OBES SURG (2011) 21:692–698
DOI 10.1007/s11695-010-0300-2

CURRENT STATUS

Are Laparoscopic Gastric Bypass After Gastroplasty and Primary Laparoscopic Gastric Bypass Similar in Terms of Results?

Guy-Bernard Cadière · Jacques Himpens · Michel Bazi · Benjamin Cadière · Michael Vouche · Elie Capelluto · Giovanni Dapri

Published online: 15 December 2010

Abstract
Background This retrospective study compares the results of primary gastric bypass (PGB) versus secondary gastric bypass (SGB) performed after gastroplasty.
Methods Between January 2004 and August 2008, 576 consecutive patients benefited from laparoscopic gastric bypass (LGB) in our hospital. Four hundred seventy patients (81.6%) were available for full evaluation. Primary outcome measures were operative time, conversion to open surgery and mortality, hospital stay, early and late complications, reoperations, efficacy, and patient satisfaction.
Results Three hundred sixty-two patients benefited from a PGB and 108 from SGB. Median preoperative BMI was 42 kg/m^2 (34.8–63.5; PGB) and 39 kg/m^2 (20.9–64.5; SGB; p=0.002). Median operative time was 109 min (40–436; PGB) and 194 min (80–430; SGB; p<0.001). There was no conversion to open surgery or mortality in either group. Median hospital stay was 4 days (3–95; PGB) and 5 days (2–114; SGB; p<0.001). Early complications were recorded in 37 patients (10.2%) after PGB and in 24 patients (22.2%) after SGB (p<0.001). Reoperation was necessary in 12 patients (3.3%) after PGB and in 9 patients (8.3%) after SGB (p=0.03). Median follow-up was 35 months (12–66; PGB), and 34 months (12–66; SGB; NS). Late complications were achieved in 46 patients (12.7%) after PGB and in 33 patients (30.6%) after SGB (p<0.001). Reoperation was necessary in 17 patients (4.7%) after PGB and in 11 patients (10.2%) after SGB (p=0.03). Mean %EWL was 74.2% after PGB and 69.9% after SGB (NS). After PGB, 89% of the patients was satisfied, 4% neutral, and 6% unsatisfied; after SGB, 79% was satisfied, 10% neutral, and 11% unsatisfied (p=001).
Conclusions Weight loss after PGB and SGB is not statistically significantly different. Otherwise, operative time, hospital stay, complications, and revision rate are statistically significantly higher after SGB (p<0.001).

Keywords Gastric bypass · Laparoscopy · Band gastroplasty · Gastric banding · Failure · Complications · Reoperations

G.-B. Cadière (✉) · J. Himpens · M. Bazi · B. Cadière · M. Vouche · E. Capelluto · G. Dapri
Department of Gastrointestinal Surgery,
European School of Laparoscopic Surgery,
Saint-Pierre University Hospital,
322, Rue Haute,
1000, Brussels, Belgium
e-mail: coelio@resulb.ulb.ac.be

Introduction

There is a general consensus on the indications for obesity surgery [1]; however, consensus on the type of procedure is still missing. The most commonly performed operations nowadays are laparoscopic adjustable gastric band (LAGB) and laparoscopic gastric bypass (LGB).

In 2002, 21,660 LAGB (9% of all 2002 obesity surgery procedures) and 27,000 LGB (91%) have been performed in the USA. In 2009, these numbers increased to 116,670 LGB (40%) and 146,670 LAGB (49%), respectively [2].

In 2002, LAGB was still the most popular procedure performed in Europe. However, this procedure is actually performed less frequently in most European countries.

LGB has the reputation of being more invasive, leading to more operative morbidity and metabolic complications than LAGB or vertical banded gastroplasty (VBG). Hence, if the effectiveness and morbidity of primary LGB (PGB) and LGB after gastroplasty or secondary gastric bypass

(SGB) indeed differ, it would be logical and even preferable to perform LAGB in all patients and to carry out LGB only in case of inefficacy or complications.

