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Laparoscopic Collis gastroplasty and Nissen fundoplication

A new technique for the management of esophageal foreshortening

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Abstract
Background: The short esophagus increases the difficulty and limits the effectiveness of laparoscopic Nissen fundoplication. In our experience, ~20–25% of esophagi judged by preoperative criteria to be foreshortened will, after dissection, be insufficiently long to allow 2 cm of esophagus to reside below the diaphragm without inferior distraction (i.e., tension free). Collis gastroplasty combined with Nissen fundoplication has become the standard approach for the creation of an intraabdominal neoesophagus and fundic wrap.
Methods: After developing methods of performing totally laparoscopic stapled gastroplasty in the cadaver lab in 1994, we started applying the technique clinically in 1996. We performed 220 laparoscopic antireflux procedures between January 1996 and July 1997. Of these 220 patients, 26% were suspected to have esophageal foreshortening based on preoperative barium studies and/or endoscopy.
Results: After hiatal dissection, nine patients, or 16% of those suspected to have esophageal foreshortening and 4% of the entire population, required the laparoscopic Collis-Nissen procedure. There was symptomatic improvement in all patients as assessed by patient-initiated symptom scores.
Conclusions: The management of patients with esophageal foreshortening is a complex problem. We believe that our technique of laparoscopic Collis-Nissen provides an effective means of achieving intraabdominal placement of the fundic wrap while maintaining the benefits of a minimally invasive approach.

Key words: Hiatal hernia — Paraesophageal hernia — Gastroesophageal junction — Esophageal stricture — Collis gastroplasty — Laparoscopic Nissen fundoplication

The shortened esophagus not only increases the difficulty but also limits the effectiveness of laparoscopic Nissen fundoplication. It has long been known to complicate the work of anti-reflux surgery and paraesophageal hernia repair. Esophageal foreshortening is found more frequently in association with a gastroesophageal (GE) junction that is >5 cm above the hiatus on barium swallow, esophageal stricture, type III (mixed) paraesophageal hernia, and Barrett's esophagus (with or without stricture) [8]. Even when these preoperative findings are noted, it is often difficult to predict which patients will have a truly foreshortened esophagus, because the esophagus, when adequately mobilized and transposed to the anterior hiatus, is still long enough to allow the GE junction to reside below the hiatus without tension. Previous investigators have demonstrated that only ~20% of esophagi believed preoperatively to be foreshortened will prove to be foreshortened intraoperatively [11].

Collis gastroplasty in combination with complete or partial fundoplication has become the standard approach to create an antireflux valve in patients with esophageal foreshortening. Collis originally described the performance of gastroplasty through a thoracoabdominal incision; however, it is now usually performed with a transthoracic approach and followed by a partial (Belsey) or complete (Nissen) fundoplication [2]. Traditional teaching has emphasized the need for extensive mediastinal dissection in order to adequately mobilize the esophagus for a tension-free transthoracic repair [1]. Though it provides adequate exposure, thoracotomy subjects patients to significant pain and morbidity. The desire to avoid inconvenience to the patient led to the development of abdominal gastroplasty techniques by Steichen and Henderson and Marryatt to manage the shortened esophagus [4, 10].

Two descriptions have been published of thoracoscopic Collis gastroplasty combined with laparoscopic fundoplication [3, 11]. Because of the additional requirements of thoracoscopy (e.g., double-lumen anesthesia, additional video-endoscopic equipment, chest preparation), we have developed a laparoscopic approach to esophageal lengthening. Our technique and results are described in this report.

