

Gastric Banding or Bypass? A Systematic Review Comparing the Two Most Popular Bariatric Procedures

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ABSTRACT

OBJECTIVE: Bariatric surgical procedures have increased exponentially in the United States. Laparoscopic adjustable gastric banding is now promoted as a safer, potentially reversible and effective alternative to Roux-en-Y gastric bypass, the current standard of care. This study evaluated the balance of patient-oriented clinical outcomes for laparoscopic adjustable gastric banding and Roux-en-Y gastric bypass.

METHODS: The MEDLINE database (1966 to January 2007), Cochrane clinical trials database, Cochrane reviews database, and Database of Abstracts of Reviews of Effects were searched using the key terms *gastroplasty*, *gastric bypass*, *laparoscopy*, *Swedish band*, and *gastric banding*. Studies with at least 1 year of follow-up that directly compared laparoscopic adjustable gastric banding with Roux-en-Y gastric bypass were included. Resolution of obesity-related comorbidities, percentage of excess body weight loss, quality of life, perioperative complications, and long-term adverse events were the abstracted outcomes.

RESULTS: The search identified 14 comparative studies (1 randomized trial). Few studies reported outcomes beyond 1 year. Excess body weight loss at 1 year was consistently greater for Roux-en-Y gastric bypass than laparoscopic adjustable gastric banding (median difference, 26%; range, 19%-34%; $P < .001$). Resolution of comorbidities was greater after Roux-en-Y gastric bypass. In the highest-quality study, excess body weight loss was 76% with Roux-en-Y gastric bypass versus 48% with laparoscopic adjustable gastric banding, and diabetes resolved in 78% versus 50% of cases, respectively. Both operating room time and length of hospitalization were shorter for those undergoing laparoscopic adjustable gastric banding. Adverse events were inconsistently reported. Operative mortality was less than 0.5% for both procedures. Perioperative complications were more common with Roux-en-Y gastric bypass (9% vs 5%), whereas long-term reoperation rates were lower after Roux-en-Y gastric bypass (16% vs 24%). Patient satisfaction favored Roux-en-Y gastric bypass ($P = .006$).

CONCLUSION: Weight loss outcomes strongly favored Roux-en-Y gastric bypass over laparoscopic adjustable gastric banding. Patients treated with laparoscopic adjustable gastric banding had lower short-term morbidity than those treated with Roux-en-Y gastric bypass, but reoperation rates were higher among patients who received laparoscopic adjustable gastric banding. Gastric bypass should remain the primary bariatric procedure used to treat obesity in the United States.

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KEYWORDS: Bariatric surgery; Laparoscopic adjustable gastric banding; Obesity; Roux-en-Y gastric bypass; Systematic review

Obesity is rapidly increasing in the United States, with the prevalence of class 3 obesity approaching 8% in some popu-

lations.^{1,2} Class 3 obesity, defined as a body mass index (BMI) of greater than 40 kg/m², is associated with premature death and an increased risk for diabetes, hypertension, hypercholesterolemia, heart disease, osteoarthritis, sleep apnea, and gallbladder disease. Previous research has shown that weight loss improves both social functioning and quality of life.^{3,4} Carefully controlled studies have demonstrated between 25% and 60% reductions in all-cause, cardiovascular, and cancer mortality associated with significant weight loss.⁵⁻⁷

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Current treatment options for morbid obesity include pharmacologic agents, low-calorie diets, behavioral modification, exercise, and surgery.⁸ Dietary treatments produce an initial weight loss of less than 15% of the starting weight, and weight reductions generally decay to zero at 5 years.⁹ More aggressive therapy with medications (eg, orlistat, sibutramine) may be indicated for patients who have medical complications of obesity. However, drug therapy is limited by side effects, and systematic reviews of behavioral and drug therapy have reported average long-term weight loss of only 4 to 7 kg.^{8,10-12} In morbidly obese patients, there is no evidence that these interventions result in either significant, sustained weight loss or a reduction in medical complications.¹³

BARIATRIC SURGERY

The failure of most current approaches to control morbid obesity has led to the development of surgical procedures of the upper gastrointestinal tract designed to induce weight loss (bariatric surgery).¹⁴

Current guidelines from the National Institutes on Health recommend consideration of bariatric surgery for patients with a BMI of greater than 40 kg/m² and for those with a BMI greater than 35 kg/m² who also have serious medical problems that may improve with weight loss, such as diabetes and obstructive sleep apnea.¹⁵ A recent systematic review concluded that patients achieved effective weight loss of approximately 40 kg after bariatric surgery and that most had complete resolution or improvement of their diabetes, hypertension, hyperlipidemia, and obstructive sleep apnea.¹⁶ Furthermore, recent studies reported that bariatric surgery reduced long-term mortality.^{6,7}

