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RESEARCH ARTICLE

Revisional Bariatric Surgery

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Abstract
Background Revisional surgery is required in a significant number of patients because of failure to lose weight, loss of quality of life, weight regain, or complications of the previous procedure. It has traditionally been associated with higher complication rates, and there appears to be no standardized surgical approach to revisional surgery. The aim of the study was to review the revisional procedures performed at St George Private Hospital and analyze the outcomes of the different types of revisional surgery.
Methods We performed a retrospective review of 75 patients who underwent revisional surgery between December 2003 and October 2007. Demographic, anthropometric, perioperative, and clinical follow-up data were collected, and statistical analyses were performed using SPSS version 14.0.
Results Sixty-six of the 75 patients were female. The mean age at the time of revision was 46.32 (22–68) years. Mean initial weight was 119.08 kg, and body mass index (BMI) was 43.42 kg/m^2. The lowest BMI and excess weight loss (EWL) recorded after primary surgery was 36.9% and 53.5%, respectively. At the time of revision, the mean EWL was 24.79. The EWL at 3 months and 6 months were 41.7% and 47.8%, respectively. Revision was performed laparoscopically in 51 patients and via laparotomy in 24 patients. There was no mortality in the cohort, but there were 17.3% minor and 4.0% major perioperative morbidities.
Conclusion Our study suggests that revision can be performed safely. Weight loss is satisfactory, and complications of the previous operations were all reversed. Furthermore, revisions may be done laparoscopically, including those who had previous open procedures.

Keywords Revision · Bariatric surgery · Morbid obesity · Laparoscopy · Gastric bypass · Gastric band · Sleeve gastrectomy

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Introduction

Drug therapy or conservative treatment of obesity is generally ineffective. Bariatric surgery has proven its effectiveness in achieving and maintaining weight loss and improving obesity-related co-morbidities, quality of life, and survival [1, 2]. As demand for bariatric surgery increases, so too will the need for revisional surgeries. The revision rate following primary bariatric surgery is reported to be between 10% and 25% [3].

In this study, we describe our experience of revisional bariatric surgery in a case series comprising 75 patients. The aim of this study was to audit revisional surgery at St George Hospital Private Hospital.

Table 1 Demographic and anthropometric characteristics of revisional cases

	At primary operation	At revision
M/F sex ratio	9:66	9:66
Age in years	39.59 (20–66)	46.32 (22–68)
Weight in kg	13.05 (71–250)	119.08 (55–192)
% Excess weight loss	0	24.79 (−82.93–135.33)
BMI	49.10 (32.70–73.84)	43.42 (21.52–69.03)

Patients and Methods

The study population consisted of 75 patients who underwent revisional bariatric surgery between December 2003 and October 2007. Clinics and telephone follow-up findings over 6 months, demographic data, medical history, and bariatric history, including type of procedure, complications, and weight loss, were recorded. The preoperative workup for patients undergoing revisional surgery included biochemical and nutritional screen, gastroscopy, and/or upper gastrointestinal barium studies.

All patients were put on the Optifast® VLCD™ (Novartis, Australia) diet for at least 2 weeks prior to revision. Statistical analyses were performed with SPSS version 14 using the *t* test and ANOVA for continuous data and chi-square or Fisher's exact test for independent categorical data.

Results

Table 1 shows the demographic and anthropometric characteristics of the patients at the time of primary and revisional surgery. Sixty-six of the patients were female. The mean age at the time of revision was 46.32 (22–68) years. Mean weight was 119.08 (55–192) kg, and body mass index (BMI) was 43.42 (21.52–69.03). The lowest mean BMI and mean excess weight loss (EWL) recorded after primary surgery was 36.9% and 53.5%, respectively. At the time of re-operation, weight regain had occurred such that the mean EWL was 24.79%. Although the majority were morbidly obese or more, there were 16 (21%) who had a BMI of less than 35.

Table 2 Latest bariatric procedure

Operation type	Number of patients
Gastric bands	35
Vertical banded gastroplasty (VBG)	17
Sleeve gastrectomy	18
Biliopancreatic diversion (BPD)	1
Transverse loop bypass	1
Roux-en-Y gastric bypass (RYGBP)	1
B2 bypass	2
Total	75

Table 3 Reason for revisional surgery

Reason for revisional surgery	Total
Band-related problems[a]	24
Inadequate weight loss	22
Weight regain	12
Staple line disruption	7
Obstructive symptoms	4
Poor patient compliance	4
Severe nutritional deficiency	1
Stomal ulcer	1
Total	75

[a] Band-related problems include band erosion, slippage, malposition, and rupture

Table 2 shows details of the last bariatric operation prior to revision. The most common operations were gastric bands, vertical banded gastroplasties (VBGs), and sleeve gastrectomies. Fifty-two of these patients underwent laparoscopic surgery, while the remaining 23 underwent laparotomy. Thirteen patients had had multiple previous bariatric operations—four had three previous procedures, and nine had two previous procedures.