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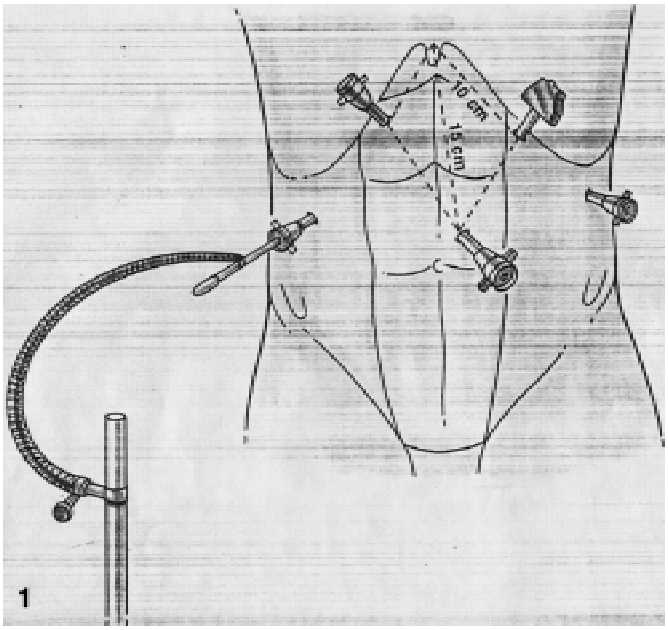
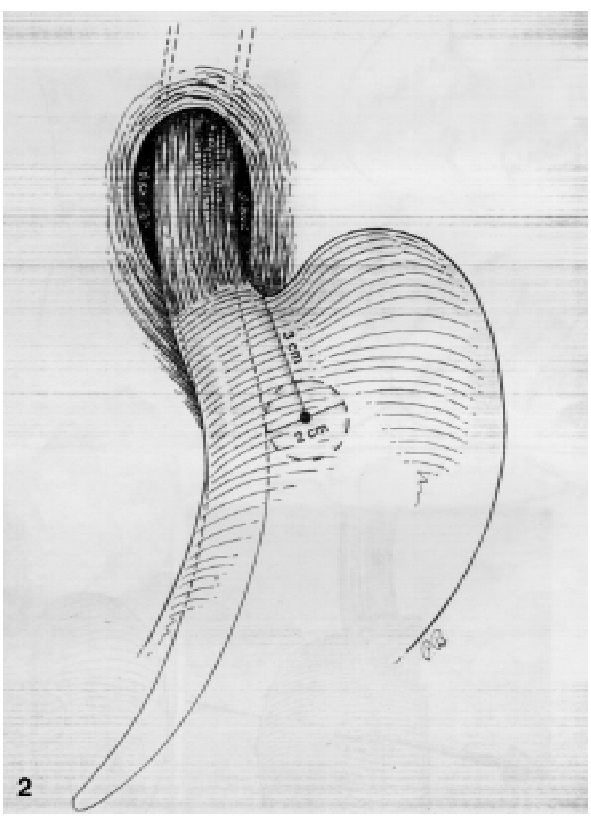
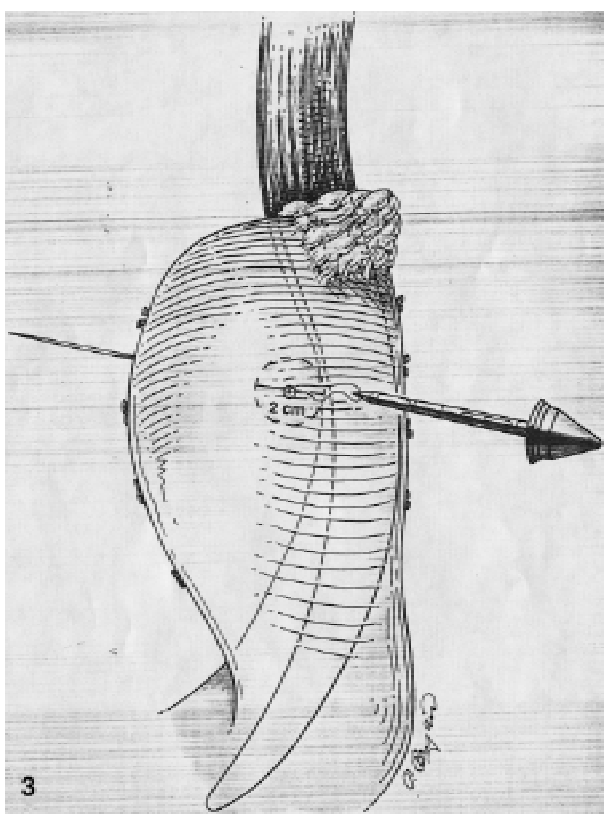


Fig. 1. Trocars are placed in the baseball diamond configuration with the 5-mm right epigastric and 12-mm left epigastric operating ports in the third and first base positions, respectively. There is also a 10-mm camera port to the left of the umbilicus, a 5-mm right subcostal port, and a 5-mm left subcostal port.