The aim of this retrospective study was to compare PGB to SGB in terms of operative time, conversion to open surgery and mortality, hospital stay, early and late complications, reoperations, efficacy, and patient satisfaction.

Patients and Methods

Between January 2004 and August 2008, 576 consecutive patients benefited from LGB for morbid obesity in our hospital. Four hundred seventy patients (81.6%) were available for this retrospective analysis. The indication for PGB was made in accordance with the NIH instructions [1]. The indications for SGB were: insufficient weight loss, side effects (nausea, vomiting, gastro esophageal reflux, pain) and band-related complications (gastric erosion, pouch dilation). Insufficient weight loss was defined as <25 of percent excess weight loss (%EWL) in accordance with Reinhold's criteria [3]. Our multidisciplinary team evaluated each patient following a standardized protocol. The patient data was retrospectively collected from the patient records on hospital stay and office visits. These data were confirmed by a questionnaire sent to every patient, by personal telephone interview and by examination during office visits. Primary outcome measures were conversion to open surgery, operative time, early complications, mortality, hospital stay, late complications, %EWL, and patient satisfaction. The ideal weight for evaluation of %EWL was set at a body mass index (BMI) of 22 kg/m^2. The operative time was recorded as the time between the insertion of the first trocar and the conclusion of laparoscopy. Complications were defined as follows: gastrojejunal (GJ) leak was diagnosed by the appearance of methylene blue in the abdominal drain or by CT evidence of intra-abdominal abscess in a symptomatic patient. Patients were grouped in five categories of follow-up time for evaluation of their weight loss.

Patient satisfaction was evaluated using a five-point score: very satisfied (=5), satisfied (=4), neutral (=3), unsatisfied (=2), and very unsatisfied (=1). In our analysis, we regrouped these results into three categories: satisfied (4+5), neutral (3), and unsatisfied (1+2).

Technique

The laparoscopic technique performed for LGB was described in the *Atlas of Laparoscopic Obesity Surgery* [4]. Three different techniques for GJ anastomosis were performed: totally handsewn, linear mechanical, and circular mechanical.

The handsewn anastomosis was performed using 1 polydiaxone in one layer side-to-side over a 34-French orogastric bougie. The linear mechanical anastomosis was performed side-to-side using a blue load of linear stapler and closure of the openings by a running suture 1 polydiaxone. The circular mechanical technique was performed using a 25-mm anvil, inserted transabdominally.

The jejunojejunal (JJ) anastomosis was in all patients side-to-side linear mechanical (one firing of white load stapler and closure of insertion opening by 2/0 polydiaxone running suture).

A drain was systematically left in the left upper quadrant, in an effort to drain the gastric pouch and the GJ anastomosis.

In SGB, an extensive adhesiolysis was performed to free the entire left upper quadrant and to separate the anterior wall of the stomach from the left liver lobe. The gastric pouch was fashioned in a specific way, depending on the type of gastroplasty (Figs. 1a, b, 2a, b, and 3)

Statistical Analysis

A p value<0.05 was considered to be significant. Differences in patient characteristics, hospital stay, and time of events were analyzed using Student's t test for unpaired bilateral data. Chi square and Fisher's exact tests were performed for early and late complications and for patient's satisfaction index. Statistical analysis was performed using Mathlab.

Results

Of the 470 retrospectively analyzed patients, 362 had benefited from a PGB and 108 from a SGB. In the group of SGB, 57 patients had had an LAGB, 43 patients a VBG, and 8 patients, an LAGB after VBG. Primary gastroplasty had been performed between 1987 and 2005 in our and in several hospitals. Median interval time between gastroplasty and conversion to SGB was 7 years (1–21 years). The indications for SGB included insufficient weight loss in 34 patients (31.5%), intractable side effects in 37 patients (34.3%), and band-related complications in 37 patients (34.3%). SGB was performed synchronously with LAGB removal in 89 patients (82.4%), and in two stages in 19 patients (17.6%).

