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NEW CONCEPTS

# Laparoscopic Reconversion of Roux-en-Y Gastric Bypass to Original Anatomy: Technique and Preliminary Outcomes

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**Abstract**
*Background* Laparoscopic Roux-en-Y gastric bypass (RYGB) is one of the most common bariatric procedures performed. Dumping syndrome, intolerance to RYGB-induced restriction, and weight loss issues are possible problems bariatric surgeons are confronted with. This study reports the feasibility, safety, and outcomes of laparoscopic reconversion of RYGB to original anatomy (OA) as treatment of these complications.
*Methods* Between January 2005 and April 2008, eight patients benefited from laparoscopic reconversion of RYGB to OA. Reason was dumping syndrome without postprandial hypoglycemia (three), intolerance to RYGB-induced restriction (three), too much (one) and too little weight loss (one). Mean weight and body mass index (BMI) at RYGB were 104.7±19.3 kg and 38.7±6 kg/m$^2$, respectively. Four patients suffered of obesity co-morbidities. Mean time between RYGB and reconversion was 21±18.8 months. Mean weight, BMI, and % excess weight loss at reconversion was 66.8±21.7 kg, 20.1±7 kg/m$^2$, and 23.7±55%, respectively. The procedure involved dismantling both gastrojejunostomy and jejunojejunostomy, reanastomosing gastric pouch to gastric remnant, and proximal alimentary limb end to distal biliary limb end.
*Results* Mean operative time was 132.2±29.5 min. There were no conversions to open surgery and no early complications. Gastrogastrostomy was performed manually (four) and by linear stapler (four), and jejunojejunostomy by linear stapler (eight). Mean hospital stay was 7.7±3.5 days. After a mean follow-up of 18.3±9.2 months, two patients continued to further lose weight, two patients maintained the same weight, and four patients presented weight regain. Gastroesophageal reflux disease appeared in three patients.
*Conclusions* Laparoscopic reconversion of RYGB to OA is feasible and safe. Dumping syndrome and intolerance to RYGB-induced restriction are resolved. The anatomy remains one of the aspects besides nutritional and psychological factors in cases of reconversion for weight issues.

**Keywords** Gastric bypass · Complications · Conversion · Original anatomy · Laparoscopy

## Introduction

Roux-en-Y gastric bypass (RYGB) and adjustable gastric banding are actually the two most commonly bariatric procedures performed. The procedure of RYGB leads to a % excess weight loss (%EWL) reported at medium term of 43–68.1% [1–3], with improvement of almost all conditions related to obesity [4]. However, this procedure needs a multidisciplinary follow-up because it may lead to some serious problems.

One problem associated with RYGB is dumping syndrome, which is clinically characterized by postprandial sweating, flushing, dizziness, weakness, tachycardia, palpitations, diaphoresis, and lassitude. This can be attributed to the rapid entrance of hyperosmotic foods to the jejunum which, according to one hypothesis, causes a fall in blood volume and significant sympathetic stimulation from various pressoreceptors [5]. It is also related to the effect of hyperosmolar fluid on the argentaffin cells in the small

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intestinal mucosa, causing release of vasoactive serotonin and vasomotor effects. A third explanation of the syndrome is hypoglycemia provoked by excessive intake of rapid sugars or foods with high glycemic index, which because increased insulin sensitivity induces abrupt glucose fluctuations in the blood [6]. In bariatric surgery the dumping syndrome has been considered as a beneficial feature because patients learned to avoid calorie-dense foods and ate less at one time [7].

Despite adequate dietary counseling (small meals, little carbohydrates), patients with RYGB still can fail to comply with restriction caused by the procedure, with subsequent excessive dumping, vomiting episodes, and abdominal pain.

