Journal of Obesity and Overweight
Volume 6 | Issue 1
ISSN: 2455-7633

Research Article Open Access

Comparison of Outcomes Following Revisional Laparoscopic Gastric Band, Sleeve Gastrectomy and Roux-En-Y Gastric Bypass

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Citation: Riaz AA, Singh K, Askari A, Ferguson J, Talbot ML (2020) Comparison of Outcomes Following Revisional Laparoscopic Gastric Band, Sleeve Gastrectomy and Roux-En-Y Gastric Bypass. J Obes Overweig 6(1): 102

Article history: Received: 18 January 2020, **Accepted:** 03 June 2020, **Published:** 05 June 2020

Abstract

Background: The number of bariatric procedures being performed worldwide has increased markedly over the past two decades and this has led to revisional bariatric surgery being increasingly performed. The aim of this study is to assess outcomes post revisional bariatric surgery in primary Laparoscopic Gastric Band (LGB) patients who went on to have Re-LGB, Laparoscopic Gastric Sleeve (LSG) and Laparoscopic Roux En-Y Gastric Bypass (RYGB) particularly with regards to weight loss, complications and resolution of symptoms.

Methods: A prospective maintained database of 307 patients undergoing revisional bariatric surgery (LGB, LGS, LRYGB) from January 2004 - July 2015 was analysed. The study population was divided into three groups: Group 1 included patients who had their LGB replaced by another LGB (n=84), Group 2 included patients who underwent a LGS (n=77) and Group 3 who had a revisional RYGB (n-144). Patient demographics, reasons for revision surgery, complications, ongoing medical problems, BMI (before and after surgery) and medication changes were all analysed.

Results: A total of 307 patients who had previously undergone LGB were included in this study, of whom 82.4% (n=253/307) were females. The mean age of the population was 40.2 years (range 15-73 years). The main reason for revisional surgery was failure of adequate weight loss (41.4%, n=127/307) and gastro-oesophageal reflux (17.9%, n=55/307). Conversion to LRYBG (47.6%, n=146/307) was the most commonly performed revision procedure followed by repeat LGB (27.4%, n=84/307) and LSG (25.1%, n=77/307) The mean difference between pre-revision and post-revision BMI was 6.9Kg/m2, with the greatest change in BMI occurring in the group going from LGB to LRYGB (mean reduction in BMI: 10.5 Kg/m^2) followed by LGB to LGS (mean reduction; 6.7Kg/m^2). The overall complication rate post revision surgery was 7.5% (n=23/307) and all patients with complications were managed conservatively.

Discussion: Revisional bariatric surgery conveys good outcomes in terms of weight loss and is associated with a low risk of complication. Our study shows that when it comes to revisional bariatric surgery, all three mainstay procedures may be considered depending on specific patient aims and requirements. We have shown that for maintenance of weight loss, LGB would suffice, whereas if further weight loss or control of symptoms is required then either LSG or LYGB should be considered.

Keywords: Obesity Surgery; Revision; Weight Loss

Introduction

The rates of morbid obesity have increased rapidly over the last two decades which has led to a concurrent increase in the number of revisional bariatric procedures being performed worldwide. Surgical intervention has been shown to be the most effective modality at achieving significant weight loss with the best long-term results. The Laparoscopic Gastric Band (LGB), Laparoscopic sleeve Gastrectomy (LSG) and Laparoscopic Roux En-Y Gastric Bypass (LRYGB) are the main procedures used in obesity; accounting for the vast majority of cases [1].

The LGB, after a short duration of popularity has been performed less commonly over the last few years. In fact, a study by Nyguen *et al.* which examined the popularity of procedures between 2008-2012 in the US found that by the end of 2012, gastric banding made up only 4.8% of all bariatric operations performed in US academic hospitals, a drop from 23.8% four years earlier [2]. Over the same time period, sleeve gastrectomy rose from 0.9% to 36.3%. LRYGB in spite of being the most popular procedure performed, the actual numbers decreased over the duration of the study, from 66.8% to 56.4% [3]. The exponential increase in the number of bariatric procedures being performed annually has had an inevitable but significant increase in the requirements for revisional bariatric surgery. The lack of popularity of the LGB has been due to the increased rates of failure and high rates of complications with this procedure [4-6].

