

# Revisional Bariatric Surgery

**Keywords:** Revisional bariatric surgery; Excess body weight loss; Comorbid conditions

## Abstract

**Background:** To elucidate percent excess body weight loss (%EBWL) gained from revisional surgery and to determine resolution of comorbid conditions given the obesity epidemic.

**Methods:** All patients undergoing revisional bariatric surgery from 2002 to 2012 were analyzed. Main outcome measures were %EBWL, resolution of comorbid conditions and complications. Descriptive statistics and paired t-tests were computed.

**Results:** 251 cases were performed. Initial mean body mass index was 48.1 kg/m<sup>2</sup> (+/- 9.4). Hypertension (32%) and treatment failure (37.5%) were most commonly reported. Mean percentage difference between reoperation and last weight and original and reoperation weight was 27.9% (29.5%),  $p < 0.001$ . Proportions of all comorbid conditions decreased, but none statistically. No deaths occurred, however 22% experienced at least one complication.

**Conclusions:** Greater %EBWL occurs between revision surgery and last follow-up. No comorbid condition decreased. Further research is needed to determine the optimal timing for revisional surgery to optimize %EBWL and resolution of comorbid condition.

## Background

Obesity and its associated co-morbid complications continue to increase. Severe morbid obesity is a pandemic that affects both adults and adolescents in which surgery has proven to be the only effective means to provide for long-term weight loss and apparent resolution of comorbid conditions as compared to medical management [1-4]. As acceptance of bariatric surgical interventions has increased, the numbers of both primary and revisional surgical interventions have also increased. For example, according to the American Society of Metabolic and Bariatric Surgery (ASMBS), the number of primary bariatric procedures has increased from approximately 13,000 procedures in 1998 to 220,000 procedures in 2008 respectively [5].

Revisional bariatric surgery entails knowledge of the primary surgical intervention, as well as expertise with regards to non-virginal operative fields. Herein, we aimed to compare the percent excess body weight loss (%EBWL) and body mass index (BMI) between each bariatric procedure, as well as between primary, revisional procedure, and final outcome measures. Secondary aims included identifying whether there was a particular bariatric operation that predicted a higher resolution of comorbid conditions and predicted less associated complications.

## Methods

Following institutional board approval, data from a retrospective case review of all patients undergoing revisional bariatric surgical interventions, excluding port revisions of laparoscopic gastric banding procedures (LAGB), at one academic medical center were analyzed from a prospective, longitudinal database. Information from 2002 to 2012 was collected. Demographic, clinical, co-morbid conditions and complications were compared between revisional groups. Weight loss was expressed as percent excess body weight loss (%EBWL), defined as the difference between initial weight and



## Journal of Obesity and Bariatrics

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**Submission:** 15 May 2015

**Accepted:** 15 June 2015

**Published:** 20 June 2015

**Reviewed & Approved by:** Dr. Francesco Saverio Papadia, Assistant Professor of Surgery, University of Genoa School of Medicine, Italy

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current weight, divided by the difference of the initial weight and ideal weight. The ideal body weight was calculated from the 1983 Metropolitan Life Insurance Company tables [6]. Percent EBWL was calculated at each revision and last clinic visit. The main outcome measure was %EBWL. Secondary outcome measures included resolution of comorbid conditions and associated complications.

For the purposes of this study, patients were grouped into 4 revision types: 1) conversion from one bariatric surgical procedure to another; 2) revision of a previous operation with no conversion; 3) reversal and 4) exploration. Conversion surgeries included: GP-to Laparoscopic Roux-en-Y Gastric Bypass (LRYGB), Jejunoileal Bypass (JIB) to LRYGB, Laparoscopic Adjustable Gastric Banding (LAGB) to LRYGB, LAGB to Laparoscopic Sleeve Gastrectomy (LSG), and Vertical Banded Gastroplasty (VBG) to LRYGB. Revisional surgeries included: open revision bypass, open revision jejunojunal (JJ), laparoscopic revision JJ, and laparoscopic revision bypass. Reversal surgeries included: open reversal RYGB, laparoscopic reversal RYGB, reversal VBG, and open Entero Cutaneous-Fistula (ECF) takedown. Overall indications for revision were divided into the following categories: 1) pain; 2) obstruction; 3) failure to thrive; 4) development of an enterocutaneous fistula; 5) treatment failure; 6) gastrointestinal issues primarily related to gastroesophageal reflux and ulcers and 7) medically or nutritional-related issues.