Patient Characteristics

Patient characteristics are shown in Table 1. Median age was 40±12 years (15–74) after PGB, and 42±9 years (18–66) after SGB (p=0.03). Sex ratio (M/F) was 70/292 after PGB, and 8/100 after SGB (p=0.03). Median preoperative BMI was 42±6 kg/m^2 (34.8–63.5) after PGB and 39±16 kg/m^2 (20.9–64.5) after SGB (p=0.002). Median

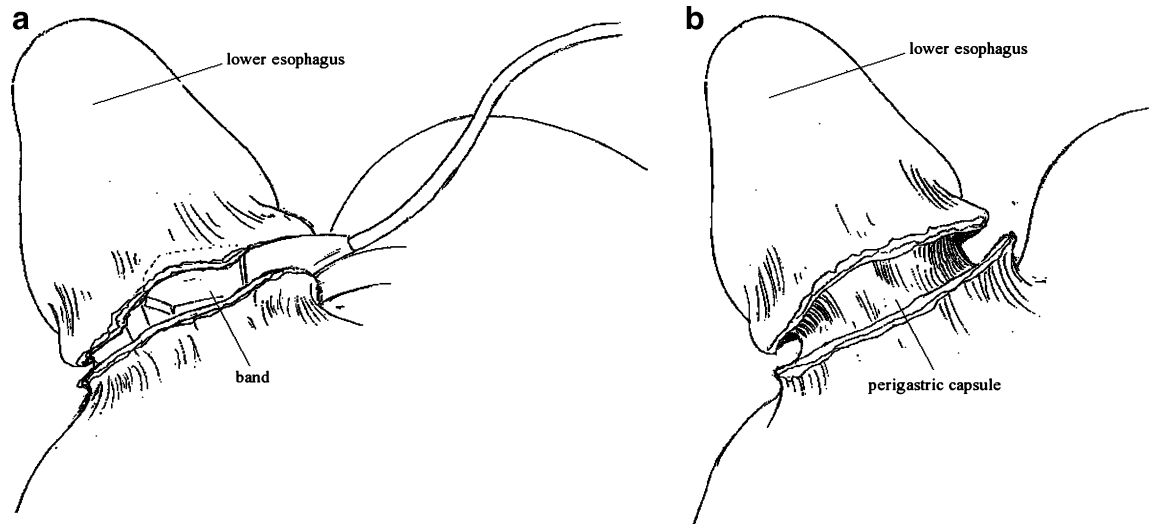


Fig. 1 **a**,**b** LGB after LAGB: dissection of the perigastric capsula surrounding the band reach the angle of His

American Society of Anesthesiology (ASA) score was 1.8±0.08 (1–3) after PGB, and 1.7±0.14 (1–3) after SGB (NS).

In PGB, the GJ anastomosis was totally handsewn in 107 patients (29.6%), linear mechanical in 184 patients (50.8%), and circular mechanical in 71 patients (19.6%). In SGB, the GJ anastomosis was totally handsewn in 81 patients (75%), linear mechanical in 11 patients (10.2%), and circular mechanical in 16 patients (14.8%).

There was no conversion to open surgery in either group. The median operative time was 109 min (40–436) for PGB and 194 min (80–430) for SGB ($p<0.001$). There was one peroperative complication in the PGB group, an esophageal perforation by the orogastric bougie introduced by the anesthesiologist.

Median hospital stay was 4 days (3–95) for PGB and 5 days (2–114) for SGB ($p<0.001$). There was no in-hospital mortality in either group. Median follow-up was