Revisional surgery following the insertion of LGB is being required for complications of the procedure namely inadequate weight loss, weight regain, gastro-oesophageal reflux disease, complications of LGB namely slippage, pouch dilatation, dysphagia, erosion as well as infection and mechanical failure. The data in relation to revisional surgery is limited both in numbers and in study designs with the majority being retrospective and uncontrolled studies with a small number of patients. Revisional bariatric surgery has been shown to be more challenging with increased morbidity and mortality [7-10]. Furthermore, there is little consensus as to which is the optimal revisional procedure. This was shown by a study by Patel et al who performed 151 revisional operations utilising a total of nine different procedures [11].

A study by Elnahas *et al.* (2013) looked at 620 patients who underwent revisional LSG and LRYGB for a period of unto 24 months following LGB. Before revisional surgery, the BMI was 38.8 (6.9), 43.3 (8.1), kg/m respectively. At 24 months the BMI was 28 (10.5), 32.2 (6.4) kg/m (2) respectively. In addition, the mean excess weight loss (EWL) was 22% (2.8), 57.8% (11.7), for the LSG, LRYGB. Several studies have shown that RYGB as a secondary intervention following a failed LGB has shown positive results [10-13]. Although the weight loss is not as rapid as after the primary procedure there is continued weight loss, and comparable rates of morbidity and mortality. Furthermore, there are continued improvements in the quality of life and resolution of co-morbidities. The aim of this study is to assess outcomes and complications after revisional bariatric surgery.

Materials and Methods

The motivation of the current study is to share our experience with our series of 307 patients undergoing revisional surgery (LGBLSG and LRYGB) following the insertion of LGB as a primary procedure. The aim of the study is to analyse our series with respect to indications, weight loss following the revision surgery, complications, 30-day hospital re-admission, Body Mass Index (BMI) and hospital stay between the three procedures for a period of 10 years in a single centre series.

Inclusion Criteria

The inclusion criteria for this study were all adult patients (consecutive) undergoing revisional bariatric surgery following primary LGB by a single surgeon or under his direct supervision, at The St George Private Hospital in Sydney, New South Wales, Australia from January 2004 to July 2015.

Patient data were reviewed from the database and also augmented by clinic consultation +/or telephone interview. The data included patient demographics, body mass index, operative times, and length of hospital stay, weight, BMI, and 30-day readmission, re-operation, morbidity, and mortality rates. Data are expressed as mean for continuous variables or as percentage. A total of 498 patients were considered eligible for the study of which 307 (61.6%) were contacted and up to date information included in this study. The indications for revision surgery included inadequate weight loss, weight regain, gastro-oesophageal reflux disease, complications of LGB namely slippage, pouch dilatation, dysphagia, erosion as well as infection and mechanical failure (Figure 1).