Another possible problem in patients after RYGB is related to weight loss, either too much or too little. The precise mechanisms whereby RYGB achieves sustained weight loss remain unknown, but many of the changes in gastrointestinal hormones, adipokines, and cytokines as well as in hypothalamic neuropeptides and neurotransmitters resemble the changes observed in cachexia rat model [8]. Hence, in humans, RYGB triggers a catabolic state responsible for loss of appetite and prolonged body weight reduction. The opposite situation of unsuccessful weight loss after RYGB can occur with poor dietary compliance, resulting in high caloric intake.

This study reports the feasibility, safety, and outcomes of laparoscopic reconversion of RYGB to original anatomy (OA) in patients presenting complications as dumping syndrome, intolerance to dietary restriction due to procedure, and weight loss issues.

## Patients and Methods

Between January 2005 and April 2008, eight patients (all females) previously submitted to laparoscopic RYGB benefited from laparoscopic reconversion to OA. Mean age was 44± 12.4 years (24–59). RYGB was performed in all the patients with an alimentary limb of 150 cm, in an antecolic antegastric position. Reason of reconversion was exaggerated dumping syndrome without postprandial hypoglycemia (three), intolerance to RYGB-induced restriction (three), too much weight loss (one), and too little weight loss (one) (Table 1). Mean weight and body mass index (BMI) at the time of RYGB were 104.7±19.3 kg (73–131) and 38.7±6 kg/m$^2$ (30–46), respectively. Four patients suffered of obesity-related comorbidities. Mean interval time between RYGB and reconversion to OA was 21±18.8 months (7–60). Mean weight, BMI, and %EWL at the time of the reconversion were 66.8± 21.7 kg (48–110), 20.1±7 kg/m$^2$ (16.6–38), and 23.7±55% (0–122.3), respectively.

Multidisciplinary consultation, involving nutritionist's and psychologist's counseling, blood tests, gastroscopy, and barium swallow, permitted to rule out the presence of technical failures of the Roux-en-Y construction in all the patients and to exclude the presence of hyperinsulinemic hypoglycemia in three patients with dumping syndrome. In these patients, the lab work failed to show fasting hypoglycemia, elevating insulin and C-peptide levels and cholesterol values within acceptable limits. One patient suffered of a dietary behavior (sweet eating), and OA was offered as first stage for a subsequent new bariatric procedure, in accordance with the patient's preference. Four other patients were psychologically labeled as loss of control.

**Table 1** Reason of reconversion of RYGB to OA

| Number | Reason of reconversion |
|---|---|
| 1 | Intolerance to RYGB-induced restriction |
| 2 | Too little weight loss |
| 3 | Dumping syndrome |
| 4 | Intolerance to RYGB-induced restriction |
| 5 | Dumping syndrome |
| 6 | Dumping syndrome |
| 7 | Too much weight loss |
| 8 | Intolerance to RYGB-induced restriction |

Our study had a main objective to describe our experience with the reconversion technique; therefore, our analysis was descriptive in nature and we did not have, at study start, formulated any formal hypothesis test to conduct and we did not perform any a priori sample size estimation. Furthermore, despite 3 years of accrual, sample size remained limited and our analysis used only descriptive methods. We used as main criteria of evaluation the %EWL, which was defined as the relative reduction of the weight in excess, the weight in excess being calculated on the basis of an ideal weight corresponding to a BMI of 22 kg/m$^2$. The reference weight for the calculation of %EWL is the weight before the procedure of RYGB. For categorical variables, we reported frequencies and for continuous variables, we used mean and standard deviation as position summary parameter and dispersion summary parameter, respectively.

### Technique

The patient was positioned supine with the legs and with both arms in abduction (French position). The surgeon stood between the patient's legs, the person holding the camera was to the patient's right and the assistant to the patient's left. The procedure started with the insertion in the abdomen of the first 12-mm trocar, using the Hasson technique, on the left upper quadrant mid-clavicular line. Four additional trocars were placed under view, usually at the same position as the original surgery, mostly without any further dissection: a 5-mm trocar on the left anterior