The reason for revisional surgery is shown in Table 3. Band-related problems, inadequate weight loss, and weight regain were the most common reasons, accounting for 58 (77.33%) of 75 cases.

Figure 1 shows the surgical approach used in the revisional operations. The operations were performed laparoscopically in 51 patients and via laparotomy in 24 patients.

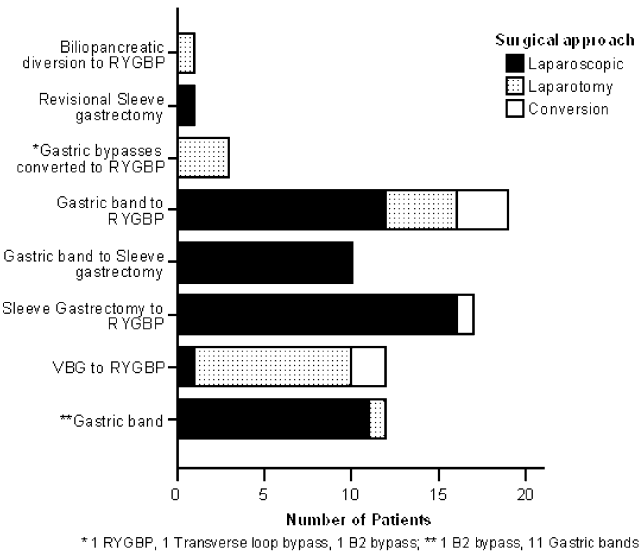

Fig. 1 Surgical approach

Table 4 Type of revisional surgery

Type of revision	Number
Gastric band	12
Sleeve gastrectomy	11
RYGBP	35
Staged sleeve gastrectomy to RYGBP	17

All gastric bands to sleeve gastrectomies were done laparoscopically, and all repeat gastric bands except for one were done laparoscopically. The repeat banding that was done via laparotomy was in a patient who had a previous B2 bypass. This same patient did not achieve any further weight loss and later developed a bowel obstruction related to her B2 bypass and had the gastric band removed as it did not have any beneficial effects. Her data were included to accomplish an intention to treat analysis. All but one (converted to laparotomy) sleeve gastrectomy to RYGBP was done laparoscopically, and the majority of gastric bands to RYGBP were done laparoscopically. A total of six patients were converted from laparoscopy to laparotomy due to technical difficulties. Seven patients who previously had open procedures underwent laparoscopic revision. Four were successful (two repeat gastric bands, one VBG to RYGBP, one gastric band to sleeve gastrectomy), but three had to be converted to laparotomy (two VBG to RYGBP, one gastric band to RYGBP). Therefore, three (50%) of the six converted cases were in patients who had previous laparotomies.

Patients who had a previous VBG were more likely to undergo laparotomy when compared to those who had sleeve gastrectomy ($p<0.001$) or gastric bands ($p<0.001$). Patients who had only one previous bariatric procedure were more likely to undergo laparoscopic revision ($p=0.001$).

There was no significant difference in the age of patients who underwent the different types of revisional surgery ($p=0.543$). However, BMI was significantly higher in patients who underwent RYGBP when compared to those who underwent repeat gastric banding ($p=0.008$).

Patients undergoing revisional surgery were divided into two groups: One group had a staged sleeve gastrectomy to RYGBP (group 1) and the other had a single, standalone operation (group 2) (Fig. 2). The mean initial excess weight of group 1 patients at sleeve gastrectomy was 84.67 kg compared to 60.54 kg in group 2 patients ($p=0.008$). The % EWL of group 1 patients just before RYGBP was higher than group 2 patients, but the difference was not statistically significant ($p=0.142$). There was no significant difference between these two groups for age and sex. Group 2 patients comprised those who had sleeve gastrectomies, gastric bands, or RYGBP. The preoperative %EWL of those undergoing RYGBP was 8.98% compared to 37.48% in the remaining members of the group taken together ($p=0.023$). The preoperative %EWL for group 2 patients revised to RYGBP was 8.98%, and for those who underwent staged sleeve gastrectomy before RYGBP, it was 40.14% ($p<0.001$).

