

Laparoscopic Technique for Performing Duodenal Switch with Gastric Reduction

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Background: The duodenal switch procedure with gastric reduction (DS) is a hybrid procedure for morbid obesity that combines moderate intake restriction with moderate malabsorption. This report describes the laparoscopic hand-assisted technique for the duodenal switch procedure (LapDS).

Methods: Restriction is achieved via a greater curvature gastrectomy, reducing gastric capacity to 120 ml. The malabsorptive component is constructed by dividing the duodenum 4 cm distal to the pylorus and anastomosing the proximal duodenum to the distal 250 cm of ileum. The biliopancreatic limb is anastomosed to create a 100 cm common channel. Laparoscopic cholecystectomy, cholangiogram, liver biopsy and appendectomy are performed in conjunction with DS.

Results: 345 LapDS procedures (27 lap-assisted; 318 hand-assisted) were performed between September 1999 and February 2002. There were 299 women and 46 men with a mean age of 43 years (range 19-67 years). Mean BMI was 50 (range 36-118 kg/m²). Mean operating time was 201 minutes (range 105-480). The median length of hospital stay was 3.0 days (range 2-22 days, excluding one outlier). There were 7 conversions to open laparotomy, 14 reoperations, and 21 readmissions. There were 3 pulmonary emboli, 2 deep venous thromboses, and 4 perioperative proximal anastomotic strictures. There were no deaths. Mean percent excess weight loss at 6, 18, and 24 months was 51%, 89%, and 91%, respectively.

Conclusion: Laparoscopic assisted duodenal switch procedure can be performed safely with acceptable operative times and without excess morbidity or mortality.

Key words: Duodenal switch, biliopancreatic diversion, laparoscopic surgery, morbid obesity, bariatric surgery, hand-assisted laparoscopic surgery

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Introduction

Coincident with increasing public awareness and technical improvements in facilities and equipment, laparoscopic surgery for morbid obesity has become more widely employed. Recent advances include the application of laparoscopic technique to the Duodenal Switch;^{1,2} the Roux-en-Y gastric bypass;³ the Biliopancreatic Diversion;^{4,5} the Vertical Banded Gastroplasty;⁶ and the LapBand.⁷

The duodenal switch procedure (DS) was first performed by Hess⁸ in 1988 via midline laparotomy. DS is a hybrid weight loss procedure combining moderate intake restriction with moderate malabsorption, resulting in significant and sustained weight loss. The restrictive element of the DS results from a pylorus-preserving greater curvature (parietal cell) gastrectomy, and the malabsorptive component is a consequence of an extended limb Roux-en-y proximal small bowel bypass. The duodeno-ileostomy conserves normal antro-pyloric anatomy and normal vagal innervation. In contrast to Roux-en-Y gastric bypass, dumping and marginal ulceration do not occur following DS.

DS is the most effective operative procedure for weight loss.⁹⁻¹² However, the technical demands of the operation are significant and the actual procedure can be quite lengthy. The laparoscopic techniques described in this paper were developed specifically to avoid the morbidity attendant to a long midline incision while maintaining acceptable operative times. Apart from the length and site of the incision, the internal anatomy of the open technique is exactly maintained, permitting management and anticipated postoperative results, both

immediate and long-term, to be consistent with those of the thousands of DS procedures performed via midline laparotomy over the past 14 years.

Three techniques are described. Operative times and operative morbidity associated with a solely laparoscopic-assisted technique used at the inception were substantially reduced after adoption of the laparoscopic hand-assisted approach that is now routine.

Materials and Methods

From September 1999 to February 2002, 345 laparoscopic duodenal switch procedures (27 lap-assisted, 318 hand-assisted) were performed. Results do not include several duodenal switch procedures utilizing a partial laparoscopic method in early 1999. There were 299 women and 46 men, with mean age 43 years (range 19-67). The mean body mass index (BMI) was 50 kg/m² (range 36-118). The mean BMI in the lap-assisted group was 47.3 kg/m² (range 37-64) and in the hand-assisted group was 50.2 kg/m² (range 37-118); 44% of patients were superobese with BMI >50 kg/m². The largest man and woman operated on were in the hand-assisted group and this included a woman who weighed 284 kg (625 lbs) with a BMI of 118 and a man who weighed 239 kg (526 lbs) with a BMI of 73.