There are 2 commonly performed bariatric surgery procedures: Roux-en-Y gastric bypass, the predominant approach used in the United States,^{17,18} and laparoscopic adjustable gastric banding, the most common bariatric surgery in Australia and Europe.¹⁹ Both Roux-en-Y gastric bypass and laparoscopic adjustable gastric banding are primarily restrictive procedures. Laparoscopic adjustable gastric banding is marketed as a less-invasive, potentially reversible alternative to Roux-en-Y gastric bypass, because the procedure does not require gastrointestinal bypass and reanastomosis. Gastric banding functions by limiting food intake after the placement of an inflatable tube around the stomach just below the gastroesophageal junction, which allows for adjustment of the size of the outlet via the addition or removal of saline through a subcutaneous port.²⁰ Roux-en-Y gastric bypass also creates a small stomach pouch to restrict food intake, but a portion of the jejunum is attached to the pouch to allow food to bypass the distal stomach, duodenum, and proximal jejunum.

Bypassing this segment of the gastrointestinal tract might contribute to the clinical success of Roux-en-Y gastric bypass by altering the secretion of hormones that influence glucose regulation and the perception of both hunger and satiety.²¹⁻²⁵

Roux-en-Y gastric bypass is currently the standard bariatric procedure in the United States.¹⁹

Given the rapid increase in bariatric procedures in the United States,²⁶ it is important for internists to understand the relative strengths and weaknesses of each procedure, such that patients and their doctors can make informed, evidence-based decisions. Conclusions about the comparative efficacy and safety of Roux-en-Y gastric bypass and laparoscopic adjustable gastric banding procedures are best made on the basis of comparative trials using concurrent, ideally randomized, controls. Randomized trials have demonstrated the superiority of Roux-en-Y gastric bypass to several gastroplasty procedures.²⁷⁻³¹ However, only 1 small randomized trial comparing Roux-en-Y gastric bypass with laparoscopic

adjustable gastric banding has been published to date.³² The present systematic review of all studies directly comparing Roux-en-Y gastric bypass with laparoscopic adjustable gastric banding was conducted with the aim of evaluating the relative safety and efficacy of the 2 procedures.

Data Sources and Study Selection

The MEDLINE database, Cochrane clinical trials database, Cochrane reviews database, Google Scholar, EMBASE, and Database of Abstracts of Reviews of Effects were searched using any combination of the following key terms: *gastroplasty*, *gastric bypass*, *laparoscopy*, *Swedish band*, and *gastric banding*. The MEDLINE search was performed for the period from 1966 to January of 2007. The bibliographies of systematic reviews and key articles were manually searched for additional references, and input was solicited from bariatric surgery specialists. The abstracts of citations were reviewed for relevance, and all potentially relevant articles were reviewed in full. Articles chosen for inclusion compared laparoscopic adjustable gastric banding and Roux-en-Y gastric bypass patient-oriented outcomes (eg, weight loss, resolution of obesity-related illnesses, mortality, procedure-specific complications) in subjects followed for a minimum of 1 year. Two investigators independently extracted the data from each article using a standard form. Differences were resolved through consensus. Quality was rated according to the GRADE criteria for individual studies.^{33,34}

The primary health measure driving the demand for surgical intervention is weight loss. When comparing across studies

CLINICAL SIGNIFICANCE

- There has been a 10-fold increase in bariatric surgeries during the past decade.
- In comparative trials, weight loss, resolution of obesity-related comorbidities, and patient satisfaction are greater after gastric bypass than gastric banding.
- Despite widespread marketing of gastric banding, no subgroups have been identified in whom it performs better than gastric bypass.
- Gastric bypass should remain the primary bariatric procedure used to treat obesity.

with differences in baseline characteristics, the percentage of excess body weight loss is the most useful measure of weight loss because average changes in both weight and BMI are greater in studies enrolling patients with higher presurgical BMI, whereas excess body weight loss is relatively consistent across studies regardless of initial BMI. We focused on excess body weight loss at 1 year, given the paucity of data for patients beyond 1 year of follow-up. Additional beneficial outcome measures included changes in obesity-related conditions, such as diabetes, hypertension, sleep apnea, dyslipidemia, sleep apnea, arthritis, and gastroesophageal reflux disease, as well as long-term patient satisfaction and quality of life. The most important harms included 30-day morbidity and mortality after the procedure, as well as long-term complications, particularly those requiring additional surgical interventions or causing significant patient morbidity. We did not use meta-analytic techniques to combine the results across studies because of significant heterogeneity in study design, different definitions for the outcomes, and different methods for assessing the outcomes. Measures of central tendency were summarized using the median value across studies to minimize the effect of outliers.