Fig. 2. A 48-Fr dilator is placed to calibrate the width of the gastric tube. The burn mark is placed 3 cm inferior to the angle of His and 1 cm away from the dilator.

Fig. 3. The Keith needle and attached anvil is passed through the posterior wall of the stomach 1 cm away from the dilator.

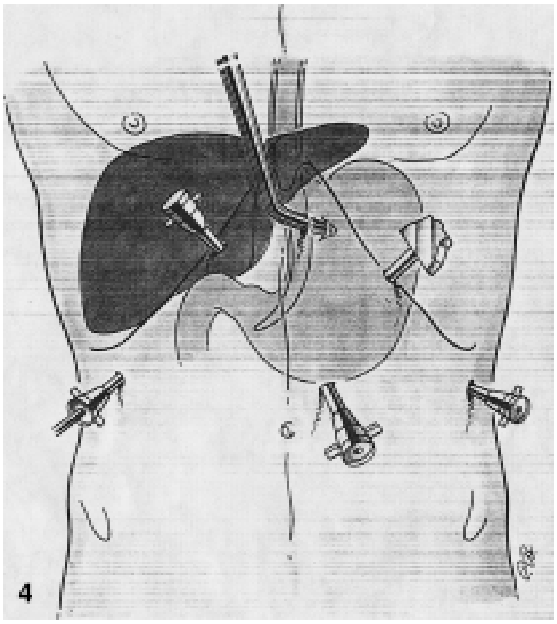


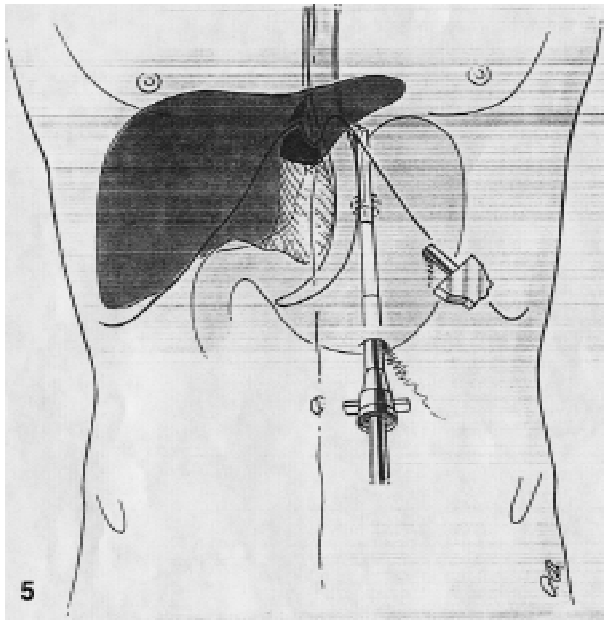


Technique

The laparoscopic Collis gastroplasty was developed in the fresh-tissue laboratory by one of our group (M.O.) in 1994 [7]. The technique utilizes the same five trocars and trocar positions as laparoscopic Nissen fundoplication (Fig. 1) [5]. The initial dissection technique is also identical to that used for uncomplicated fundoplication. The hiatal hernia is reduced, and the hernia sac is dissected from the crura. The gastric fundus is mobilized from the spleen and the left hemidiaphragm by dividing the short gastric vessels, the posterior gastric artery, and all posterior gastrophrenic attachments. The retroesophageal window is developed, and a Penrose drain encircles the esophagus. This maneuver provides optimal inferior traction for esophageal dissection in the mediastinum.