Previous abdominal/pelvic surgery was common, including: 54 Cesarean sections, 43 hysterectomies, 35 appendectomies, 30 laparoscopic cholecystectomies, 21 open cholecystectomies, 20 tubal ligations, seven diagnostic laparoscopies, and one sigmoid colectomy.

Laparoscopic technique was intended to reproduce the open technique internally as closely as possible. The DS procedure as performed by the author since 1993 is illustrated in Figure 1. The gastric pouch is constructed after first clearing the greater curvature vessels cephalad to 5 cm proximal to the pylorus. A vertical division of the stomach is achieved by serial application of the linear stapler, leaving a lesser curvature sleeve configuration and allowing preservation of the pylorus and vagal innervation. The duodenum is divided 4 cm beyond the pylorus and anastomosed to the distal 250 cm of

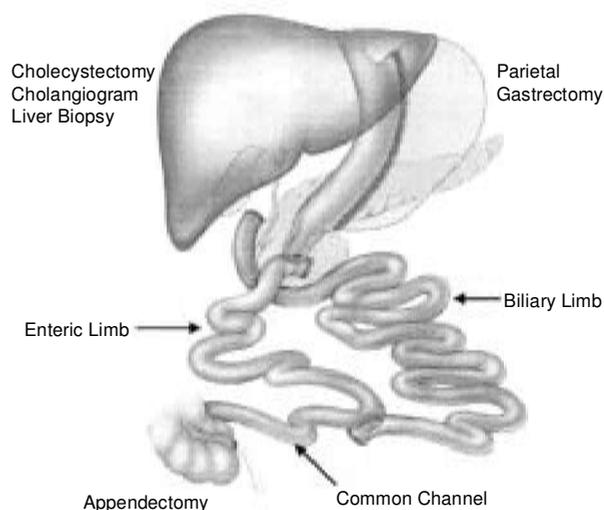


Figure 1. Laparoscopic duodenal switch and concurrent procedures.

ileum, which thereby becomes the combined enteric and common limb. The remaining proximal biliopancreatic limb is anastomosed side-to-side to the distal ileum at a point 100 cm proximal to the ileocecal valve, thereby delineating the enteric limb (proximal) and the common channel (distal). Liver biopsy is routine and appendectomy, cholecystectomy and operative cholangiogram are performed when these organs are present.

Laparoscopic-assisted Technique (Patients 1-27):

The pylorus is marked and the duodenum mobilized and then transected 4 cm distal to the pylorus using a 45 mm linear stapler (EndoGIA, US Surgical, Norwalk, CT). Cholecystectomy, operative cholangiogram, appendectomy and a liver biopsy are performed. The greater curvature of the stomach is denuded of all vessels cephalad to 5 cm proximal to the pyloric valve, and a vertical gastrectomy is then performed over a 53-French bougie using serial applications of the linear stapler. The spring is removed from the anvil of a circular stapler (25 mm Curved Premium CEEA, US Surgical Corporation, Norwalk CT), allowing the head to collapse in line with the shaft. The anvil is attached to a nasogastric tube and pulled through the pylorus into the proximal duodenum using a trans-oral technique.

The periumbilical port site is then extended to a 4

cm total length, and stomach, gallbladder and appendix are delivered through the extended incision. The complete small intestine is measured extracorporeally, and the distal anastomosis is constructed along the antimesenteric aspect of the terminal ileum 100 cm proximal to the ileocecal valve. The circular stapler is then secured within the lumen of the ileum, replaced in the peritoneal cavity, and pneumoperitoneum is re-established. Under direct vision, the stapler is docked to the shaft of the anvil and fired, creating the proximal anastomosis. Because of the technical aspects of the retrocolic construction, an antecolic approach is generally employed.