axillary line at 5 cm distal to the costal margin, a 10-mm trocar at some 20 cm below the xyphoid process, a 12-mm trocar on the right mid-clavicular line on the same horizontal line, and a 5-mm trocar just distal to the xyphoid process. The alimentary loop was identified and the adhesions between the peritoneal sheet and greater omentum and/or small bowel, and between the left liver lobe and the gastrojejunostomy were severed, trying not to damage the hepatic capsule. The stomach was sectioned by a firing of linear stapler green load (EndoGIA, Covidien, New Haven, CT, USA) just proximal to the anastomosis, in healthy tissue, care being taken not to devascularize the little stomach pouch, which usually survives on one or two branches of the left gastric artery (Fig. 1). Subsequent dissection of the gastric remnant was kept minimal just sufficiently so as to allow linear stapler or manual suturing technique. The linear stapled gastrogastrostomy was performed with one firing of blue load, and introduction openings were closed with two 1 polydiaxone (PDS) running sutures. The manual gastrogastrostomy was fashioned in one layer using two 1 PDS running sutures (Fig. 2). The jejunojejunostomy was localized and the three components (alimentary, biliary, and common limbs) were identified. The anastomosis was dismantled by firings of linear stapler blue load, more of which were required on the distal end of the biliary limb than of the distal end of the alimentary limb (Fig. 3). The proximal end of the alimentary limb and the distal end of the biliary limb were then anastomosed by a linear stapler white load, and the enterotomy was closed by two 2/0 PDS running sutures (Fig. 4). The blind loop of these latter both limbs was resected after the jejunojejunostomy (Fig. 5). The mesenteric window, created at the time of RYGB, was closed hereby reestablishing the OA, using a non-absorbable purse string suture (1 polypropylene). The gastrointestinal conti-

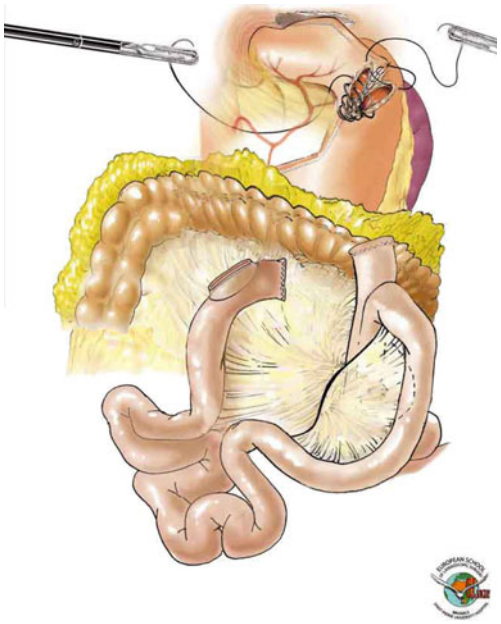

**Fig. 2** Restoration of the gastric continuity through a manual gastrogastrostomy between the gastric pouch and the gastric remnant

