

Article

# Efficacy and Safety of Dor Fundoplication in Patients with Severe Gastroparesis and Refractory Gastroesophageal Reflux Disease

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**Abstract:** Poor quality of life is a major problem in patients with gastroesophageal reflux disease (GERD). Delayed gastric emptying in patients with severe gastroparesis (GP) worsens GERD symptoms and particularly nocturnal heartburn and regurgitation refractory to medical therapy. With limited therapeutic options, a Nissen fundoplication may be considered but concerns for this surgery are inability to wretch and vomit post-op, increasing the risk of wrap rupture. Dor fundoplication, a 180–200 degree anterior wrap, may improve sphincter competency and provide symptom relieve while minimizing these concerns and avoiding vagal nerve damage.

Keywords: Dor fundoplication; GERD; gastroparesis

# 1. Introduction

Gastroesophageal reflux disease (GERD) is characterized by heart burn and regurgitation resulting from gastric acid and also non-acid contents flowing back through an incompetent lower esophageal sphincter causing mucosal irritation. GERD often is controlled by an antacid or PPI [1]. However GERD symptoms can be refractory to conservative medical treatment i.e., the occurrence of GERD symptoms nocturnally, specifically regurgitation and coughing in the setting of anti-reflux therapy indicates that the medical treatment is failing. Gastroparesis (GP) is a syndrome of delayed gastric emptying without any evidence of gastric obstruction where nausea and vomiting are the cardinal symptoms [2]. When refractory GERD is combined with severe gastroparesis, the quality of life becomes very debilitating particularly due to severe nocturnal symptoms and a surgical intervention may be required to relieve patients' symptoms [3]. Several surgical techniques have been described to help with refractory GERD including Nissen (complete) fundoplication, Dor (anterior) partial fundoplication, and Toupet (posterior) partial fundoplication [4]. In addition, surgical approaches to manage refractory gastroparesis include gastric electrical stimulation, pyloroplasty and total gastrectomy [5,6]. Yet, there have been no studies addressing a surgical approach for combination of refractory GERD and severe GP. The theory behind the Dor partial fundoplication concept is that GP patients may need to vomit or retch from time to time; however, it is not possible with the standard Nissen fundoplication and it may even lead to rupture of the wrap. In addition, the Dor partial fundoplication will minimize gas-bloat syndrome, a very common complication of standard fundoplication because burping and belching is difficult. The possibility that vagal nerve damage could occur is markedly reduced by the anterior Dor surgical technique. Therefore, we sought to study the safety and efficacy of a laparoscopic surgical approach to perform a (Dor fundoplication (DF), Pyloroplasty (PP) and gastric electrical stimulation (GES) placement) for the combination of refractory GERD and severe GP.



#### The Surgical Technique

Anterior 180-degree fundoplication was originally described by the surgeon Dor in 1962 as an adjunct to reduce complications of reflux in patients undergoing simultaneous Heller myotomy for achalasia [7]. Laparoscopic anterior fundoplication was reported in conjunction with the Heller in the 1990s, Watson et al. 2000 [8], analyzed long-term outcomes of laparoscopic anterior 180-degree fundoplication. Our study group modified this procedure using a robotic-assisted approach to create a fundoplication that covers the anterior and right esophagus and anchors the fundus to the right hiatal rim.

Anterior Dor 180- degree fundoplication begins with a similar technique to the laparoscopic and robotic approaches to the Nissen. A robotic vessel sealer and electro-cautery shears complete the sharp dissection of the hiatus. The gastro-hepatic ligament is initially opened to find the right crus and dissection is continued anteriorly to the level of the left gastric artery. Sharp dissection is continued anteriorly across the apex of the hiatus to expose the left crus to the base of the angle of His. The anterior dissection of the esophagus is completed extending into the anterior mediastinum in order to ensure adequate intra-abdominal esophageal length. The posterior phreno-esphageal ligament is not routinely dissected, especially in the absence of a hiatus hernia. Any apparent herniation or diastasis of the anterior crural pillars is repaired with interrupted braided non-absorbable sutures.