The open end of ileum is closed with a linear stapler. With the enteric limb clamped, the stomach is filled with methylene blue, pouch volume is measured and recorded, and the proximal anastomosis and greater curvature staple-line are inspected for leakage before removing the surgical ports.

Laparoscopic Hand-assisted Technique #1 (Patients 28-207):

Laparoscopic hand-assisted technique is initiated with a 7 cm periumbilical incision. The small intestine is delivered and measured along its entire length. The ileum is then transected approximately 60% beyond the Ligament of Trietz and the distal anastomosis is formed 100 cm proximal to the ileocecal valve using two applications of the 60 mm EndoGIA 3.5 stapler to appose the antimesenteric aspects of the lumen. The mesenteric defect is closed using 3-0 absorbable monofilament suture.

The hand-assist port is now placed in the incision, and a plastic sleeve is placed on the left forearm. The left hand is used to facilitate the remainder of the operation within the peritoneal cavity. A 10-mm reusable camera port is placed in the right upper quadrant and pneumoperitoneum is established. Two 5/12 mm ports are placed under direct vision in the right and left lateral subcostal position. The pylorus is marked, and the small vessels posterior to the duodenum are cauterized with the Bovie as the duodenum is mobilized. A 60-mm EndoGIA 3.5 stapler (US Surgical, Norwalk, CT) is used to transect the duodenum 4 cm distal to the pylorus. Cholecystectomy, operative cholangiogram, and liver biopsy are performed using standard laparo-

scopic technique. The proximal duodenal staple-line is excised and a purse-string suture placed to secure the anvil of the circular stapler.

The short gastric vessels along the greater curve are cleared and a vertical gastrectomy is performed over a 53-French bougie using serial applications of the EndoGIA. A retrocolic mesenteric window is opened anterior to the duodenal stump. Pneumoperitoneum is released, and the stomach segment and gallbladder are removed via the hand-assist port. The CEEA stapler is then secured within the lumen of the ileum, brought through the hand-assist port and docked to the anvil under direct vision after restoring pneumoperitoneum. The proximal anastomosis is then created and the open end of ileum closed with a linear stapler. (I prefer retrocolic position; however, this anastomosis can safely be placed antecolic in patients with BMI <50.)

Laparoscopic Hand-assisted Technique #2 (Patients 208-present):

In our current practice (Patients 208+), the greater curvature of the stomach is now cleared starting 5 cm proximal to the pylorus and continuing to the gastroesophageal junction. With #58-French bougie in the stomach as a guide, the stomach is transected with serial vertical applications of the 60-mm EndoGIA 3.5-mm stapler. The distal cut end of the small bowel is now brought through a retrocolic defect created in the hepatic flexure mesocolon and anastomosed to the proximal duodenum using three applications of the 45-mm Endo-GIA stapler. The stomach is filled with methylene blue colored saline to determine that the staple-lines are intact and watertight. The midline fascia is closed with #1 PDS and the skin closed with 3-0 and 4-0 subcuticular Biosyn. All patients undergo a water-soluble contrast upper gastrointestinal X-ray series on the first postoperative day, after which a clear liquid diet is started.

Results

The mean operating time for all patients was 201 minutes (range 105-480). The mean operating time for the first 27 lap-assisted patients was 322 minutes

(range 220-480). The mean operating time for the 318 hand-assisted patients was 191 minutes (range 105-360). The mean operating time in the hand-assisted group decreased to 188 minutes for the last 45 consecutive patients and the maximum weight of 284 kg was readily accommodated.

The mean gastric pouch volume was 124 cc (range 80-240). The mean total intestinal length was 684 cm (range 460-979); the mean enteric limb length was 171 cm (range 100-320); the mean common limb length was 100 cm (range 90-120) and the mean biliary limb length was 409 cm (range 150-618).

