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# Laparoscopic Greater Curve Plication as an Outpatient Weight Loss Procedure

Donald J. Waldrep, MD, Ilvia Pacheco, MPH


## ABSTRACT

**Background and Objectives:** Laparoscopic greater curve plication is emerging as a weight loss procedure that avoids many of the complications of other surgeries that require gastrointestinal division, amputation, or use of a foreign body. Cost savings and affordability have also been promoted, as plication does not require the use of stapling devices, adjustable gastric bands, or prolonged hospitalization. The ability to predictably perform plication as an outpatient surgery may further define its role as a therapeutic option for treating morbid obesity. We present the 30-day outcomes and supplementary 12-month data in a series of 141 laparoscopic greater curve plication surgeries performed as outpatient procedures.

**Methods:** Laparoscopic greater curve plication was performed as outpatient surgery in 141 consecutive patients. Outcomes including perioperative complications, incidental 12-month follow-up for weight loss, and change in diabetic and hypertensive medication are reported.

**Results:** Of the 141 plications performed, 138 patients were discharged from the recovery room and 6 were readmitted. There was no conversion to open surgery and no mortality.

**Conclusions:** The ability to reliably perform greater curve plication as an outpatient surgery may further define its role as an additional weight loss surgery technique.


**Key Words:** Bariatric, Gastric, Laparoscopic, Outpatient, Plication.

## INTRODUCTION

Since the 1990s, there has been a dramatic increase in the number of people affected by morbid obesity. Unfortunately, even when supported with conscientious and diligent medically controlled dietary methods, many people are unable to maintain a healthy body weight. Nonsurgical therapy leads to modest and transient weight loss at best,[1] and surgery has been advocated as the only effective "large-scale" treatment for obesity.[2] Despite the availability of gastric bypass, adjustable banding, sleeve gastrectomy, and duodenal switch, the number of potential candidates who undergo surgical therapy for obesity in the United States remains approximately 1%.[3] A contributing factor to the low number of obese patients seeking surgery may be the unappealing aspects of gastrointestinal division, anastomoses, foreign bodies, and gastric amputation, with the attendant risks of leak, hemorrhage, obstruction, nutritional complications, and socially embarrassing side effects. Laparoscopic greater curve plication is gaining interest because it appears to avoid many of the intrinsic risks of more established procedures. The ability to predictably perform plication as an outpatient surgery may further define its role as an option for treating morbid obesity. We present 30-day outcomes in a series of 141 laparoscopic greater curve plications performed as outpatient procedures as well as the 12-month weight loss trend and reported changes in medication management for diabetes and hypertension.

## METHODS

Laparoscopic greater curve plications (N = 141) were performed by a single surgeon between June 1, 2009 and August 31, 2013. All patients completed a preoperative assessment and extensive informed consent process. A chart review protocol was approved by an institutional review board, and patients with a minimum body mass index (BMI) of 35 who presented for outpatient laparoscopic greater curve plication as a weight loss procedure with an opportunity for at least a 12-month follow-up are reported. Patient characteristics are presented in **Table 1**.

CURE Center, Thousand Oaks, California (both authors).

Address correspondence to: Donald J. Wadrep, MD, CURE Program, 110 Jensen Court, Suite 1B, Thousand Oaks, CA 91360. Telephone: (805) 230-0030, Fax: (805) 230-2995, E-mail: DrWaldrep@cureprogram.com

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**Table 1.**
Patient Characteristics

| Patients (n = 141) | n (% or Range) |
|---|---|
| Female | 113 (80) |
| Male | 28 (20) |
| Age, years | 47 (18–72) |
| Weight, kg | 119 (78–118) |
| EBW, kg | 59 (30–116) |
| BMI | 42 (35–63.5) |
| 35–40 | 56 (40) |
| 40–50 | 69 (49) |
| 50+ | 16 (11) |
| Diabetes | 30 (21) |
| Hypertension | 57 (40) |

EBW = excess body weight.

### Surgical Technique

A 5-port (5 and 8 mm) laparoscopic approach was used. The gastrocolic ligament was opened with a harmonic-energy device starting approximately 6 cm proximal to the pylorus and extending to within 2 cm of the left crus of the diaphragm. The greater curve of the stomach was imbricated in layers with interrupted seromuscular non-resorbable sutures (**Figure 1**). A calibration tube was advanced from the esophagus above the plication to the antrum below the plication to assess resistance and gastric luminal patency. No leak tests, upper endoscopy, or drains were used.