All patients met the criteria for bariatric surgery established by the National Institutes of Health Consensus Development Panel with patients having a body mass index (BMI) of  $>40$  kg/m<sup>2</sup>, or  $>35$  kg/m<sup>2</sup> in the presence of obesity related comorbidities. All had failed to maintain weight loss by non-surgical means. All patients were

required to attend a public information session given by one of the surgeons and be assessed by both a clinical psychiatrist and dietician.

Preoperative investigations were guided by the patient history and type of surgery. Routine investigations included an upper gastrointestinal barium study for all patients. The decision for each particular revisional surgical intervention was made by the patient after an extensive period of counseling and education. Revisional bariatric patients were recovered in a surgical ward by staff experienced in management of postoperative bariatric patients. All patients were reviewed in outpatient clinic at 2 weeks, as well as regularly assessed for vitamin and mineral deficiencies and treated accordingly. Descriptive statistics for continuous and categorical variables were presented, as appropriate. Paired t-tests were computed to assess outcome measure differences between original and last follow-up.

### Results

From 2002-2012, a total of 251 revisional bariatric operations were performed, 28% of which underwent more than one subsequent operation. Baseline demographic data was included in Table 1. Eighty-five percent (n=213) were female. Mean age at the time of the original operation was 39 years (+/- 12 years) (Table 1). The most common (51%) original operation was a Laparoscopic Roux-En-Y Gastric Bypass (RYGB). The most common indication for revision of the primary surgical procedure was treatment failure/failure to lose weight (n=94, 37.5%); other etiologies found independently or concurrently included fistulas (n=84, 33.5%) and previous technical complications (n=31, 12.4%). Of note, the majority of fistulas (gastro-gastric fistulas) were identified concurrently during the revision for treatment failure/failure to lose weight (Table 1).

Approximately 6.5% (n=97/251) were considered conversion surgeries, 55% (n=139/251) were considered revisional surgeries, 2.7% (n=7/251) were considered reversal surgeries and 1.5% (n=4/251) were considered exploratory surgeries (Table 2A). Ninety percent (n=226) of the operations were performed laparoscopically. At the time of the original operation, mean body mass index (BMI) was 48.1 kg/m<sup>2</sup> (+/- 9.4) and decreased on average to 40.4 kg/m<sup>2</sup> (+/- 10.4) prior to the first re-operative surgery and 34.0 kg/m<sup>2</sup> (+/- 8.8) at the last hospital visit (Table 2B). The mean difference, in pounds (lbs), between pre-reoperation and original was 7.7 lbs. (s.d. 8.4 lbs, p<0.001, paired t-test) and between last clinic visit and original operation was 14.1 lbs (s.d. 7.3 lbs, p <0.001, paired t-test). The mean percentage difference between reoperation and last weight (%EBWL) and original and reoperation weight (%EBWL) was 27.9% (29.5%, p <0.001, paired t-test).

The most common comorbid conditions were hypertension (32%), obstructive sleep apnea (21%), asthma (19%) and diabetes (18%) (Table 1). There was a decrease in the proportions of all comorbid conditions between the original and last visit, but none reached statistical significance. At the original operation, 41/224 (18.3%) had Diabetes Mellitus (DM). At first revision, 41/249 (16.5%) had DM, whereas, at last visit, 24/236 (10.2%) had DM. The procedure with the largest proportional change of DM was the laparoscopic conversion of the laparoscopic-adjusted gastric banding (LAGB surgery) to Roux-En-Y Gastric Bypass (RYGB); however, this difference did not reach statistical significance (p=0.47) (Table 3).