The median length of hospital stay was 3.0 days (range 2-22 days, excluding one outlier) for all patients. The mean length of stay in the hand-assisted group was 4.3 days.

The conversion to open laparotomy rate was 2.0% for a total of seven conversions. Four of these were in the lap-assisted series and were related to attempting to place the proximal anastomosis in the retrocolic position, which led to splitting of the duodenal or ileal sides of the anastomosis. The three conversions in the hand-assisted group were in a patient with bleeding related to Lovenox therapy and in two patients with dense adhesions throughout the abdomen. Additional intraoperative problems that did not require conversion include: one patient with a bougie perforation of the proximal stomach which was oversewn; one patient with preexisting chronic renal failure developed intraoperative acidosis which required relieving the pneumoperitoneum for 30 minutes while resuscitation was performed; and two patients whose proximal anastomosis required immediate revision for technical reasons.

There were 14 perioperative reoperations, representing a reoperative rate of 4.1%. Seven patients (2.0%) developed perioperative leaks in the gastric staple-line; three were reoperated on. Four patients (1.2%) developed leaks at the proximal duodenal anastomosis; all were reoperated on. One of these was from delayed necrosis on the duodenal side of the anastomosis, and this presented with tachycardia and an elevated white blood count 5 days after surgery. Two were from the posterior side of the anastomosis and these were seen on the upper gastrointestinal series the day after surgery. Five patients (1.5%) developed perioperative obstructions; three were reoperated on.

Readmission was necessary in 21 patients, for a readmission rate of 6.1%. Two were for dehydration, corrected with intravenous fluids. Six patients (1.7%) developed proximal anastomotic strictures. Four patients were readmitted with gastric leaks. Other perioperative complications include three pulmonary emboli and two deep venous thromboses.

Overall perioperative morbidity, including reoperation, was 10%. Operative mortality was 0% with no deaths.

There were several patients who underwent additional incidental procedures, evident in a review of the pathology. Liver pathology revealed that 61% of patients had steatosis, 14% had cholelithiasis, 28% had evidence of acute and chronic cholecystitis and 16% had cholesterolosis. Previous cholecystomy had been performed in 51 patients. Cholangiograms were performed in all patients who had not had a prior cholecystectomy. All of these were normal.

Figures 2 and 3 report mean BMI reduction and mean percent excess weight loss up to 24 months after surgery. Six patients required revisions of the common limb due to excessive weight loss.

Discussion

The surgical treatment of morbid obesity has evolved rapidly over the past decade. The two most prevalent advancements have been the introduction of the laparoscopic technique (Wittgrove) to the Roux-en-Y gastric bypass³ and the emergence of the duodenal switch operation as a hybrid procedure providing superior sustained weight loss while preserving vagal, antral, and pyloric function. This paper reports the first performed laparoscopic-assisted and first performed hand-assisted duodenal switch procedures for morbid obesity. The laparoscopic-assisted technique we utilized in the first 27 patients permitted measuring the full intestinal length, constructing the distal anastomosis and closing the mesenteric trap through a small periumbilical incision. The lowest operating time of 225 minutes and an antecolic proximal anastomosis were less satisfactory. In addition, the procedure required 6 ports and a significant amount of torquing on the abdominal wall, which may have translated into increased postoperative pain.

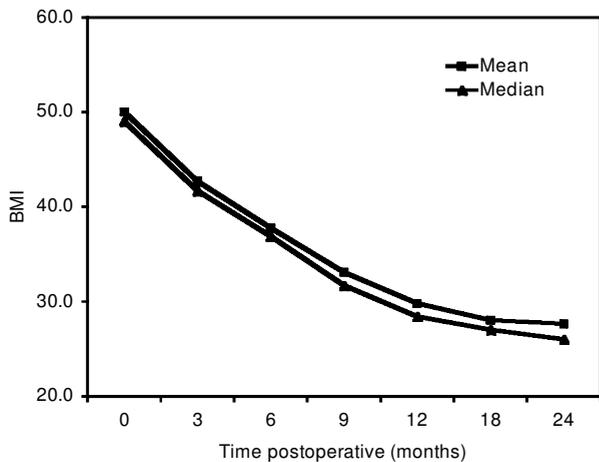


Figure 2. BMI over time.