Dissection proceeds into the meddiastinum for 4–6 cm. It is occasionally possible to mobilize the entire distal third





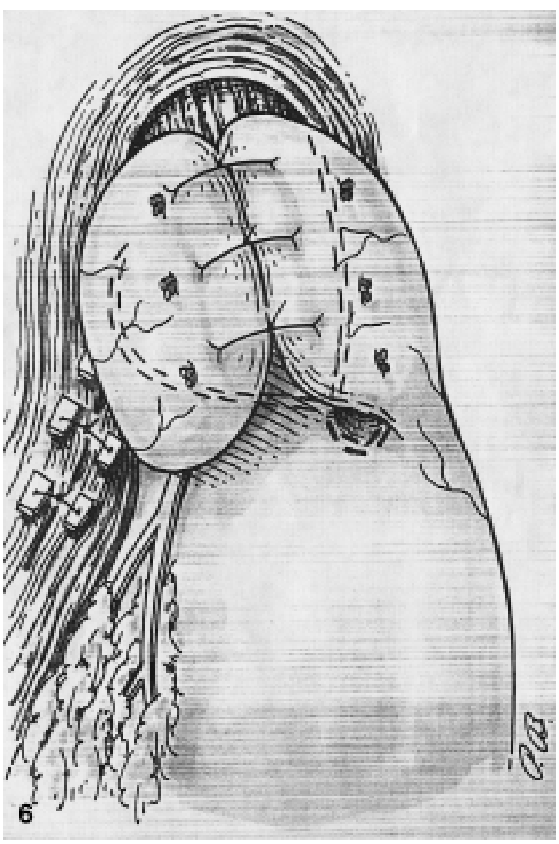


Fig. 4. The 21-mm circular stapler is introduced through an incision to the left of the xiphoid and then docked with the anvil to create a sealed gastric window.

Fig. 5. A 30-mm endoscopic stapler is inserted and fired adjacent to the dilator, thus lengthening the esophagus by 4 cm.

Fig. 6. The completed wrap with the fundic staple line behind the esophagus. The apex of the staple line abuts the esophagus on the right. Fundoplication sutures are placed on either side of the staple line.

of the esophagus through the hiatus laparoscopically. It is difficult to mobilize higher than this in most patients, since access to the mediastinal esophagus is limited by anterior deflection of the esophagus around the heart and close apposition of the pleura to the middle third of the esophagus. Once the esophagus is completely mobilized, it is verified that the GE junction cannot be adequately reduced to allow 2 cm of esophagus to reside in the abdomen without tension. If the Penrose drain creeps above the hiatus after release, a Collis gastroplasty should be performed.

Next, it is extremely important to remove the hernia sac and epiphrenic fat from the angle of His anteriorly and posteriorly. We find that the Ultracision LCS (Smithfield, RI, USA) accomplishes this task bloodlessly. When it be-

comes clear that esophageal lengthening is necessary, the 10-mm laparoscope port (above and to the left of the umbilicus) is replaced with a 12-mm trocar to accommodate the linear cutting stapler. A 48-Fr dilator is placed to calibrate the width of the gastric tube (Fig. 2). A burn mark is then placed 3 cm inferior to the angle of His and 1 cm from the dilator on the anterior wall of the stomach to indicate the exit point of the anvil of a 21-mm circular stapler. This procedure will create a 4-cm ''neoesophagus.''

A 2-cm vertical mini-laparotomy is made just to the left and slightly inferior to the xiphoid and divided down through the peritoneum with electrocautery. The mini-laparotomy is dilated with a large hemostat. A 2-0 Prolene suture on a Keith needle is attached to the open hole on the plastic skewer of a 21-mm circular cutting anvil (CLH-21; Ethicon Endosurgery, Cincinnati, OH, USA) and popped into the peritoneal cavity through this mini-laparotomy. The skin is closed with towel clips in order to maintain the pneumoperitoneum.

The anvil is placed in the lesser sac by elevating the well mobilized gastric fundus. The greater curvature of the stomach is held anteriorly with two graspers. The Keith needle and attached anvil are then passed through the posterior wall of the stomach, exiting the anterior wall of the stomach at the burn mark 1 cm away from the dilator (Fig. 3). The body of the 21-mm circular stapler is introduced through the xiphoid incision, docked with the anvil, and fired to create a sealed window through both gastric walls (Fig. 4). The laparoscope is shifted to the left subcostal position, and a 30-mm linear cutting stapler (Ethicon Endosurgery) is inserted through the primary trocar near the umbilicus and fired adjacent to the dilator (Fig. 5).