Table 5 shows the complications of revisional surgery. There was no mortality in the cohort, but there were 17.3% minor and 4.0% major perioperative morbidities. Minor complications occurred in seven patients who underwent RYGBP compared to no patients undergoing banding ($p=0.037$). Other comparisons did not yield significantly different results. There was one (1.92%) anastamotic leak among the 52 RYGBP cases.

Figure 3 shows the duration of operation and length of stay according to type of revision. RYGBP took significantly longer than gastric banding ($p=0.001$) and staged sleeve gastrectomy to RYGBP ($p=0.008$). There was no significant difference in operation times between the other groups. Patients who had undergone RYGBP required a significantly longer convalescent period in hospital when compared with patients who underwent banding ($p<0.001$) and sleeve gastrectomy ($p<0.001$). The length of stay in hospital for

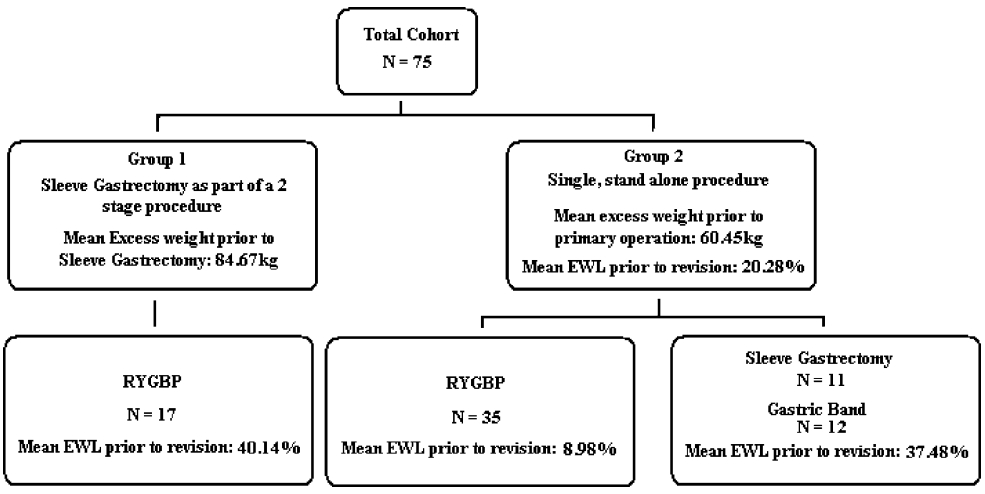

Fig. 2 Categories of patients undergoing revisional surgery

Table 5 Complications of revisional surgery

Type of surgery	Minor complications[a]	Major complications[b]
Gastric band	0 (0.0%)	1 (8.3%)
RYGBP	7 (20.0%)	0 (0.0%)
Sleeve gastrectomy	1 (9.1%)	1 (9.1%)
Sleeve gastrectomy to RYGBP	6 (29.4%)	1 (5.9%)
Total	13 (17.3%)	3 (4.0%)

[a] Minor complications: pneumonia (1), wound infections (4), stricture-pneumatic dilatation (4), non-specific fever/abdominal pain (4)
[b] Major: bleeding requiring gastroscopy and hemostasis (sleeve gastrectomy; 1), omental patch for anastomotic leak (sleeve gastrectomy to RYGBP; 1), bowel obstruction (repeat banding; 1)

patients who underwent the staged sleeve gastrectomy to RYGBP compared to repeat banding was also significantly longer (p=0.004).

Figure 4 shows the change in %EWL of the entire cohort, which was 41.7% at 3 months and 47.8% at 6 months. These figures were statistically higher when compared with the % EWL at the time of revision (p<0.001; p<0.001, respectively).

Figures 5 and 6 show the progress of %EWL according to each procedure. %EWL change was significant for RYGBP at 3 months (p<0.001) and 6 months (p<0.001) but not for rebanding (p=0.978 and p=0.791, respectively). The increase in %EWL was significant for patients who underwent sleeve gastrectomy to RYGBP at 3 months (p=0.033) but not 6 months (p=0.240). There was a wide variation in the %EWL at 3 and 6 months for patients converted to sleeve gastrectomy and no significant difference when compared with the %EWL at the time of revision (p>0.05). Change in %EWL was significantly better in patients who underwent RYGBP than gastric bands at 6 months (p=0.01).

Discussion

Revisional surgery will increase as the number of bariatric operations increase. In this study, the most common reasons for revisional surgery were inadequate weight loss, weight regain, and band-related problems. Other studies have also cited inadequate weight loss and side effects of previous bariatric surgery as the most common reasons for revisional surgery [4–8].