**Figure 1.** Completed greater curve plication.

## RESULTS

Procedure data are presented in **Table 2**. Of the 141 patients scheduled for outpatient laparoscopic greater curve plications, 138 patients were discharged, and 3 were admitted for noncritical reasons: nausea in 2 and observation for sleep apnea in 1. Twelve patients (9%) who were discharged as outpatients had 1 episode of outpatient management: 6 of these patients had symptoms of dehydration treated electively at outpatient infusion centers, whereas the remaining 6 patients were evaluated at an urgent care or emergency department and discharged home. All interventions were within 7 days of surgery.

Six patients (4%) were readmitted between 2 and 14 days after surgery. Three admissions were for evaluation and treatment of nausea and dehydration; 1 patient underwent revision surgery, and all were discharged after 1 day. Three patients were admitted for other reasons: 1 for acute *Clostridium difficile* colitis; 1 for deep vein thrombosis

**Table 2.**
Procedure Data

| Variable | n (%) |
|---|---|
| Facility | |
| Hospital | 66 (47) |
| Ambulatory surgery center | 75 (53) |
| Additional procedures[a] | 28 (17) |
| Hiatal hernia repair | 8 |
| Lysis of adhesions | 4 |
| Gastric band removal | 4 |
| Umbilical hernia repair | 4 |
| Biopsy | 3 |
| Cholecystectomy | 2 |
| Ventral hernia repair | 2 |
| Diaphragmatic hernia repair | 1 |
| Conversion to open surgery | 0 |
| Outpatient discharge | 138 (98) |
| Admit from recovery room | 3 (2) |
| Nausea | 2 |
| Observation for sleep apnea | 1 |

Data are the number, with the percentage of the total procedures (n = 141) in parentheses.

[a]n = 28 procedures in 24 patients.

evaluation, which was negative; and 1 for evaluation of gastrointestinal bleeding related to nonsteroidal anti-inflammatory drug (NSAID) use.

In the 12-month period after surgery, 15 of the 30 patients (50%) who presented on prescription medications for diabetes and 25 of 57 (44%) who presented on prescription medications for hypertension reported a decrease in or discontinuation of medication. The percentage of body weight loss is shown in **Figure 2**.

## DISCUSSION

Surgical management of morbid obesity has been shown to provide effective long-term weight loss, weight maintenance, and reduction of comorbidities. A variety of surgical techniques have evolved over the years, but each includes significant potential risks that diminish the attractiveness of surgery to potential patients and referring physicians. In addition, cost considerations continue to have an impact on access provided by health insurance coverage and to influence public policy. Perhaps these are among the many reasons that surgical intervention for patients who qualify under traditional weight loss surgery guidelines remains low.

Although gastric bypass and vertical sleeve gastrectomy have been shown to be relatively safe,[4,5] many patients voice apprehension about the perceived complexity of these techniques. Gastric banding is generally considered the least invasive available weight loss procedure. Although adjustable banding has been reported to lead to an excess body weight loss of approximately 50%,[6] it can require intervention for maintenance and surgery for several device-related complications. Patients may also have difficulty in maintaining an optimal adjustment schedule, thus contributing to unsatisfactory weight loss.[7] One advantage of gastric banding is that it is often performed as an outpatient procedure, eliminating hospitalization and associated costs. Although vertical sleeve gastrectomy is technically more involved, it is possible to perform it as an outpatient procedure in selected patients.[8]

Limiting gastric volume is a universal component of weight loss procedures. In 1969, Kirk[9] showed in labora-