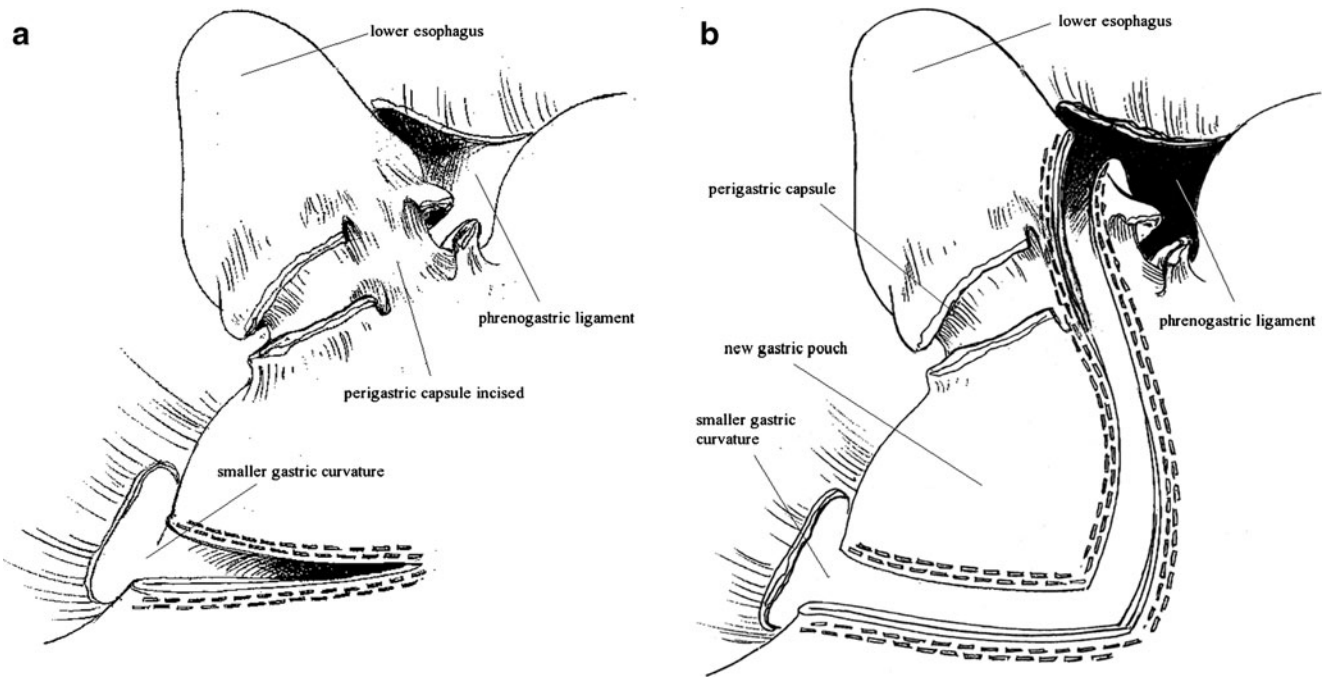


Fig. 2 **a**, **b** LGB after LAGB: incision of the perigastric capsula; the first horizontal stapler firing is performed in healthy tissue, usually distal to the capsula

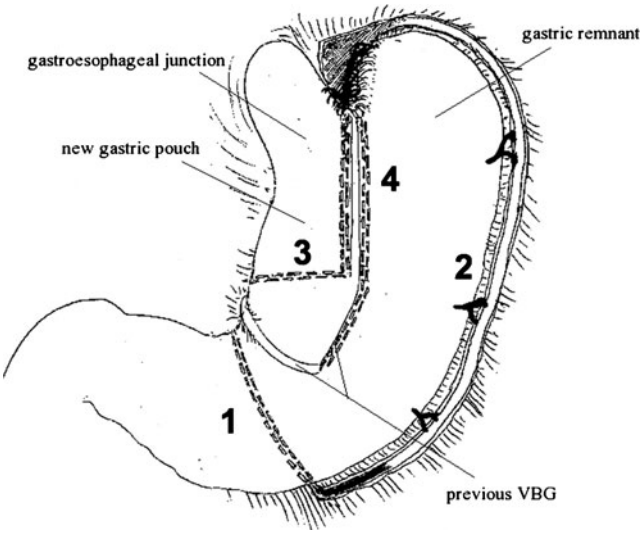


Fig. 3 LGB after VBG: *1* The first oblique stapler firing is performed in healthy tissue, caudal to the silastic ring. *2* The greater curvature is freed until the left artery is identified. *3* The second staple firing is performed in healthy tissue cranial to the silastic ring below the left gastric artery. *4* The vertical staple firing is always performed medial to the previous staple line. The entire fundus comprising the old staple line and the silastic ring is resected

35 months (12–66) after PGB, and 34 months (12–66) after SGB (NS). One patient died (PGB group) from suicide for reasons unrelated to the surgery, 2 years after the procedure.