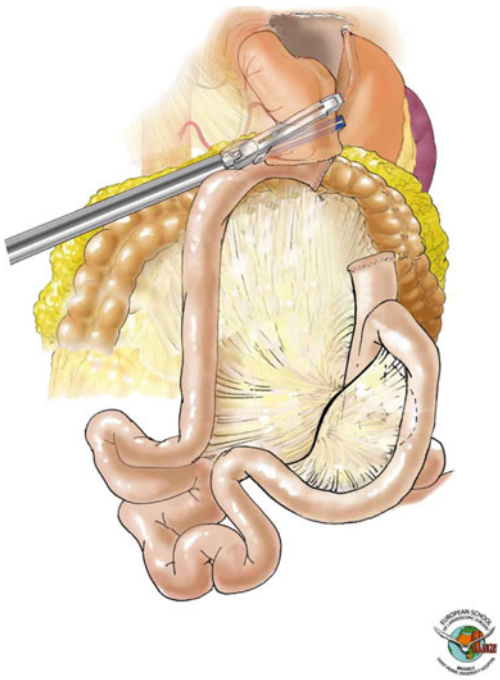

**Fig. 1** Dismantling of the previous gastrojejunostomy on the gastric side

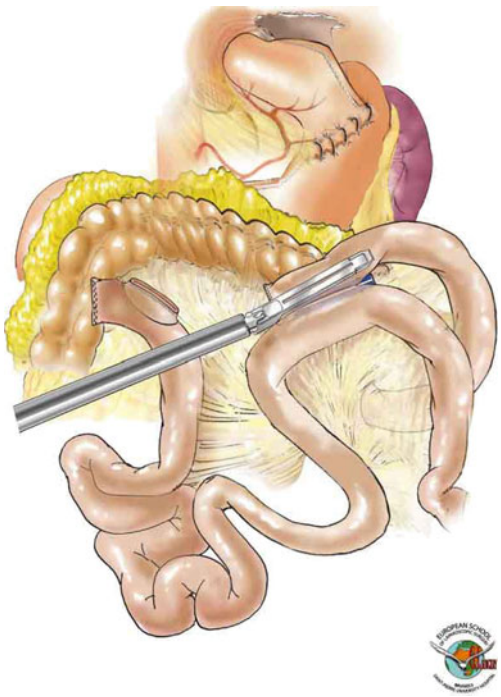

**Fig. 3** Dismantling of the previous jejunojejunostomy (more on the biliary limb)

**Fig. 4** Restoration of the small bowel continuity through a new jejunojejunostomy, performed between the previous alimentary proximal end, and the previous biliary distal end

**Fig. 5** Sectioning at the new jejunojejunostomy of both extremities of previous alimentary proximal end, and previous biliary distal end

nuity was checked by insufflation of compressed air through the orogastric bougie. A drain was left in the abdominal cavity near the gastrogastrostomy. The specimen was retrieved from the abdomen by enlarging the left 12-mm upper quadrant trocar, which was subsequently closed in layers. A methylene blue swallow was realized on the first postoperative day, and if negative a liquid diet was started on second postoperative day. The patient was usually discharged on a pureed diet on the fifth postoperative day, and a normal diet was started after the first office visit at the fourth postoperative week.

## Results

Mean operative time was 132.2±29.5 min (95–180). There were no conversions to open surgery, no mortality and no early complications. Gastrogastrostomy was performed manually (four) and by linear stapler (four) and jejunojejunostomy by linear stapler in all patients. Mean hospital stay was 7.7±3.5 days (5–13) (Table 2).

All patients were followed up by office visits, and after a mean follow-up of 18.3±9.2 months (7–36), two patients (25%) continued to lose weight (13 and 35 kg), with a drop in BMI to 27 and 25.5 kg/m$^2$, respectively; two patients (25%) maintained the same weight as at the time of reconversion; and four patients (50%) presented a mean weight regain of 20.2±8.8 kg (7–32), with a mean increased BMI to 28±0.7 kg/m$^2$ (25–31.5) (Table 3). During this follow-up time, appearance of gastroesophageal reflux disease (GERD) was recorded in three out of eight patients (37.5%).

## Discussion

In our department, we have performed the first laparoscopic reconversion of RYGB to OA in 2005 [9]. Since that time the RYGB, usually considered as permanent, has been demonstrated to be reversible at least anatomically.

**Table 2** Type of gastrogastrostomy and outcomes

| Number | Gastrogastrostomy | Operative time (min) | Hospital stay (days) |
|---|---|---|---|
| 1 | Linear stapler | 120 | 5 |
| 2 | Manual | 120 | 5 |
| 3 | Manual | 95 | 5 |
| 4 | Linear stapler | 120 | 6 |
| 5 | Manual | 165 | 5 |
| 6 | Linear stapler | 180 | 12 |
| 7 | Manual | 108 | 11 |
| 8 | Linear stapler | 150 | 13 |
| Mean | | 132.2 | 7.7 |
| SD | | 29.5 | 3.5 |