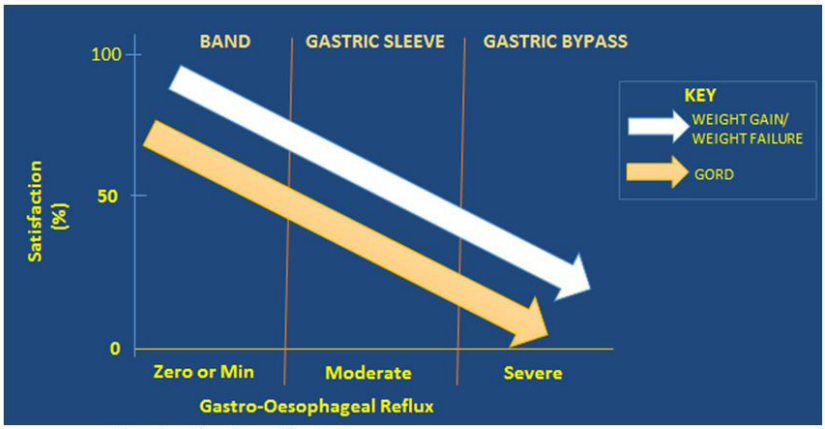

Figure 1: Decision algorithm for revisional surgery

All procedures were performed as a two-stage operation with the LGB being removed at the first operation only and then the revision procedure being performed approximately 12 weeks later. The type of revisional procedure performed was determined by extent of weight loss failure/weight gain, severity of Gastro-Oesophageal Reflux Disease (GORD), patient wishes, vomiting or food intolerance and factors related to the LGB Patients who presented with significant weight failure/weight regain and severe GORD and or who were not tolerating the LGB were advised to undergo either LGS or LRYGB. The greater the weight loss required and the more severe the GORD, the more likely the chance of having a LRYGB (Figure 2). Patient choice was a major factor in deciding the type of surgery and this was accommodated as much as possible. For example, all technical LGB related complications such as infected port, port failure, slippage, pouch dilation was managed with re-do LGB provided that the patient was satisfied to undergo the same repeat procedure and there were no surgical contraindications with the Laparoscopic Gastric Band. At the time of re-do surgery, if there was a significant hiatus hernia, it was repaired using non-absorbable suture to approximate the two crural pillars (Table 1).

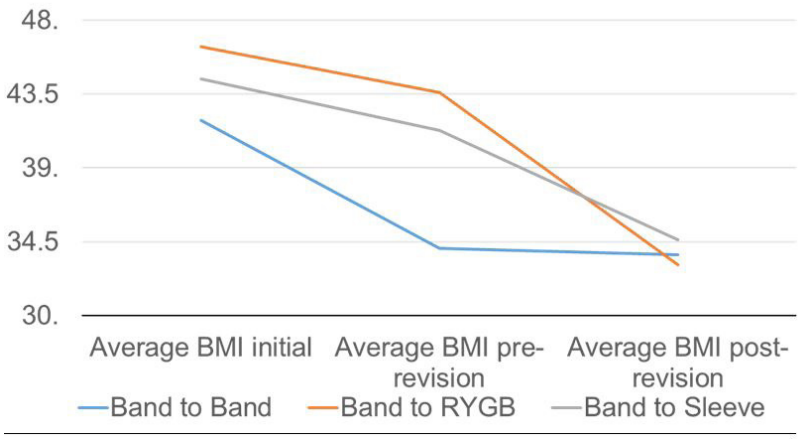

Figure 2: Change in BMI after revisional surgery

Reason for Failure	Band to Band	Band to Sleeve	Band to RYGB
Slipped Band	21	7	12
Inadequate Weight Control	16	39	72
Reflux	21	5	29
Vomiting/Food Intolerance	5	4	6
Infected Band/Port	5	0	0
Mechanical Band Failure	7	2	2
Other	4	7	9
Dysphagia	1	2	0
Pouch Dilation	3	3	3
Missing	1	4	4
Erosion	0	4	8
Total	84	77	145

Table 1: Reasons for Primary failure after LGB

Results

At total of 307 patients were included in this study, of whom 82.4% (n=253/307) were females and the mean age was 40.2 years (range 15-73 years). The mean pre-operative BMI was 44.6 (range 23.5-50.3, SD 8.1). All patients had undergone a previous LGB and the average time since their primary LGB operation and revisional procedure was 59.1 (range 0.5–263.0) months. The mean follow-up post revisional surgery was 29 months (range 2-123 months). The three subgroups of revision procedures included: Group 1 LGB (n=84), Group 2 LGS (n=77) and Group 3 LRYGB (n=145) (Tables 2 and 3).