Early Complications

Early complications are shown in Table 2. Twenty-one patients (4.5%) were re-operated on for early complications, 12 patients (3.3%) in PGB group and 9 patients (8.3%) in SGB group (p=0.035). We recorded 65 early complications in 60 patients (12.7%), 37 patients (10.2%) with 39 complications in PGB group and 24 patients (22.2%) with 27 complications in SGB group (p<0.001).

We recorded 29 GJ leaks (6.2%), 16 after PGB (4.4%), and 13 after SGB (12%; p=0.004). In the SGB group, 6 patients (14%) suffered a leak after VBG, 5 patients (8.8%) after LAGB, and 2 patients (25%) after LAGB placed after VBG. Treatment was conservative in 16 patients, CT-guided drainage in 2 patients, laparoscopic drainage in 8 patients, laparoscopic drainage followed by laparoscopic revision of anastomosis in one patient, and placement of esophageal prosthesis in two patients. Between the two groups, the in-hospital length of stay was not statistically different after GJ leak (NS).

Four JJ leaks (0.9%) occurred, all caused by anastomosis kinking. Treatment was laparoscopic revision in three and conservative therapy in one. We recorded 3 occlusions (0.6%) caused respectively by twist of the alimentary loop in one and kinking at the JJ in two. Treatment was laparoscopic revision in all three.

Two intra-abdominal abscesses (0.4%) were treated conservatively. We counted ten wound abscesses (2.1%), 5 after PGB (1.4%) and 4 after SGB (4.6%). Treatment was laparoscopic drainage in three and conservative in seven.

There were more wound abscesses after circular mechanical GJ anastomosis than after linear mechanical or totally handsewn technique, 6.9% versus 3.7%, respectively (p=0,004). Treatment was percutaneous drainage in three and conservative in seven.

There were 5 bleedings (1.1%), four requiring reintervention. One JJ anastomotic bleeding was complicated by multiple organ failure with ischemic encephalopathy.

Synchronous cholecystectomy was performed in 37 patients, with one complication (0.2%): a biliary leak treated laparoscopically.

Eleven patients developed pneumonia (2.3%); all were treated conservatively.

Finally, no significant differences were found between PGB and SGB in terms of occurrence of JJ leak, occlusion, bleeding, cystic duct leak, or pneumonia (Table 2).

Late Complications

Late complications are shown in Table 3. Twenty-eight patients (6%) were re-operated on for late complications: 17 patients (4.7%) after PGB and 11 patients (10.2%) after SGB (p=0.035). Seventy-nine patients (16.8%) suffered 89 late complications: 46 patients (12.7%) suffered 53 complications in PGB group and 33 patients (30.6%), 36 complications in SGB group (p<0.001). Forty patients developed GJ stenosis (8.5%), 20 after PGB (5.5%) and 20 after SGB (18.5%; p<0.001). In the SGB group, 15 patients developed stenosis after LAGB (26.3%), 3 after VBG (7%), and 2 after VBG followed by LAGB (25%).

Table 1 Patient characteristics (median value ± SD)

	PGB (n=362)	SGB (n=108)	p value
Age (years)	40±12 (15–74)	42±9 (18–66)	0.03
Sex (M/F)	70/292	8/100	0.003
BMI (kg/m^2)	42±6 (34.8–63.5)	39±16 (20.9–64.5)	0.002
ASA score	1.8±0.08 (1–3)	1.7±0.14 (1–3)	NS
Follow-up (months)	35±14 (12–66)	34 (12–66)	NS