Following dissection of the crural pillars and esophagus, anterior 180-degree Dor fundoplication is created by suturing the anterior wall of the gastric fundus to the left and right crural pillars and the diaphragmatic hiatus. A mobile portion of gastric fundus approximately 3 centimeters caudal and lateral to the gastro-esophageal junction is manipulated so that it loosely rests across the front of the esophagus. A loose wrap should be mobile enough to reach the base of the right crural pillar without division of the short gastric vessels.

Seromuscular stitches are placed through the right side of the fundus and through the adjacent left crural pillar to recreate the angle of His. An apex suture is placed through the top of the fundus and the apex of the diaphragmatic hiatus. The posterior left fundus is then sutured to the right hiatal pillar to the level of the left gastric artery to complete the 180-degree fundoplication (see Figure 1). There is no indication to use a rubber esophageal Bougie since there is no risk of esophageal stenosis. We routinely then performed an upper GI endoscopy to examine the partial fundoplication and rule out esophageal or gastric injury (see Figure 2). The patient starts on a clear liquid diet the evening of surgery and is discharged without oral intolerance or dysphagia on post-operative day 3 without complications.



Figure 1. Dor fundoplication being performed laparoscopically.



Figure 2. Intraoperative image showing endoscopic retroflexion view of the Dor wrap.

Ethical approval: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent: Informed consent was obtained from all individual participants included in the study.

## 2. Results

Six patients (83.3% females), mean age of 49.9 (33-65) with gastroparesis documented by a 4-h scintigraphic study, one of diabetic etiology and five regarded as idiopathic in etiology underwent simultaneous GES, PP and DF for drug refractory GP and GERD, from October 2015 to August 2018. The patients were referred to us with a symptom duration that ranged from 2 to 8 years despite being on maximum medical therapy which included lifestyle modification, dietary changes, metoclopramide, domperidone, erythromycin and high dose proton pump inhibitors twice daily. The mean duration of post-surgical follow up was 19.7 (4–33) months. All patients had esophagogastroduodenoscopy (EGD) before surgery. Three patients had hiatal hernia less than three centimeters. The other three had no hernia. They had esophageal and gastric biopsies that were negative for eosinophilic esophagitis and H pylori, respectively. Endoscopic evaluation post operatively showed no esophagitis or hernia in all patients. The wrap was patent and there was evidence of surgical pyloroplasty seen in the pylorus. Patients rated their heartburn and regurgitation on a PAGI-SYM scale of 0–5 (0—none; 5—very severe) before and after the surgery. The average nocturnal heartburn score of 3.4 and daytime score of 2.6 were both significantly reduced post-surgery to 2.5 (t = 2.25, p = 0.033). Heartburn severity was also significantly less after surgery, t = 2.97 (p = 0.008). Prior to fundoplication, the mean regurgitation scores of 3.8 nocturnally and 3.6 when in the upright position improved to 2.2 and 2, respectively, post-surgery. Based on their global assessment, all patients indicated a symptom improvement of >50% post-op, with

the dominant change being a reduction in nocturnal regurgitation (Table 1). Based on their motility studies, patients had low lower esophageal sphincter pressure (mean 6 mmHg, normal is 10–40 mmHg based on our equipment). Their pH testing confirmed abnormal day time and night time reflux of acid despite being on maximum medical therapy. There was no complication either immediately post-op or upon long term follow up (up to 33 months); specifically, none of the patients reported an inability to belch, new onset dysphagia or odynophagia or rupture of the wrap. Following the pyloroplasty and implantation of GES device, there was a significant acceleration in the gastric emptying. Pre-op mean gastric retention at 1 h, 2 h and 4 h was 79.1%, 62.6% and 31.3% respectively while post-op average gastric retention at 1 h, 2 h and 4 h was 72.8%, 47.1% and 16.1% respectively. Two patients particularly had normalized their gastric emptying (less than 10% retention of the isotope at 4 h).