The staple line is oversewn with two running vertical mattress sutures of 2-0 braided nylon, one starting at the GE junction and one starting at the distal margin of the staple line on the fundus. This suture reinforcement of the staple line may not be essential, but it provides additional security against leak or bleeding. The sutures are tied to each other when they meet in the region of the circular staple line. After an appropriate crural closure, a 2-cm floppy Nissen fundoplication is sutured. The fundic staple line lies behind the esophagus, with its apex becoming the middle point of the fundic suture line to the right of the esophagus (Fig. 6).

Clinical experience

Our technique of laparoscopic Collis-Nissen was performed in nine patients between January 1996 and July 1997 (Table 1). Large hiatal hernias were present in all patients. Two patients had intrathoracic stomachs, and both of these patients had esophageal strictures requiring dilation. There has been symptomatic improvement in all patients in whom we have utilized this technique; however, one patient suffered a recurrence of moderate dysphagia from a distal esophageal stricture present before the operation. This patient has responded to dilation and standard doses of omeprazole, a dosage that did not control his heartburn preoperatively. We believe that the additional length of this patient's esophagus may be contributing to symptom control, since endoscopic examination suggests that the fundoplication may have come apart.

Table 1. Patient demographics

Patient no.	Age/ sex	Cause	O.R. time (min)	Length of stay (days)	Complications
1	70/F	Large HH/stricture	285	6	atelectasis
2	35/M	HH/stricture	351	3	none
3	65/M	Para HH/stricture	289	2	none
4	83/M	Large Para HH	394	4	A-fib
5	48/M	Large HH/esophagitis	332	2	none
6	67/M	Large HH/stricture	210	3	none
7	69/F	Para HH/stricture	232	2	none
8	68/M	Para HH	287	2	none
9	57/F	HH/stricture	269	3	none

Para, paraesophageal; HH, hiatal hernia

Between January 1996, when we performed the first Collis gastroplasty, and July 1997, we did a total of 220 laparoscopic antireflux procedures. Of this population, ~58 patients (26%) were suspected to have esophageal foreshortening prior to surgery. Of these 58, nine patients (16% of those suspected, 4% of entire population) required esophageal lengthening with a laparoscopic Collis gastroplasty. As compared to a group of patients that underwent laparoscopic fundoplication, operative time was longer and length of stay was longer, but there was no additional morbidity. Using a five-point patient-initiated symptom score pre- and postoperatively (0 = no symptoms, 1 = rare symptoms, 2 = moderate symptoms, 3 = severe symptoms, 4 = inccapacitating symptoms), we found no differences in clinical response between these patients and our control group of 300 patients undergoing Nissen fundoplication (Table 2) [6].

Discussion

Laparoscopic Nissen fundoplication has become a routine procedure; many centers have reported >200 procedures. In most centers, Collis gastroplasty is not considered necessary. Our development of the Collis gastroplasty technique started in the cadaver lab shortly after we had reached 100 procedures and was not applied until we had reached 400 procedures. We believed that this additional procedure was occasionally necessary because of the high rate of paraesophageal herniation following laparoscopic Nissen fundoplication reported by others as well as ourselves (range, 3–8%) [6, 13]. One of the avoidable causes of postoperative paraesophageal hernia is the need to ensure adequate esophageal length to allow the GE junction to reside in the abdomen without tension. When we specifically looked for a cause of paraesophageal herniation among the 3% of our patients that developed this problem, esophageal foreshortening contributed in less than a third of patients (1%). While it may be enticing to attribute the high frequency of postoperative dysphagia reported during the learning curve of laparoscopic fundoplication to a short esophagus and paraesophageal herniation, this does not appear to be the case. In most cases, persistent postoperative dysphagia occurs be-

Table 2. Typical symptoms pre- and postoperatively of Collis-Nissen patients ($n = 9$) and population undergoing laparoscopic fundoplication ($n = 300$) 1 year following operation