Table 2 Early complications

	Number of complications (number of patients in %)				Median hospital stay in days (min-max)		
	Total	PGB (n=362)	SGB (n=108)	p value	PGB	SGB	p value
GJ leakage	29 (6.2%)	16 (4.4%)	13 (12%)	0.004	27.5 (13–41)	32 (8–114)	NS
JJ leakage	4 (0.9%)	3 (0.8%)	1 (0.9%)	NS	30 (25–47)	54	NS
Occlusion	3 (0.6%)	3 (0.8%)	0 (0%)	NS	17 (7–20)	0	NS
Intra-abdominal abscesses	2 (0.4%)	0 (0%)	2 (1.9%)	0.05	0	8.5 (4–13)	NS
Wound abscesses	10 (2.1%)	5 (1.4%)	5 (4.6%)	0.05	5 (4–11)	5 (4–8)	NS
Bleeding	5 (1.1%)	4 (1.1%)	1 (0.9%)	NS	9.5 (9–95)	0	NS
Cystic duct leak	1 (0.2%)	1 (0.3%)	0 (0%)	NS	19	0	NS
Pneumonia	11 (2.3%)	7 (1.9%)	4 (3.7%)	NS	7 (5–21)	14.5 (11–21)	NS
Total	65 (12.7%)	39 (10.2%)	27 (22.2%)	p<0.001	19 (4–95)	17 (114–4)	NS

This complication rate statistically appears significantly different for the LAGB group and VBG group (p=0.02). Stenosis occurred after a median of 60 days (4–730) in PGB and 30 days (3–450) in SGB. Treatment consisted of endoscopic dilatation (36), esophageal prosthesis (1), and revision of GJ anastomosis (3). Nineteen patients (4%) presented with a GJ ulcer, 17 patients (4.7%) after PGB and 2 patients (1.9%) after SGB (NS). Treatment with proton pump inhibitors was sufficient in 15 patients, but 4 required revision of the GJ anastomosis [4]. We detected 28 trocar incisional hernias (5.9%), 14 (3.9%) after PGB, and 14 (13%) after SGB (p<0.001). Nineteen patients required surgery for this latter complication, 8 after PGB and 11 after SGB. Treatment consisted of laparoscopic mesh repair (ten) or primary suturing (nine).

Two internal hernias (0.4%) occurred after PGB. One appeared after 3 months and necessitated resection of a necrotic small bowel loop, and another one after 10 months and required simple re-closure of the mesenteric defect.

Efficacy

Median follow-up was 35 months (12–66; PGB) and 34 months (12–66; SGB; NS). Using the pre-gastroplasty weight as starting point, %EWL after PGB was 74.2% compared with 69.9% after SGB (NS) (Table 4). Using the weight before SGB as starting point, %EWL after SGB was 66.1%, which was statistically less than after PGB (p=0.006).

Patient's Satisfaction Index

Satisfaction index was available in only 462 patients, since eight patients declined to answer our questionnaire (five after PGB and three after SGB). Four hundred two patients (87%) were satisfied about their LGB, 26 (6%) were neutral, and 34 (7%) were unsatisfied. After PGB, 89% were satisfied, 4% were neutral, and 6% were unsatisfied. In the SGB group, 79% were satisfied, 10% were neutral, and 11% were unsatisfied (p=0.01).