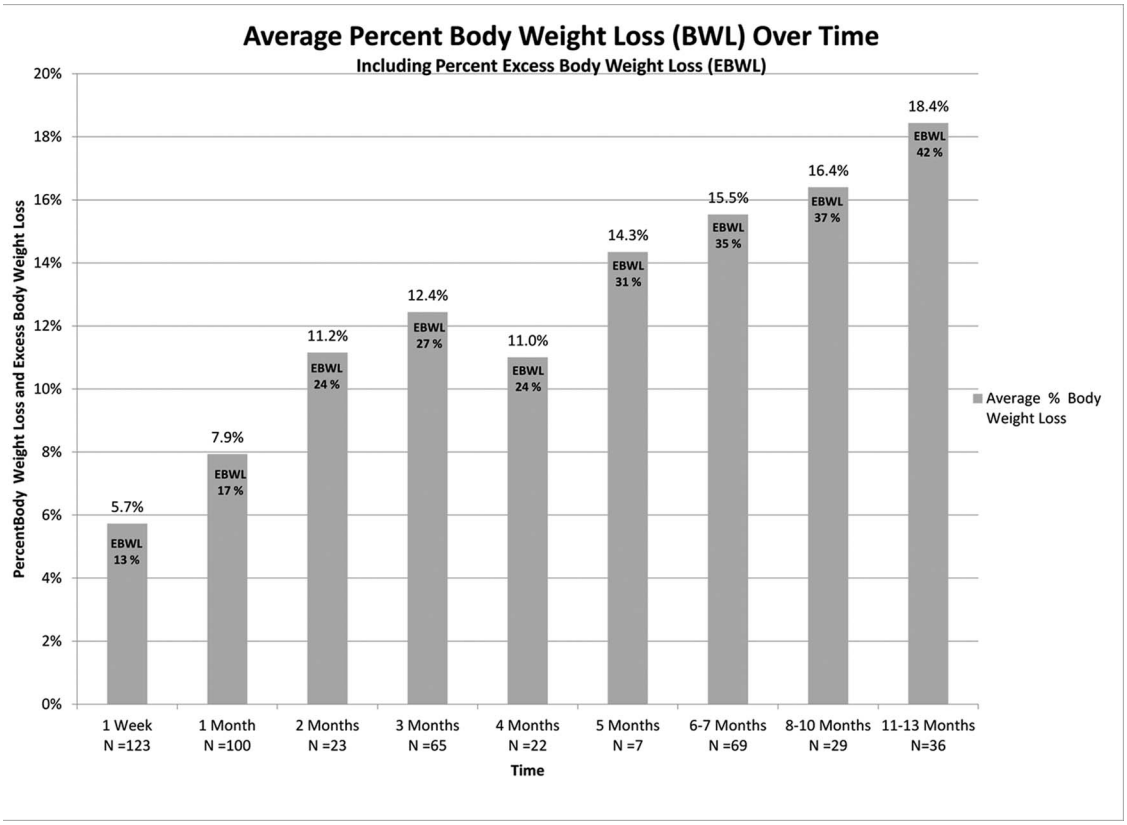


**Figure 2.** Average percentage of body weight loss and excess body weight loss (EBWL) over time (n = number of all 141 patients presenting during the specific time interval).

tory studies that inversion of the gastric wall slowed, stopped, or reversed weight gain when compared to controls. Tretbar et al[10] was inspired by the observation of weight loss after antireflux procedures and proposed gastric wrapping as an alternative to more aggressive techniques of gastric bypass and jejunoileal bypass. Wilkinson[11] advanced this idea clinically and added a polypropylene mesh encasement that unfortunately contributed to a significant number of erosions near the gastroesophageal junction. Curley et al[12] contributed the addition of a silicone mesh. Hoekstra et al[13] compared bypass patients to a group of patients who had fundoplication reinforced with Teflon mesh and found the weight loss, weight maintenance, and patient satisfaction rates to be higher in the plication group.

Plication-based concepts essentially disappeared in the transition of bariatric surgery in the laparoscopic era. However, in 2006, Fusco et al[14,15] presented data suggesting that plication in rats creates significant weight loss and subsequently showed that infolding of the greater curve produces superior results to anterior wall plication. In 2007, Talebpour and Amoli[16] presented the results of 100 patients undergoing laparoscopic plication. The results supported the idea that plication may be a safe and effective weight loss surgery alternative. Multiple authors have since contributed to the gastric plication literature with remarkably similar results.[17–25] These studies routinely present low incidences of complication and intervention, with excess body weight loss approaching that of bypass and sleeve gastrectomy. The operative experiences presented exhibit similar safety with no conversions, no critical complications, and no mortality.

Effective and efficient intracorporeal suturing has long been considered one of the essential skills of advanced laparoscopic surgery. There is a great deal of variability in suture technique among published authors. In dog models, tensile strength has been shown to be higher with increased density and number of rows of fixation points.[26] Running sutures, at least conceptually, may create a constant line of tension, creating areas more prone to ischemia or areas of tension prone to herniation of the plicated segment. Previous reports include readmission and reoperation for herniation of the plicated segment between sutures, leading to pain, obstruction, and perforation.[19,27]

Several surgeons have reported use of leak testing,[16,17,21,23–25] intraoperative endoscopy,[19,22,27] peritoneal drains,[20,25] and postoperative upper gastrointestinal radiography.[20] Although these choices should be guided by the surgeon's discretion, the lack of staple lines or gross anatomic changes are likely to lead to a low incidence of positive findings. No special monitoring, endoscopy, leak test, or drain was necessary in this series.