Cohort	Males	Females	Total	Mean age (yrs)	Time between primary surgery and revision (months)	Mean Height (m)	Mean Maximum Weight (SD)
Band to Band	18	66	84	40.5 (15.2-73.0)	30.9 (0.5-232.1)	1.67	118.0 (23.1)
Band to Sleeve	10	67	77	39.5 (18.4-64.7)	61.8 (13.3-263.0)	1.66	121.0 (24.7)
Band to LRYGB	27	119	146	40.6 (15.9-65.2)	66.8 (4.6-204.5)	1.66	128.9 (27.7)
Overall	55	252	307	40.2 (15.2-73.0)	59.1 (0.5-263.0)	1.66	124.1 (26.3)

Table 2: Patient demographics of the population included in the study (n=307)

Cohort	Mean Initial BMI (SD)	Mean BMI Pre-Revision (SD)	Mean BMI Post-Revision (SD)	Mean reduction in BMI	Mean Follow-up in Months Post-Revision (SD)	Median Follow-up in Months Post-Revision (Range)
Band to Band	41.9 (6.0)	34.1 (6.5)	33.7 (6.5)	0.4	44.4 (33.5)	40.7 (0.5-123.3)
Band to Sleeve	44.4 (8.0)	41.3 (8.4)	34.6 (7.0)	6.7	33.1 (28.9)	23.4 (0.5-121.7)
Band to LRYGB	46.4 (9.0)	43.6 (8.9)	33.1 (8.0)	10.5	28.9 (25.3)	22.1 (0.4-113.3)
Overall	44.5 (8.2)	40.5 (9.1)	33.6 (7.4)	6.9	34.2 (23.9)	23.9 (0.4-123.3)

Table 3: Changes in BMI in different patient groups (n=307)

The most common reason for revisional surgery was inadequate weight loss/weight regain which accounted for 41.4% (n=127/307) of the study population. The other major reason for revision surgery was gastro-esophageal reflux disease which accounted for 17.9% (n=55/307) of patients. In our study severe GORD was a relative contraindication for a revisional LGB and LGS and therefore of these 55 patients, 29 (52.7) underwent a LRYGB procedure for severe GORD. Mild or moderate GORD reflux was managed less vigorously with other factors such as patient wishes, weight issues etc taken into consideration prior to planning revisional procedure. Further, specific LGB related issues for failures such as slippage, infection, pouch dilatation, and band issues (erosion, or failure) were managed with replacement of LGB (Table 4).

Complications	Band to Band	Band to Sleeve	Band to RYGB
Anastomotic Stenosis	0	1	2
Anastomotic Ulcer	0	0	2
Bowel Obstruction	0	2	1
Complex Reflux	0	0	2
Displaced Port	1	0	0
Gastric Fistula	0	0	2
Gastric Perforation	0	1	0
Incisional Hernial	0	0	4
Upper GI Bleed	0	0	1
Volvulus	0	0	2
Other	2	0	1
Total	3	4	17

Table 4: Complications post revisional surgery

There were no significant differences between the three groups in relation to their initial BMI before their primary LGB insertion with a mean BMI +/- SD of 41.9+/-6.0 (Group 1), 44.4+/-8.0 (Group 2) and 46.4+/-8.2 (Group 3) P=0.05. At their pre revision BMI, Group 1 (LGB) patients had a statistically significant lower BMI 41.0+/-6.0 to 34.1+/-6.5 kg/m^2 (P<0.05) whereas Group 2 and Group 3 had no reduction in their BMI's. This perhaps reflects the fact that those patients who had managed to lose appropriate weight with their initial LGB or were getting on well with their LGB were more likely to be treated with another LGB. The post revision BMI taken at their last consultation showed that Group 1(LGB) had maintained their weight loss which is shown with their pre and post revisional BMI being almost unchanged i.e. 34.1+/-6.5 to 33.7+/-6.5 kg/m^2. Furthermore, Group 2 (LGS) and Group 3 (LRYGB) showed a significant reduction in BMI reducing from 41.3+/-8.4 to 34.6+/-7.0 kg/m^2 and 43.6+/-8.9 to 33.1+/-8.0kg/m^2, (p<0.05) (Graph 1). Of note, Group 3 (LRYGB) had a mean BMI reduction after revision surgery of 10.5 BMI units with a mean follow up 29 months.