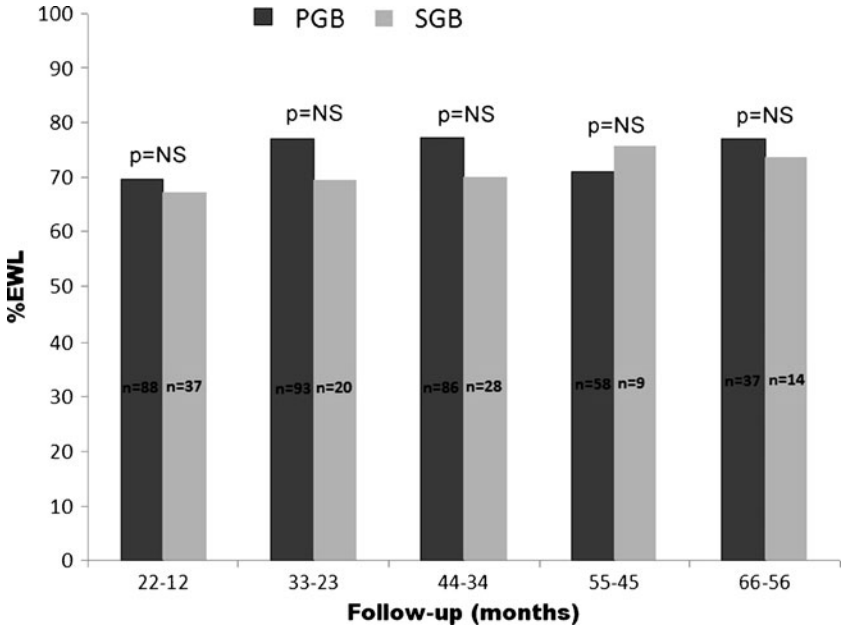
Discussion

The results we report here therefore must be analyzed and interpreted with some caution. This study compares LGB performed in patients who had not benefited from obesity surgery versus patients after gastroplasty. Despite the long delay (7 years) between gastroplasty and LGB, preoperative BMI was statistically still significantly lower in the

Table 3 Late complications

	Number of complications (number of patients in %)				Median time in days (min-max)		
	Total	PGB (n=362)	SGB (n=108)	p value	PGB	SGB	p value
GJ stenosis	40 (8.5%)	20 (5.5%)	20 (18.5%)	<0.001	60 (4–730)	30 (3–450)	NS
GJ ulcer anastomosis	19 (4.0%)	17 (4.7%)	2 (1.9%)	NS	300 (20–540)	635 (540–730)	NS
Incisional hernia	28 (5.9%)	14 (3.9%)	14 (13.%)	<0.001	255 (5–730)	300 (5–1000)	NS
Internal hernia	2 (0.4%)	2 (0.6%)	0 (0%)	NS	190 (80–300)	0	NS
TOTAL	89 (16.8%)	53 (12.7%)	36 (30.6%)	<0.001	120 (4–730)	75 (3–1000)	NS

Table 4 %EWL in five categories of follow-up time



SGB than in the PGB group. This indicates that gastroplasty still had at least some effect, unlike some other surgical and non-surgical treatment modes reported in literature [5]. Moreover, the study evidences that weight loss is identical in primary cases and after gastroplasty. This means that the effect of gastroplasty followed by SGB (intention to treat) is the same as the effect of simple PGB. This finding was already confirmed by other authors [6] and indicates that gastroplasty actually had initiated successful weight loss. Given that SGB after gastroplasty is as efficient as PGB, other aspects will determine superiority of one treatment over the other: preoperative technical difficulty, postoperative morbidity, hospital stay, early and late complications, and number and type of reoperations. All these latter aspects appear to be less favorable in SGB. Some authors [7] perform SGB a certain time after removal of the band, but we do prefer a one-stage procedure with the aim of avoiding more adhesions, especially since they usually already are significant at the time of band removal. Gagner et al. reported a complication rate of 7% in a series of LAGB converted to LGB [8]. Roller et al. observed that increasing numbers of revisional surgeries in the same patient increase the number of complications [9]. We recorded a higher fistula rate after SGB than the 3.6% reported in the literature [6]. Fistulae are responsible for the higher number of revisions after SGB. They were most likely caused by fibrosis of the tissues, which precluded adequate closure of the staples and by ischemia linked with the need to work in previously dissected areas.

The appearance of fistulae will also influence the in-hospital length of stay. In this study, we noted a significant difference in stay between PGB and SGB, clearly because of a higher leak rate.

Stenosis at the GJ anastomosis was the primary late complication after SGB, and its incidence was statistically significant from PGB. In the subgroups of SGB, a higher anastomotic stenosis rate was found in the patients previously submitted to LAGB. This is noteworthy if one considers our peroperative efforts to avoid fibrotic areas during both stapling and suturing. The most likely explanation for this finding is, again, ischemia. We believe ischemia might at least partially explain our stenosis rate of 18.5% in SGB, which is markedly higher than the reported 3.6% [6].

In the group of SGB, the incidence of leak and stenosis at the GJ anastomosis surprisingly did not depend on the technique. This finding is identical after PGB [10–13], which indicates that anastomotic problems cannot be avoided by technical variations even in virgin tissue.

