakis E, Pechlivanides G, Tzortzinis A, Mantides A and Xynos E. The effect of total and anterior partial fundoplication on antireflux mechanisms of the gastroesophageal junction. *Am J Surg* 2004; 188: 39-44.