Post Revisional Surgery Complications and Outcomes

One of the major aims of the study was to record post-operative complications. The overall complication rate post revisional surgery was 7.8% (n=24/307, (Table 5) the majority of which resolved completely with conservative management. Groups 1, 2 and 3 had complication rates of 3.6%. 3.9% and 11.6% respectively. There was no mortality in our series of cases. Post revisional surgery, the majority of patients had a good outcome and succeeded in overcoming the reason for revisional surgery, However, 5.2% (n=16/307) failed to improve (LGB n=9 LGS n=3, RYGB n=4).

Study	Year	Cases (n)	Complication (%)
Koursheed	2010	42	14.2
Patel	2010	33	13.2
te Riele	2008	55	30.9
Iannelli	2008	18	22
VanWageningen	2006	26	17
Riaz (current study)	2019	307	7.5
Weber	2003	32	6.2

Table 5: Studies looking at complications after Revisional RYGB

Discussion

Our study highlights that revisional bariatric surgery is not only feasible but delivers excellent further weight loss; resolution of symptoms (especially when the primary LGB is converted into LSG or RYGB) and it is also safe. Notably, the present study has shown no mortality and revisional surgery is associated with a low rate of complications (n=23, 7.5%). The reported rate of complications in revisional bariatric surgery has varied in the literature between 6-30% [5-8,11,12]. Of note, the most serious complications, i.e. anastomotic stenosis and bowel obstruction are uncommon, with only six patients (2.0%, n=6/307) experiencing these complications.

There is evidence in the literature showing that LGB are notorious for complications and a significant portion of individuals will require some sort of revision. Furthermore, the LGB has fallen away from popularity with number of patients wanting LGB falling greatly. To highlight this Koy *et al.* (JAMA 2017) from a 6-year US series of 28,202 patients who underwent LAGB insertion noted that the annual procedures decreased steadily. In the same time period, 12,157 patients underwent LAGB removal (43%). In 2013 the last year of the study, the number of LAGB explanation procedures exceeded that of implantation. Indeed, like our studies the reasons for LGB failures include inadequate weight loss/weight gain, GORD, LGB issues (slipped band, patient intolerance, erosion, mechanical band failure, proximal pouch enlargement, intractable vomiting, and port and tubing problems) [13-15].

Whilst LRYGB appears to give the maximal weight loss in primary as well as revisional surgery, it does also appear to have the highest rate of complications associated with it. This was the case in both our study as well as the reported literature. The main concern regarding revisional bariatric surgery is whether the weight loss obtained is adequate to justify the risk of complications, although an increasing number of authors are reporting that the risk of complications in revisional bariatric surgery is not significantly greater than in primary surgery [16-18].

In our study our low morbidity and mortality is in part aided by the fact that this is a single surgeon experience who is also associated with a Centre of Excellence as well as a High-Volume Bariatric Centre (The St George Private Hospital in Sydney, New South Wales, Australia). Accordingly, it has sufficient infrastructure in place which includes: 24 hr specialist bariatric cover, common protocols regardless of surgeon, engaged hospital staff/ up to date and regular training on management of bariatric patients and ability to manage own complications strict patient protocols are in place all of which have been shown to reduce both morbidity and mortality [2,3,19-21].

Another very important factor that the authors feel may have contributed to the low rates of morbidity and mortality is the intervening gap of at least 12 weeks between the LGB removal and the revisional surgery. Although this is not commonly practiced in our experience, we have anecdotal evidence in the form of photographic evidence at the removal and revisional stage showing that this reduces the inflammation adhesions and hostility of the operative site and subsequently makes the revisional surgery easier. In the current study almost all the patients were private patients and hence were well informed and relatively forthright with their wishes. The choice of revisional procedure is determined by the surgeons recommendations, patient wishes, weight loss goals and severity of symptoms. For example, if the primary procedure (LGB) had fulfilled the weight goals with manageable symptom and the reason for the revisional surgery is the LGB failure then this is simply replaced by another LGB or part thereof. If there is inadequate weight loss/weight regain, severe GORD, intractable vomiting and pain, other options such as a LSG, or RYGB will be considered. The decision is based on the patients' goals severity of symptoms and expectations. For example, if there is weight gain, severe GORD and uncontrolled medical conditions such as Non-Insulin Dependent Diabetes Mellitus (NIDDM), hypertension then a RYGB would be the first choice.