Operative time appears longer in SGB than in PGB, which is in accordance with the literature [6, 7, 14]. This is obviously due to the time needed in freeing the adhesions in order to reach the left upper quadrant and the gastroesophageal junction and in dissecting the angle of His from the left liver lobe. Furthermore, in SGB, after LAGB, the recorded time obviously includes removal of the subcutaneous port.

Contrary to Riele et al., we did not find similar outcomes in patients with PGB and SGB [6]. In this study, despite the same final weight loss, the patient satisfaction index was lower after SGB than after PGB. Possible explanations are

the necessity for more than one surgery, or the patient perception of postoperative complications and the inherent longer hospital stay.

In conclusion, this study shows that weight loss figures are similar for PGB and SGB. Otherwise, operative time, hospital stay, complications, and revisional rate are statistically significantly higher after SGB ($p<0.001$).

Acknowledgment The authors thank Mrs. Melanie Dumoulin for the data-retrieving help.

Disclosures The authors have no commercial associations that might be a conflict of interest in relation to this article.

References

1. Gastrointestinal Surgery for Severe Obesity. NIH Conference. Ann Intern Med. 1991;115:956–61.
2. Total Procedures—ASMBS; Banding 2002–2007—Actual LAP-BAND® Sales; Bypass/Sleeve Sales—AGN Estimates
3. Reinhold RB. Critical analysis of long term weight loss following gastric bypass. Surg Gynecol Obstet. 1982;155:385–94.
4. Cadière GB, Himpens J, Dapri G. Atlas of Laparoscopic Obesity Surgery. Lesaffrel, Tournai, Belgium 2007
5. Jants EJ, Larson CJ, Mathiason MA, et al. Number of weight loss attempts and maximum weight loss before Roux-en-Y laparoscopic gastric bypass surgery are not predictive of postoperative weight loss. Surg Obes Relat Dis. 2009;5:208–11.
6. Te Riele WW, Sze YK, Wiezer MJ, et al. Conversion of failed laparoscopic gastric banding to gastric bypass as safe and effective as primary gastric bypass in morbidly obese patients. Surg Obes Relat Dis. 2008;4:735–9.
7. Topart Ph, Becouarn G, Ritz P. One-year weight loss after primary or revisional Roux-en-Y gastric bypass for failed adjustable gastric banding. Surg Obes Relat Dis. 2009;5:459–62.
8. Gagner M, Gumbs AA. Gastric banding: conversion to sleeve, bypass, or DS. Surg Endosc. 2007;21:1931–5.
9. Roller JE, Provost DA. Revision of failed gastric restrictive operations to Roux-en-Y gastric bypass: impact of multiple prior bariatric operations on outcome. Obes Surg. 2006;16:865–9.
10. Dillemans B, Sakran N, Van Cauwenberge S, et al. Standardization of the fully stapled laparoscopic Roux-en-Y gastric bypass for obesity reduces early immediate postoperative morbidity and mortality: a single center study on 2606 patients. Obes Surg. 2009;19:1355–64.
11. Kothari SN, Kallies KJ, Mathiason MA, et al. Excellent laparoscopic gastric bypass outcomes can be achieved at a community-based training hospital with moderate case volume. Ann Surg. 2010;252:43–9.
12. Csendes A, Burgos AM, Burdiles P. Incidence of anastomotic strictures after gastric bypass: a prospective consecutive routine endoscopic study 1 month and 17 months after surgery in 441 patients with morbid obesity. Obes Surg. 2009;19:269–73.
13. Suggs WJ, Kouli W, Lupovici M, et al. Complications at gastrojejunostomy after laparoscopic Roux-en-Y gastric bypass: comparison between 21-mm and 25-mm circular staplers. Surg Obes Relat Dis. 2007;3:508–14.
14. Gagner M, Gentileschi P, de Csepel J, et al. Laparoscopic reoperative bariatric surgery: experience from 27 consecutive patients. Obes Surg. 2002;12:254–60.