**Table 1:** Preliminary descriptive information regarding the dataset (n=251).

Characteristic	N (%) or Mean (standard deviation)
Gender (female)	213 (84.9%)
Age at original surgery	39.2 (11.7)
Original surgery type	
VBG	9 (3.6%)
LAGB	88 (35.1%)
LRYGB	128 (51.0%)
Open RYGB	22 (8.8%)
Other	4 (1.5%)
Original weight	291.3 (66.4)
Original height	65.2 (3.6)
Original Body Mass Index (BMI)	48.1 (9.4)
Ideal Body Weight (IBW)	135.6 (12.3)
DM	41 (18.3%)
HTN	72 (31.9%)
OSA	48 (21.4%)
Asthma	42 (18.9%)
Age at second operation	45.1 (10.7)
Weight at reoperation	245.4 (71.9)
Body Mass Index (BMI) at reoperation	40.4 (10.4)
%EBWL	30.4 (33.7)
DM at second operation	41 (16.5%)
HTN at second operation	81 (32.5%)
OSA at second operation	56 (22.5%)
ASH at second operation	40 (16.1%)
Indication for Revision	
Pain	14 (5.6%)
Obstruction or Technical	31 (12.4%)
Failure to thrive	3 (1.2%)
Fistula	84 (33.5%)
Treatment Failure	94 (37.5%)
Gastrointestinal issues	6 (2.4%)
Medical protracted issues	19 (7.6%)
Perioperative complications	54 (21.5%)
DM at third operation	24 (10.2%)
HTN at third operation	47 (19.9%)
OSA at third operation	29 (12.2%)
Surgical time (minutes)	234 (90)
Length of stay	Median (IQR): 3 (2,5)
Length of follow-up (mos.)	Median (IQR): 11 (5, 27)
Last weight	206.4 (59.9)
Last Body Mass Index (BMI)	34.0 (8.8)
Last %EBWL	58.3 (32.2)
Estimated blood loss*	155.7 (29.0)

\*Median (IQR): 0 (0,300); VBG: Vertical Banding; LAGB: Laparoscopic Gastric Banding; LRYGB: Laparoscopic Roux-En-Y Gastric Bypass; Open RYGB: Open Roux-en-Y Gastric Bypass; DM: Diabetes Mellitus; HTN: Hypertension; OSA: Obstructive Sleep Apnea; %EBWL: Percent Excess Body weight loss

**Table 2A:** Indications and procedures performed for bariatric cohort.

Original Surgery	Number (#)	Procedure Revised To	Pertinent Operative Characteristics (if Applicable)	How it Was Coded	Main Indication for Revision
VBG	9	LRYGB		Conversion	Treatment Failure
LAGB	8	LSG		Conversion	Treatment Failure
LAGB	80	LRYGB		Conversion	Treatment Failure
LRYGB	25	RYGB	Open Revision of the Pouch (n=21) Open Revision of GJ (n=3) Open Revision of JJ (n=1) Remnant Gastrectomy in 11 patients (44%)	Revision	Treatment Failure
LRYGB Open RYGB	83 22	LRYGB	Laparoscopic Revision of Gastric Pouch Remnant Gastrectomy in 51 patients (50%)	Revision	Treatment Failure
LRYGB	9	LRYGB	Laparoscopic Revision of the J-J anastomosis	Revision	Pain
LRYGB	7	Native anatomy	Laparoscopic Reversal	Reversal	Protracted Medical Issues
LRYGB	4	LRYGB	Laparoscopic lysis of adhesions	Exploration	Pain

BMI: Body Mass Index; VBG: Vertical Banding; LAGB: Laparoscopic Gastric Banding; LSG: Laparoscopic Sleeve; LRYGB: Laparoscopic Roux-en-Y gastric Bypass; Open RYGB: Open Roux-en-Y Gastric Bypass