The current study contains 307 patients which is a large of cases series looking at Revisional Bariatric surgery. Table 5 shows comparable series which shows complication rates between 6.2-30%. Our study shows complications rates of 7.8% and sits on the lower side of the complication scale. The other positive of our study is the relatively large numbers in our series and the extended follow-up. It is also important remember that the type of revisional surgery undertaken offers significantly different levels of risk in terms of complications. In our study Group 1 (LGB) had the lowest number of complications; with three patients experiencing complications of port displacement, Transient Ischaemic Attack, port site hematoma). The TIA and the port site hematoma were treated conservatively whereas the other was treated with surgery and made a full recovery. Complications with Revisional RYGB which were more common, complex, and significant (n=17, 74%): OGD and dilation, four hernias (two internal, PUH, incisional), two anastomotic ulcers, two fistulae (GG and GE fistula), and UGI bleed (Table 4). This is in keeping with the reported literature, the majority of complications being in the LRYGB group [22].

A common issue facing patients following post revisional bariatric surgery, is whether the benefits of increased weight loss, resolution of NIDDM, HT and GORD against the increased risks of complications, mortality and long-term issues of undergoing a more complex procedure RYGB/LSG rather than LGB. We found that patients who underwent a re-do gastric band experienced no significant further weight loss. However, those converted into RYGB or LSG had a further significant substantial weight loss comparable to primary LGB (Graph 1). Other authors have also reported that revisional surgery can offer an excellent rate of weight loss albeit with significant variation in results across different bariatric centres for both primary and revisional surgery depending on the revisional procedure chosen [23,24]. Much has been written on improving outcomes and reducing complication rates in primary bariatric surgery by centralising bariatric services25, however, there is very little data on outcomes in revisional surgery.

In the present study we had a 30-day readmission rate of 2.8% (n=307), this is well within the readmissions rates for primary surgery published in the literature of 0.6-6.6% [20-23]. LGB is associated with high rates of complications such as pouch dilation, slippage, erosion and failure [6,8-10] requiring significant re-intervention. Revisional LSG and RYGB has been shown to be associated with significantly higher rates of morbidity, mortality and the requirement for even further surgical intervention [24,25]. The most significant limitation of this study is the lack of randomisation between the Revisional Groups I-III. Each patient was managed individually and their management planned agreed. The current study although has large numbers are private patients of a single

surgeons practice which has to be taken within a Centre of Excellence, high volume set up as part of a larger Bariatric service. This practice will undoubtedly be different to the experience of other colleagues around the world and therefore extrapolating these findings to other hospitals with different patient populations, healthcare economies, clinical practices and administrative models maybe a little difficult.

Our study confirms what has previously been shown with regards to revisional bariatric surgery and builds on the published literature. Taken together, this study provides further evidence that revisional Bariatric surgery is safe and can be associated with low morbidity and mortality. Furthermore, our study highlights that revisional surgery is associated with significant weight loss and resolution of symptoms, and all options in the surgeons armoury should be considered. Our study highlights that all three Study Groups have a reduction in their BMI. Group 1 (LGB) maintained the significant weight loss (after their primary procedure) and following their revision surgery and Group 2 (LSG) and Group 3 (RYGB) made a further significant reduction in BMI (RYGB>LSG) over the study period. Furthermore, revision LGB has been shown to be a safe and effective in maintaining the previously attained weight loss.

Conflict of Interests & Funding

The authors declare no conflict of interests and no funding has been sought for this study.

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