RESULTS

Search Results

The literature search identified 14 trials that directly compared laparoscopic adjustable gastric banding with Roux-en-Y gastric bypass.^{32,35-47} One additional comparative trial did not report weight loss outcomes or complications and was not included in this review.⁴⁸ There have been many randomized trials comparing laparoscopic adjustable gastric banding and Roux-en-Y gastric bypass with other bariatric procedures,^{27,49-55} but only one³² directly compared Roux-en-Y gastric bypass with laparoscopic adjustable gastric banding.

Study Characteristics

Patients in these studies were on average approximately 40 years old and had an initial BMI of 45 m/kg² (Table 1); 80% were female. In general, the quality of the comparative studies was low. With the exception of 1 randomized, controlled study, all studies were retrospective. There were no propensity score analyses or standard outcomes assessments. Only 2 of the studies^{37,46} matched patients for the known predictors of poor surgical outcome: age, sex, and BMI. In

Table 1 Characteristics of Studies Comparing Laparoscopic Adjustable Gastric Banding with Roux-en-Y Gastric Bypass

Study (First Author, Year)	Design	Arm	N	Age	BMI, kg/m ²	FU, mo	1-y FU, %	Quality
Hell 2000	Retrospective, no matching	SAGB and LapBand	30	36	47	40	—	Very low
		RYGB	30	41	45	60		
Biertho 2003	Retrospective, no matching	SAGB	805	42	42		82	Very low
		RYGB	456	40	49	—	31	
Weber 2004	Matched by age, sex, BMI	LapBand	103	40	48	42	—	Low
		RYGB	103	40	48	18	—	
Jan 2005	Retrospective, no matching	LapBand	154	46	51	—	—	Very low
		RYGB	219	42	50	<24	60	
Mognol 2005	Retrospective, no matching	LapBand	179	40	54	24	—	Very low
		RYGB	111	40	59	24	—	
Parikh 2005	Retrospective, no matching, BMI > 50	LapBand	197	43	55	NR, <24	80	Very low
		RYGB	97	42	55		74	
Bowne 2006	Retrospective, no matching, BMI > 50	LapBand	60	42	55	18	92	Very low
		RYGB	46	43	57	13	85	
Cottam 2006	Matched on age, sex, BMI, date of surgery	LapBand	181	42	47	NR, 23% at 36+ months	—	Low
		RYGB	181	43	47			
Galvani 2006	Retrospective, no matching	LapBand	470	41	47		—	Very low
		RYGB	120	41	46	NR	—	
Kim 2006	Retrospective, no matching	LapBand	160	42	47		—	Very low
		RYGB	232	39	47	NR	—	
Parikh 2006	Retrospective, no matching	LapBand	480	42	46	12	—	Very low
		RYGB	235	41	47	12	—	
Rosenthal 2006	Retrospective, no matching	LapBand	152	54	40	77% with "complete" FU	—	Very low
		RYGB	849	47	56			
Angrisani 2007	Randomized trial	LapBand	27	33	43	60	96	Moderate
		RYGB	24	35	44	60	100	
Jan 2007	Retrospective, no matching	LapBand	406	47	51	~12	65	Very low
		RYGB	492	44	49	~16	48	

BMI = body mass index; FU = follow-up; NR = not reported; RYGB = Roux-en-Y gastric bypass; SAGB = Swedish adjustable gastric band (Obtech Medical AG, Zug, Switzerland).

Table 2 Percentage of Excess Body Weight Loss and Resolution of Comorbidities Among Patients Entering Study with the Condition*

Study	Arm	N	%EBWL, 1 y	DM	HTN	Dyslipidemia	OSA	GERD	Arthritis	Asthma
Hell 2000	LAGB	30								
	RYGB	30	—	—	—	—	—	—	—	—
Biertho 2003	LAGB	805	33							
	RYGB	456	67							
Weber 2004	LAGB	103	35	59	70	0				
	RYGB	103	55	84	75	50				
Jan 2005	LAGB	154	34							
	RYGB	219	64							
Mognol 2005	LAGB	179	41							
	RYGB	1)	63							
Parikh 2005	LAGB	197	35							
	RYGB	97	58							
Bowne 2006	LAGB	60	31	40	27	40	34		14	12
	RYGB	46	52	100	63	43	88		29	73
Cottam 2006	LAGB	181	48 (± 19)	50	56	46				
	RYGB	181	76 (± 16)	78	81	81				
Galvani 2006	LAGB	470	39	68	59		55	56	60	
	RYGB	120	65	75	61		63	75	69	
Kim 2006	LAGB	160	34	77	56	37		88	84	
	RYGB	232	64	72	66	48		84	75	
Parikh 2006	LAGB	480								
	RYGB	235	—	—	—	—	—	—	—	—
Rosenthal 2006	LAGB	152	54							
	RYGB	849	73							
Angrisani 2007	LAGB	27	35		0		100			
	RYGB	24	51	100	0	100				
Jan 2007	LAGB	406	34							
	RYGB	492	65							

DM = diabetes mellitus; EBWL = excess body weight loss; GERD = gastroesophageal reflux disease; HTN = hypertension; LAGB = laparoscopic adjustable gastric banding; OSA = obstructive sleep apnea; RYGB = Roux-en-Y gastric bypass.