Advancing to the laparoscopic hand-assisted technique produced a two-hour reduction in operating time and a surgical port count reduction from 6 to 3. The pylorus is more readily located. The diameter of the gastric remnant can be calibrated by palpation and any anastomotic problems or areas of bleeding can be corrected and reinforced more quickly, even in the super obese, in whom a retrocolic proximal anastomosis is particularly important to avoid constricting the colon. The heaviest woman had a BMI of 118 and the heaviest man had a BMI of 73. Over 95% of patients qualify for the laparoscopic-assisted approach. Present contraindications to the laparoscopic approach are two: history of multiple prior operations with associated dense adhesions and medical concerns related to anesthesia.

Our approach has yielded acceptable morbidity (10%) compared with the open duodenal switch series (Rabkin,⁹ Hess,⁸ Marceau,¹¹ Baltasar¹²). Fortunately, we have had no mortalities. Gastric staple-line leaks occurred in eight patients; three were reoperated on. We routinely reinforce malformed staple-lines or suspicious areas with absorbable suture. We use the EndoGIA II 60-mm, 3.5 staple cartridge along the entire vertical extent of the stomach. The antrum is the thickest portion of the wall and sometimes requires suture reinforcement of the staple-line.

Proximal anastomotic staple-line leaks occurred in three patients, of whom all were reoperated. Our technique of constructing this anastomosis initially required applying a pursestring suture to secure the

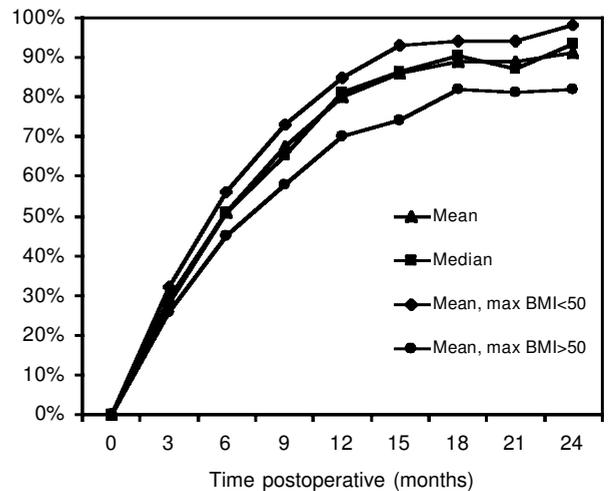


Figure 3. Percent of excess weight loss.

EEA anvil within the open end of the duodenum and then doing an end-to-side duodeno-enterostomy. On an intermediate basis we used a trans-oral insertion of the anvil with no pursestring. By eliminating the EEA stapler altogether in the thin-walled duodenum, we believe we have reduced the potential for leaks and strictures. Obstructions occurred in five patients due to the antecolic positioning of the proximal anastomosis, now abandoned in favor of retrocolic.

Both laparoscopic and hand-assisted techniques are technically feasible and have an acceptable morbidity. There is a steep learning curve, and prior laparoscopic and bariatric surgical experience is essential. Advantages of the laparoscopic-assisted approaches include decreased pain, improved pulmonary function in the early postoperative period, reduced hospital stay, and a more pleasant cosmetic result. Those candidates that are excluded include patients with extensive prior surgery or large patients with a high medical risk who may not tolerate a potentially prolonged operation and the attendant pneumoperitoneum. In conclusion, our technique has evolved to the hand-assisted approach because of the reduced operating time and its applicability to nearly all patients regardless of size. Longer-term data remain pending, as does a comparison between open and laparoscopic patients. Our current protocol is to approach nearly all patients laparoscopically. There has been no operative mortality among the more than 500 laparoscopic duodenal switch procedures in our series.

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