The advantage of significant cost reduction, because of the absence of stapling devices or other hardware, has been promoted.[16,18] Cost was not specifically evaluated in the series presented herein, but cost-related factors were obviously absent, including special monitoring, surgical stapling devices, gastric band systems, use of endoscopy, leak test time and materials, use of drains, upper gastrointestinal radiography, and most notably, the routine need for inpatient hospitalization. Use of outpatient services and facilities resulted in minimal hospitalization.

Despite a low complication rate, greater curve plication has routinely been presented as an inpatient procedure with length-of-stay typically between 1 to 2 days.[16–25,28,29] In the series presented herein, outpatient intervention was needed in 12 patients after discharge. Six of these patients felt unable to take adequate liquids in the first few days, but were otherwise without complaint. These patients were directed to an infusion center for intravenous crystalloid, and all patients rapidly improved. Six patients had nausea or discomfort to a degree that they were directed to an urgent care or emergency department for evaluation. In these cases, the evaluations were unremarkable, and patients improved immediately, possibly due to empiric administration of antiemetics and intravenous crystalloid at the time of assessment.

Readmission was indicated in 4% of the patients in this series. Only 2 were admitted urgently. One patient experienced syncope on postoperative day 5 and was subsequently diagnosed with *C. difficile* colitis, which was treated with intravenous antibiotics, and the patient was discharged after 2 days. One patient experienced hematemesis on postoperative day 3. Urgent endoscopy identified a nonbleeding 2-cm well-circumscribed ulcer with a visible vessel along the distal lesser curvature in an area that was undisturbed during the plication technique and remote from suture placement. It was the judgment of the gastroenterologist and surgeon that the ulcer's appearance was consistent with side effects of NSAIDs, which the patient subsequently reported using before and after surgery. The 4 remaining admissions were of lower acuity. One patient (0.7%) had reoperation after experiencing recurrent nausea and emesis. A contrast study demonstrated flow past the plication. The patient was given the option to treat medically, but chose surgical revision.

Laparoscopy revealed no gross abnormalities and a calibration tube passed easily, but it was decided to revise the position of the lowest outer sutures by approximately 5 mm. The patient was discharged approximately 12 h after surgery without nausea. One patient with persistent nausea was also evaluated for pneumonia and discharged the next day; 1 patient was admitted to an outlying hospital for evaluation of possible deep vein thrombosis, which was negative; and 1 patient was admitted overnight to an outlying hospital for rehydration.

In the 141 patients, the total hospitalization for all patients admitted and readmitted those who underwent reoperation was 12 days. By comparison, if each patient in this series had been hospitalized for 1.5 days—the estimated average for plication, according to several published series—the total elective hospital days would have been 211 days. It is possible that routine admission would have prevented or captured problems that led to some of the subsequent interventions. All patients presented at or after the 30-day postsurgery date, and their postoperative outcomes were documented. Longer range outcomes must be viewed with caution, as the attrition rate was significant, with 25% of all patients undergoing surgery presenting at the 11- to 13-month postoperative interval. Although the trend for self-reported changes in the use of diabetic and antihypertensive medications reinforces the established benefits of successful weight management, regardless of the method of weight loss, the actual impact may be muted by the attrition rate noted in this series. Weight loss was progressive over the first 12 months.

The simple concept of plication may belie the meticulous skills needed to achieve optimal, sustainable results. Ultimately, the minimally invasive aspect of plication may contribute to expanding the benefits of bariatric surgery to obese patients who do not meet the traditional BMI criterion for surgery and may be open to a less complicated technique. The follow-up observations are limited by the small number of patients, the attrition in postoperative presentation, and the retrospective nature of a review.

## CONCLUSION

Obesity is a burgeoning medical and social concern because of the associated health and financial costs. Unfortunately, use of bariatric surgery remains relatively static. Laparoscopic greater curve plication offers several possible safety advantages. The current literature for plication is limited but is increasing and fairly consistent in concluding that the technique is a safe and effective adjunct to the current menu of bariatric procedures. The attraction and practicality of plication as a surgical option may be further enhanced by its availability as an outpatient procedure. Surgeon experience and skill, patient selection, longer observation times, and additional prospective studies will continue to contribute to the evolution of the role greater curve plication as a primary weight-loss surgery option.

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