**Table 2B:** BMI changes over time and per operative intervention.

Operations	N	Mean (standard deviation)		
		Between original and pre-reoperation	Between pre-reoperation and last	Between original and last
VBG	9	4.4 (5.9)	10.5 (6.2)	14.9 (4.3)
LAGB	88	2.9 (4.5)	8.5 (5.0)	11.4 (5.6)
LRYGB	128	10.6 (9.0)	4.6 (6.7)	15.2 (8.3)
Open RYGB	22	11.0 (7.2)	5.9 (6.3)	16.9 (4.2)
Other	4	2.9 (7.9)	7.8 (9.9)	10.8 (1.9)

BMI: Body mass Index; VBG: Vertical Banding; LAGB: Laparoscopic Gastric Banding; LRYGB: Laparoscopic Roux-en-Y Gastric Bypass; Open RYGB: Open Roux-en-Y Gastric Bypass

Regarding hypertension, 72/226 (31.9%) reported it originally, 81/249 (32.5%) had it at first revision and 47/236 (19.9%) at the final visit. Comparing those who had hypertension at last follow-up to the others, the percentages are quite similar between the various operations (p=0.68). Regarding OSA, 48/224 (21.4%) reported it originally, 56/249 (22.5%) had it at first revision and 29/237 (12.2%) had it a last visit. Of those with improved OSA status, LAGB has a slightly higher proportion than those with no change in OSA status (p=0.26). Regarding asthma, 42/224 (18.8%) reported it originally, 40/249 (16.1%) had it at first revision and 22/237 (9.3%) had it a last visit. Among those with improved asthma status, most either had LAGB or LRYGB surgeries and this was similar to those without improved asthma status (p=0.73) (Table 3).

Median intraoperative time was 234 minutes and median length of hospital stay was 3 days (range 2-5 days) (Table 1). Overall, there were 21.5% of cases that had perioperative complications (54/251); however, no deaths occurred. The distributions with and without complications differ according to surgery type (Fisher’s exact test, p<0.001). Among those who had complications, the highest proportion of complications occurred within LRYGB and included postoperative bleeding and obstruction (Table 4).

## Discussion

Revisional bariatric surgery is now commonplace. In our study, it appears that greater %EBWL occurred between revision surgery and last clinic visit than between the original surgery and first reoperation. There was not a single comorbid condition that decreased statistically significantly during the study period; however, all of them had a downward trend. Overall, complications did occur; however, there was no mortalities reported. These results are not unlike contemporary research on revisional bariatric surgery. The reported incidence of reoperation in bariatric surgery ranges from 5-57%, but the quality and integrity of what is reported is sometimes questioned [3,7-9]. Previous studies have grouped their patients based on the etiologies for revisional surgery [10]. However, given that a majority of our patients were referred to a tertiary weight loss center for inadequate weight loss, we chose to group our patients based on the type of revision surgery performed. The majority of our patients benefitted from either laparoscopic conversion of their primary procedure to a RYGB or revision of their primary procedure. Success, as defined by a %EBWL>50, was achieved in our cohort at the last clinic visit (%EBWL of 58.3%) and was consistent with current literature on the

**Tables 3A-3D:** Changes in Percentages (%) of Comorbid Conditions over time and per Operation.

Diabetes (DM)		
Surgery type	No change in DM status	Improved DM status
VBG	3 (1.6%)	0
LAGB	67 (34.9%)	9 (52.9%)
LRYGB	98 (51.0%)	8 (47.1%)
Open RYGB	22 (11.5%)	0

  

Hypertension		
Surgery type	No change in hypertension status	Improved hypertension status
VBG	3 (1.7%)	0
LAGB	65 (37.4%)	13 (35.1%)
LRYGB	87 (50.0%)	19 (51.4%)
Open RYGB	18 (10.3%)	4 (10.8%)

  

Obstructive Sleep Apnea		
Surgery type	No change in OSA status	Improved OSA status
VBG	3 (1.7%)	0
LAGB	63 (35.0%)	14 (46.7%)
LRYGB	92 (51.1%)	14 (46.7%)
Open RYGB	21 (11.7%)	1 (3.3%)

  