**Table 3** Weight, BMI, and %EWL at RYGB, at reconversion to OA, and at follow-up

| Number | RYGB | | Time after RYGB (months) | Reconversion | | | Time after reconversion (months) | Follow-up | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Weight (kg) | BMI (kg/m$^2$) | | Weight (kg) | BMI (kg/m$^2$) | % EWL | | Weight (kg) | BMI (kg/m$^2$) | % EWL | |
| 1 | 131 | 44 | 7 | 110 | 38 | 31.8 | 20 | 75 | 25.5 | 84.8 | ↓ |
| 2 | 90 | 32 | 14 | 90 | 32 | 0 | 18 | 76 | 27 | 50 | ↓ |
| 3 | 110 | 46 | 7 | 64 | 27 | 97.8 | 36 | 64 | 27 | 80.7 | Stable |
| 4 | 100 | 44 | 7 | 62 | 27.5 | 74.5 | 8 | 62 | 27.5 | 74.5 | Stable |
| 5 | 104 | 39 | 14 | 51 | 19 | 115.2 | 24 | 83 | 31.5 | 45.6 | ↑ |
| 6 | 73 | 30 | 38 | 55 | 23 | 90 | 19 | 70 | 29.5 | 15 | ↑ |
| 7 | 130 | 45 | 60 | 48 | 16.6 | 122.3 | 15 | 75 | 26 | 83.3 | ↑ |
| 8 | 100 | 40 | 21 | 55 | 22 | 100 | 7 | 62 | 25 | 84.4 | ↑ |

Possible problems related to RYGB like dumping syndrome must in first instance be treated by multidisciplinary counseling. Patients presenting dumping syndrome after RYGB usually benefit from dietary measures and experience significant improvement of the symptoms [10]. Kellogg et al. observed that after a low-carbohydrate diet, patients demonstrated very little change in plasma glucose and only a modest increase in serum insulin, with at least some improvement of the symptoms [11]. However, some cases are refractory to diet measures and medical treatments with serotonin antagonists or somatostatin analogs can be attempted [10, 12, 13]. Evidence exists that slowing down the clearance of foods from the gastric pouch may be efficient in the treatment of these conditions. Z'graggen et al. placed a silastic ring or adjustable gastric band around the gastric pouch and obtained an improvement of hypoglycemic episodes [14]. Alternatively, endoscopic techniques using StomaphyX (Endogastric Solution, Palo Alto, CA, USA) or Endocinch devices (Bard, Covington, GA, USA) [15] can be proposed with encouraging results. A last surgical option is the reconversion of RYGB to OA [9].

A different strategy is proposed for patients with postprandial hyperinsulinemic hypoglycemia associated or not to dumping syndrome. Firstly, the ill dietary behavior has to be corrected and medical therapy with insulin-modulating agents like acarbose or glyclaside can be attempted. Surgical treatment options can be to delay gastric pouch emptying by adding restriction, or reconversion to OA. This latter option is obviously associated to the risk of weight regain, which can be resolved with the next malabsorptive procedure. There is no question that these less aggressive methods should be attempted before possible pancreatic lesions are investigated [16, 17].

Technically, it is our policy to perform minimal dissection in order to respect general vascularization. Our strategy is to minimally free the gastrojejunostomy, which avoids jeopardizing the vascularization of the gastric pouch in view of its transection. This is important since this latter part survives on only one or two branches of the left gastric artery located at the lesser curvature. The gastrogastrostomy that might forward the only limiting factor is the possible traction between the gastric pouch and the gastric remnant. Again for vascularity reasons, dissection should be kept minimal, just sufficient for the fundus to reach the gastric pouch without traction. The anastomosis is performed using the linear stapler technique. Sometimes, however, the gastric pouch is a micropouch which does not accommodate the insertion of linear stapler; hence, a manual anastomosis is preferred. The gastrogastrostomy is performed on a 34-Fr orogastric bougie, which can be considered a safe diameter. Sutures used for gastrogastrostomy are reabsorbable and thick (1 PDS) so as not to cut through the gastric tissue. In this series we did not use the circular stapler technique, as reported by other authors [18], because we prefer to maintain intact the rest of the stomach (gastric remnant), which has to be reanastomosed. The jejunojejunostomy is usually found without effort, thanks to its antecolic position. However, when a transmesocolic route had been performed, dissection of the alimentary limb is far more extensive and a longer portion of the loop may need to be sacrificed because of ischemia. Moreover, there is the risk of ischemia to the transverse colon, which is yet another argument in favor of the antecolic position, besides the risk of postoperative obstruction [19, 20]. Correct dismantling of the jejunojejunostomy consists of sectioning the bowel on the biliary loop side rather than the alimentary one, in order to respect the integrity of the alimentary and common loops. The mesenteric window between the new enteral anastomosis, which is the consequence of the mesenteric transection—all be it small—created at the original construction of RYGB, has to be closed.