	Pre-op				Post-op			
Patient/Symptoms	DHB	NHB	DR	NR	DHB	NHB	DR	NR
Patient 1	1	4	4	4	1	1	0	0
Patient 2	1	2	2	3	2	2	2	2
Patient 3	4	4	5	5	4	4	3	4
Patient 4	5	5	5	5	4	4	1	1
Patient 5	2	2	2	2	1	1	2	2
Patient 6	3	3	4	4	3	3	4	4
Mean Score	2.6	3.4	3.6	3.8	2.5	2.5	2	2.2

**Table 1.** Baseline and post-operative symptoms of patients with gastroparesis and GERD, showing significant improvement in nocturnal regurgitation post-operatively. DHB: day time heartburn, NHB: nocturnal heartburn, DR: day time regurgitation, NR: nocturnal regurgitation.

#### 3. Discussion

In this study, we demonstrated that Dor fundoplication can be performed safely in patients with refractory GERD in the setting of severe GP. No postoperative complications were reported. Furthermore all patients reported symptom improvement. Both heartburn and regurgitation scores improved significantly after the procedure, particularly nocturnal regurgitation symptoms including coughing, which was a major goal of this surgery. During a mean follow up of 19.7 months, no serious complication was reported and none of the patients required repeat surgery. Although Nissen fundoplication could have been considered for refractory GERD, a prior study showed that gastroparesis symptoms related to the gas bloat syndrome become more prominent after Nissen fundoplication [9]. A Nissen fundoplication leads to the inability to retch and vomit post-op, increasing the risk of wrap rupture particularly in the setting of a gastroparesis patient. On the other hand, Dor fundoplication (DF), a 180–200 degree anterior wrap, improves lower esophageal sphincter competency and provides symptom relief while minimizing these concerns, avoiding the risk of vagal nerve damage and development of new onset dysphagia. An important contributing factor to the improvement of GERD symptoms was the acceleration of gastric emptying which, in two cases, actually normalized after the PP&GES, thus reducing the volume of reflux that could regurgitate into the esophagus particularly in the evening. A follow-up upper endoscopy showed mild erythema at the GE junction in two patients as well as endoscopic evidence of the DOR and all patients demonstrating the expected findings of a post pyloroplasty, open pylorus.

#### Limitations

This is the first study that investigated the safety and efficacy of simultaneous GES, PP and DF for drug refractory GP and GERD symptoms utilizing a single surgeon and gastroenterologist and with long-term follow up. However, it has some limitations, including the relatively small sample size,

which can be attributed to the fact that this was a single-center study. Multi-center clinical trials with larger patient numbers in the future will help validate the results of this study.

# 4. Materials and Methods

We performed a chart review of 6 patients who were under the ongoing care of one of the authors (Dr. Richard McCallum) who had refractory GERD defined as persistent heartburn, mostly nocturnal heartburn, despite being on maximum medical therapy with high-dose proton pump inhibitors twice daily and life style modification, and severe GP undergoing a simultaneous (PP) using Heineke-Mikulicz approach, placement of (GES) system, as well as an accompanying DF (Figure 1) to address heartburn and regurgitation not responding to medical therapy and dominated by nocturnal symptoms. The surgical approach of Dor fundoplication is detailed below. The surgeon starts with performing pyloroplasty, then, Dor fundoplication is done before placing the gastric electrical stimulator. Baseline clinical characteristics were reviewed and recorded. To determine the efficacy of our surgical approach, we used patient assessment of upper gastrointestinal disorder- symptom severity index (PAGI-SYM [10]) to assess GP and GERD symptoms before surgery and at the follow up visits.

## 5. Conclusions

Based on this clinical experience including follow up data, the Dor fundoplication (180–200 degree anterior wrap) performed for refractory GERD in the setting of severe GP significantly decreases heartburn and regurgitation, specifically nocturnally, thus improving the quality of life without accompanying complications and therefore offers a major advance in managing refractory GERD in this specific clinical setting.

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