The incidence of revision varies according to the previous type of bariatric surgery. Van Gemert et al. reported a 56% incidence of revision after primary VBG over a 12-year period compared with a 12% incidence of revision after RYGBP [9]. The incidence of revision after gastric banding is variable, ranging from 3.5% to 60% [10, 11]. In our own series, four (5%) of the 75 patients undergoing revision had previous malabsorptive procedures; the remaining 71 (95%) patients had restrictive bariatric surgery. One of these patients had previous RYGBP and was operated for stomal ulcer. RYGBP is frequently performed in this center, so the scarcity of RYGBP among patients undergoing revision suggests that RYGBP is less likely to require revision.

Overall, revisional cases achieved significantly better weight loss at 3 and 6 months when compared with baseline values at the time of revision. Mean %EWL was 41.7% and 47.8%, respectively. This shows that revisional surgery is effective in achieving short-term weight loss. Other studies have reported successful short- to medium-term weight loss after revisional surgery [4, 5, 9, 12–15]. There was no statistical significant difference between % EWL after revision and the best %EWL achieved after the last bariatric procedure, suggesting that revisional surgery can achieve weight loss comparable to primary surgery. Revision of other procedures to RYGBP has been reported to produce weight loss comparable to primary surgery [4, 5]. All complications from the primary procedure were reversed after revision.

Failed gastric bands are normally rebanded, or the band is removed and revised to RYGBP. Our results on rebanding showed no significant change in %EWL at 3 and 6 months compared to baseline %EWL. Literature suggests that

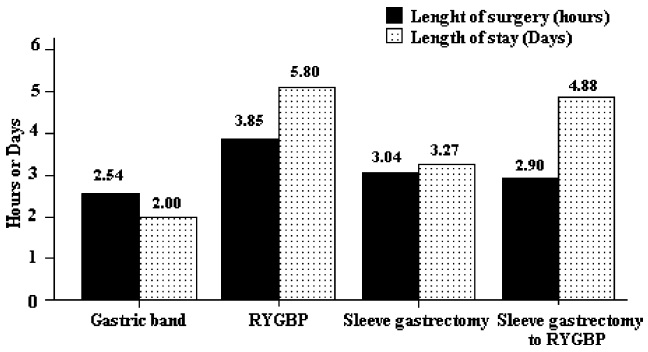

Fig. 3 Operative details of patients undergoing revisional surgery

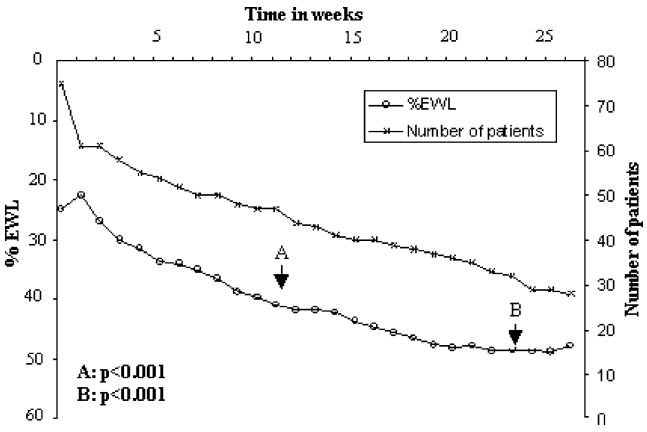

Fig. 4 Progress of %EWL for the entire cohort

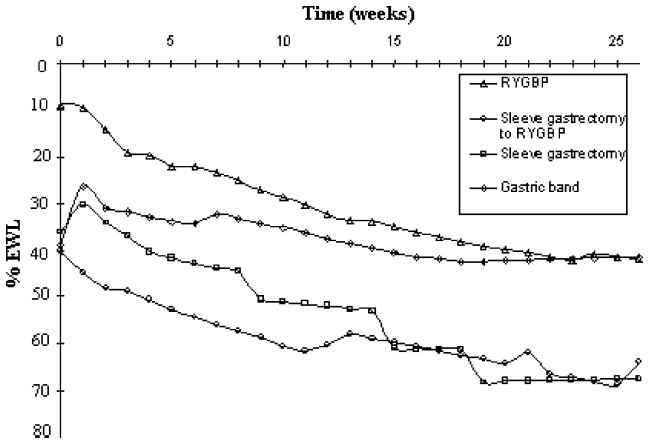

Fig. 5 Progress of %EWL according to each procedure

rebanding after failed adjustable gastric banding or VBG after previous VBG were not as effective as conversion to RYGBP [16, 17]. Likewise, we did not find any significant difference in %EWL in patients who underwent sleeve gastrectomy as a standalone procedure. These findings suggest that restrictive surgery may not be very effective as a revisional procedure for inadequate weight loss. In contrast, %EWL change was significant at 3 and 6 months for all patients who were converted to RYGBP and at 3 months (though not 6 months) for those who had sleeve gastrectomy converted to RYGBP. %EWL was significantly higher for RYGBP than banding (p=0.01). Angrisani et al. [18] and Sjostrom et al. [19] have illustrated the superiority of RYGBP over purely restrictive procedures in the setting of primary bariatric surgery, so it is hardly surprising to find the same in revisional RYGBP.