	Preop						Postop					
	Collis-Nissen ($n = 9$)			Nissen ($n = 253$)			Collis-Nissen ($n = 9$)			Nissen ($n = 253$)		
SSS[a]	0–1	2	3–4	0–1	2	3–4	0–1	2	3–4	0–1	2	3–4
Heartburn	56%	0	44%	21%	22%	70%	89%	11%	0	92%	4%	4%
Regurgitation	49%	22%	33%	56%	13%	31%	100%	0	0	95%	3%	2%
Dysphagia	78%	11%	11%	62%	13%	31%	89%	11%	0	88%	7%	5%

[a] Symptom Severity Score (SSS): 0 = no symptoms, 1 = rare symptoms, 2 = moderate symptoms, 3 = severe symptoms, 4 = incapacitating symptoms

cause the fundoplication has been misformed. In our experience, most of these patients have had the Rosetti modification of the Nissen fundoplication [12].

The key to managing patients with esophageal foreshortening is making an accurate intraoperative determination that the esophagus is truly foreshortened. After dissecting 4–6 cm up into the mediastinum with the GE junction retracted inferiorly, the esophagus is transposed to the anterior hiatus and released. If it springs back to the diaphragm or above, it is too short and should be lengthened. Preoperatively, a short esophagus was predicted in 16% of patients who met liberal preop criteria; this group represents 4% of our entire population. In another series, a 14% incidence of esophageal foreshortening was predicted by preoperative criteria, of which 9% (1.2% of the patient population) required esophageal lengthening with a thoracoscopic Collis gastroplasty [11].

With our technique, considerable time may be required to oversew the gastric staple lines. The staple line of the gastroplasty may not need to be oversewn; however, it adds additional security in preventing gastric leakage, since the endoscopic linear cutting staples are only 3.5 mm long as opposed to the 4.8-mm staple length generally used on the stomach. A running vertical mattress suture has been most effective for oversewing these staple lines.

Two other minimally invasive techniques of performing Collis gastroplasty have been described [3, 11]. In the first technique, the usual subdiaphragmatic and mediastinal dissection for laparoscopic fundoplication is performed with laparoscopic visualization, followed by right thoracoscopy and placement of the linear stapler for the gastroplasty through a second port. This maneuver facilitates the placement of the stapler at the angle of His in the proper orientation. Crural closure and fundic wrap are then completed laparoscopically [11]. In the second technique, the entire procedure is performed with left thoracoscopic access. The gastroplasty is created using a noncutting linear stapler, followed by fundic wrap and reduction below the diaphragm [3]. Although these techniques recapitulate the standard open surgical techniques, they require single-lung ventilation, chest preparation, two video carts, thoracotomy privileges, and the increased pain associated with thoracoscopy. These disadvantages can be avoided if laparoscopic Collis gastroplasty is performed instead.

Certainly, other traditional approaches for the performance of Collis gastroplasty should not be neglected. Although most surgeons perform this procedure through a left thoracotomy, the technique performed by Steichen through a laparotomy yields equivalent results [10]. Although our preferred access is laparoscopic in patients without previous operation, in one patient we elected to perform Collis gastroplasty through a laparotomy because the patient had previously undergone open fundoplication. It is generally most expedient to perform redo surgery through a laparotomy if the first operation was performed through a laparotomy. Another very acceptable approach is to convert a laparoscopic Nissen to an open Collis-Nissen when esophageal foreshortening is discovered intraoperatively. It is more important that the operation be performed correctly than that laparoscopic access be maintained. Because we developed this technique in the cadaver lab and practiced multiple times in both the pig and human cadaver, it was not necessary for us to convert any of our cases.

The surgical management of patients with esophageal foreshortening is a complex problem. In patients with extremely poor esophageal motility and a tight stricture, segmental esophagectomy is often the optimal therapy [8]. When esophageal motility is poor and the esophagus is short but there is no stricture, the Collis gastroplasty may be combined with a posterior partial fundoplication. Less definitive approaches, such as gastropexy with crural closure and mediastinal positioning of the fundoplication, result in unacceptably high recurrence rates and postoperative discomfort. Most authors agree that in order to obtain the best results, the fundoplication following gastroplasty must be placed below the diaphragm and under no tension [9]. We believe that our technique of laparoscopic Collis-Nissen provides an effective means of managing patients with a foreshortened esophagus while also offering the advantages of a minimally invasive approach.

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