One should resist the tentation to overly dissect the gastroesophageal junction, in an effort to isolate the gastric pouch and the gastric remnant, since this area is sensitive to surgical dissection especially in reoperations. Severance of

all the adhesions in this area could induce GERD, as seen in three of our patients. Indeed, unlike after band gastroplasty the long-time strain on the lower esophageal sphincter (LES) [21], caused by the hyperpression, is likely to provoke irreversible damage to the LES, RYGB should not have created such situations, since it is a low pressure system. Hence, GERD encountered in three of our patients was probably caused by overzealous dissection at the time of the revision.

Two of our patients never recovered a normal weight and actually continued to lose weight after the procedure. This can be explained by the refeeding syndrome [22, 23]. In order to avoid this syndrome, it is probably preferable to do the reconversion in staged procedures. First, a feeding gastrostomy is performed, followed by very careful and slowly increasing enteral feedings over the normal anatomical route. Reconversion is only performed when weight regain has been clearly initiated. Preoperative nasoenteral feedings are much more difficult to handle and are less effective since the use of the normal anatomical pathway, including the antrum and the duodenum, is essential in absorbing vitamins and minerals. Surprisingly, one of these two patients with excessive weight loss after reconversion had presented too little weight loss after the procedure of RYGB. This patient with a sweet-eating behavior at preoperative workup was offered OA as first stage for a subsequent new bariatric procedure, in accordance with the patient's preference. During follow-up after reconversion, the patient presented a surprising weight loss, probably because of fear for having to undergo a new bariatric procedure. New surgery was therefore not proposed.

Similarly, the two patients who remained at a stable weight after reconversion allegedly have fear to having to undergo a new bariatric procedure, which to them had proven to be very uncomfortable.

The four patients presenting weight regain after reconversion were patients evidenced with loss of control at psychologist's consultation. Longer follow-up will need to confirm the partial or total regain weight. This again highlights the need of a multidisciplinary approach before all bariatric surgery and the necessity to tailor the bariatric procedure to the personality of the patients. Our patients probably were candidate for a malabsorptive procedure as biliopancreatic diversion than a mixed procedure as RYGB, which can still be a viable option because all the upper parts of the stomach are in place and of the very few adhesions after the laparoscopic procedures.

The operative time recorded in this small series of reversal procedures appeared acceptable, but tight adhesions from other previous abdominal surgeries can be factors of time-consuming factors.

The relatively long hospital stay was never caused by physical complications, but rather had to do with the psychological complexity of the patients. Indeed, it is mandatory not to neglect the psychological impact of the reconversion, which should be accounted for already in the preoperative period [24].

Finally, despite the fact that after these reversal procedures patients are anatomically restored, it would be presumptuous to think that the preoperative integrity can be re-achieved.

In conclusion, laparoscopic reconversion of RYGB to OA is feasible and safe. This procedure in patients with RYGB abolishes the presence of dumping syndrome without postprandial hypoglycemia and intolerance to RYGB-induced restriction. The anatomy remains one of the aspects besides nutritional and psychological factors in cases of reconversion for weight issues. Special care in limited dissection around the low esophageal sphincter could be useful in avoiding GERD.

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