Asthma		
Surgery type	No change in Asthma status	Improved Asthma status
VBG	3 (1.7%)	0
LAGB	65 (35.7%)	12 (42.9%)
LRYGB	91 (50.0%)	15 (53.6%)
Open RYGB	21 (11.5%)	1 (3.6%)

VBG: Vertical Banding; LAGB: Laparoscopic Gastric Banding; LRYGB: Laparoscopic Roux-en-Y Gastric Bypass; Open RYGB: Open Roux-en-Y Gastric Bypass; DM: Diabetes Mellitus; HTN: Hypertension; OSA: Obstructive Sleep Apnea

**Table 4A:** Complication data.

Surgery type	No complications	Complications
VBG	8 (4.1%)	1 (1.9%)
LAGB	82 (41.6%)	6 (11.1%)
LRYGB	89 (45.2%)	39 (72.2%)
Open RYGB	17 (8.6%)	5 (9.3%)

Among those who had complications, the highest proportion was of type LRYGB. The distributions with and without complications differ according to surgery type (Fisher's exact test, p<0.001).

VBG: Vertical Banding; LAGB: Laparoscopic Gastric Banding; LRYGB: Laparoscopic Roux-en-Y Gastric Bypass; Open RYGB: Open Roux-en-Y gastric Bypass

**Table 4B:** Complication data.

Revision Surgery type	No complications	Complications
Conversion	91 (46.2%)	9 (16.7%)
Revision	100 (50.8%)	44 (81.5%)
Reversal	3 (1.5%)	1 (1.9%)
Lap Exploration	3 (1.5%)	0

Among those who had complications, 82% were revisions which was different from those with no complications (Fisher's exact test, p<0.001).

effectiveness of transitioning or revising the roux-en Y gastric bypass [3,8,10-14].

Unlike other contemporary literature, there appeared to be fewer revisions for gastrointestinal complaints, failure to thrive or medically-protracted conditions [3,15,16]. The percentages of revision cases in our cohort for technical and mechanical complications, as well as fistulas, were consistent with previously reported literature with most cases attempted laparoscopically [3,10,17]. It was interesting that fistulas were often found concurrently with treatment failure cases; however, further studies are needed to elucidate whether this plays a larger role in weight loss in our cohort. We did not necessarily see an increased rate of complications with performing these operations laparoscopically, as revisional bariatric surgery is often quoted as having a complication rate of between 10-50% [8,10,18,19]. Our complication was approximately 22%, albeit, 28% of our cohort had more than one operation. We believe that this approach may be taken and does not necessarily increase the rate of complication at high-volume centers. Juxtaposed to the previously reported operative mortality rates of less than 2.5%, we had no mortalities in our series [8,10,11,13].

Surprisingly none of our comorbid medical conditions reached a statistical significant decrease following re-operations. According to one of the most recent review papers by the American Society for Metabolic and Bariatric Surgery Revision Task Force, resolution of comorbid conditions must be considered as important as and/or more important than reduction in %EBWL and BMI [9]. Given that our study had a shorter follow-up, these conditions may become significant over time. Further long-term studies are needed to elucidate this.

Despite this study's strengths, one limitation is that given our institution is a tertiary referral facility, often we cannot control for loss to follow up, especially in the setting of a retrospective study following revision surgeries. Attrition is not uncommon following bariatric surgery and is possibly related to durable weight loss. In addition, since we are a high volume referral center, some patients choose to establish follow up care with bariatric surgeons closer to home and we do not have the long-term data on co-morbid conditions and longer-term %EBWL.

## Conclusion

Revisional bariatric surgery is now a commonplace surgical intervention. Greater %EBWL occurs between revision surgery and last clinic visit than between the original surgery and reoperation. No single comorbid condition reached statistical significance during the study period; however, there was an overall decrease in the rates of hypertension, diabetes and obstructive sleep apnea. Further research is needed to determine the optimal timing for revisional bariatric surgery once initial treatment has failed to optimize excess weight loss and resolution of comorbid conditions.

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ISSN: 2377-9284

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