Revisional surgery is technically more difficult and associated with a higher morbidity and mortality compared to primary procedures. Mortality rates of 0.1–0.2% have been reported for primary bariatric surgery [20]. A review of revisional bariatric surgery by Jones reported a 14% major complication rate and a 0.86% mortality rate [21]. Sugerman et al. reported no deaths in patients revised to RYGBP [4]. The major complication rate in our own study was 4%, and there was zero mortality. Revision of previous bariatric procedures carries a higher risk of leakage, reportedly as high as 19% [22]. Indeed, revisional surgery has been identified as one of the most influential factors for predicting major complications after open RYGBP [23]. Gastrointestinal anastomotic leak after an RYGBP is a known complication with a reported incidence of 1% and 5.1% [24, 25]. In our series, there was one leak occurring in a patient who had staged sleeve gastrectomy to RYGBP and concomitant small bowel resection.

Laparoscopic bariatric surgery is becoming the standard primary surgical treatment for morbid obesity [26–28]. Although revisional bariatric surgery is traditionally performed by laparotomy because of adhesions and uncertain anatomy, there has been an increasing trend to use laparoscopy for revisional surgery. Fifty-one of our cases underwent laparoscopic revision, and the rates of major and minor complications in laparoscopic group were not significantly different from the laparotomy group (p=0.960, p=0.107, respectively). Additionally, four of seven patients who previously had open procedures underwent successful laparoscopic revision. This suggests that laparoscopic revisional surgery can be performed on previously open bariatric cases as has been the experience of others [29–31].

The mean duration of surgery was 2.54 h in patients undergoing rebanding and 3.85 h in those undergoing RYGBP. This is within the range of published figures for laparoscopic banding [3, 32, 33] and open and laparoscopic RYGBP [30, 34, 35]. The length of stay in our laparoscopic group was significantly shorter compared to open surgery (p<0.001). Interestingly, the laparoscopic operations were also significantly shorter when compared to open surgery (p=0.001). This is most likely due to careful preoperative evaluation and selection of patients such that more complicated cases ended up having open surgery. Our finding that patients who had one previous procedure were significantly more likely to undergo laparoscopic surgery at revision compared with those who had multiple bariatric procedures corroborates this. Patients who underwent VBG in the past were also more likely to undergo laparotomy.

Our results showed that patients with a higher excess weight (mean of 84.67 kg) and BMI (mean of 55.59) were more likely to undergo staged sleeve gastrectomy to RYGBP. This may suggest that there is a general tendency for surgeons in our center to use staged operations in the super obese. The effectiveness of sleeve gastrectomy in producing initial weight loss is corroborated by a %EWL of 40.14% at the time of RYGBP. Patients who re-presented with a lower EWL were more likely to undergo RYGBP.

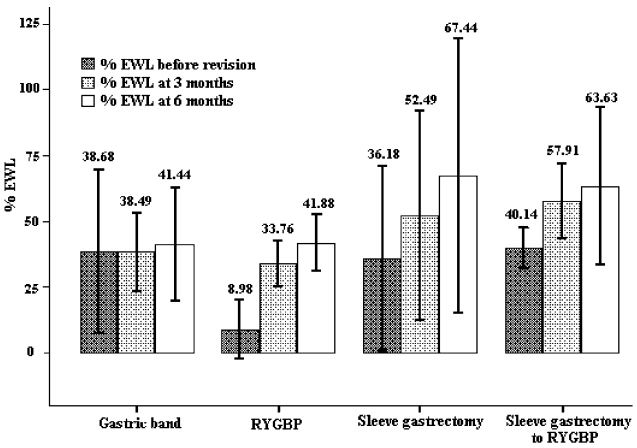

Fig. 6 Bar chart showing progress of %EWL according to each procedure

Our study suggests that revisional bariatric surgery can be performed safely with satisfactory short-term weight loss. Furthermore, revisions may be done laparoscopically, including those who had previous open procedures. Longer follow-up is required to evaluate weight loss and effect on co-morbidities after 5 years and study the late complications compared to primary surgery. More cases of laparoscopic revision of failed open bariatric procedures are required to determine its place in revisional surgery.

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