*Percentages of patients with comorbidity before surgery with complete resolution after the bariatric procedure.

most of the studies, the 2 surgical groups were far from comparable. For example, patients who received laparoscopic adjustable gastric banding in 2 of the studies were treated in Europe, whereas those who received Roux-en-Y gastric bypass were treated in the United States.^{35,39} It is impossible to determine whether the observed differences in outcomes reflect differences in the respective health care systems and patient populations, or true differences between the procedures. Similarly, the patient groups in 2 of the studies had age differences of 4 to 5 years at the time of surgery.^{39,40} Two other studies had differences in baseline BMI that ranged from 7 to 15 kg/m².^{35,45} The median follow-up time was less than 18 months, a relatively short period for the assessment of long-term benefits and harms of procedures intended to last for 30 to 50 years.

Weight Loss and Resolution of Comorbidities

Weight loss outcomes consistently favored Roux-en-Y gastric bypass by a substantial margin (Table 2). The median absolute difference in excess body weight loss between the 2 groups across the 12 studies reporting weight loss outcomes at 1 year was a large and clinically significant dif-

ference of 25%. In several of the studies, these differences tended to narrow over time, although in others, the differences remained stable. In the only randomized trial, weight loss differences seen at 1 year were preserved through 5 years of follow-up. These results were mirrored in the data for the resolution of comorbidities (Figure 1). The results of the 2 studies that matched patients^{37,46} strongly favored the Roux-en-Y gastric bypass group, with absolute differences in the resolution of comorbidities of 25% or more (number needed to treat \square 4). Thus, on average, for every 4 patients with an obesity-related condition treated with Roux-en-Y gastric bypass rather than laparoscopic adjustable gastric banding, 1 additional patient will be cured of the disease. Even larger differences were reported by Bowne et al³⁶ in their study of patients with a BMI of greater than 50 kg/m². For instance, 100% of patients with diabetes who were treated with Roux-en-Y gastric bypass showed blood glucose normalization without medication, compared with only 40% of diabetic patients treated with laparoscopic adjustable gastric banding. However, 2 recent large studies reported that improvements in comorbidities were similar between the 2

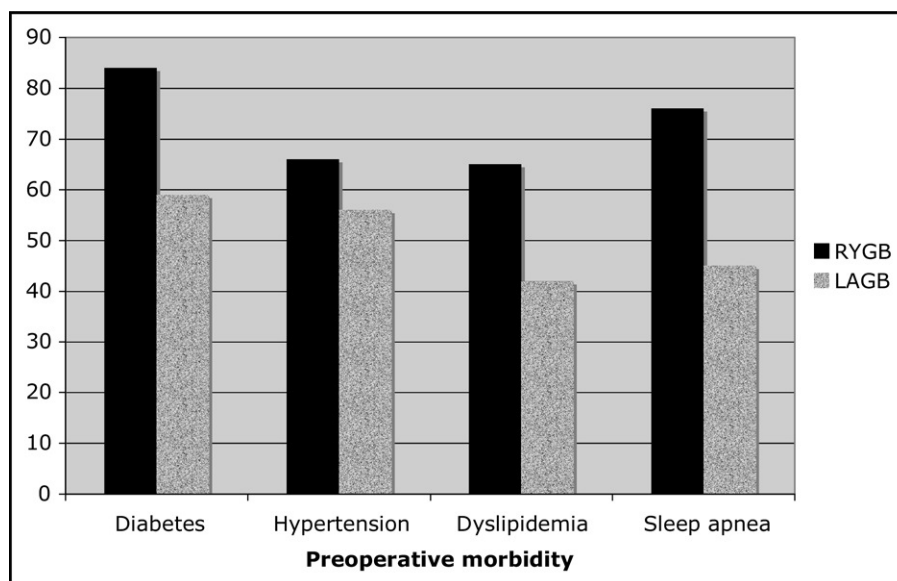


Figure 1 Comparison of the resolution* of obesity-associated comorbidities after Roux-en-Y gastric bypass or laparoscopic adjustable gastric banding. LAGB = laparoscopic adjustable gastric banding; RYGB = Roux-en-Y gastric bypass. *Median value from comparative studies reporting resolution of comorbidity.

groups, although weight loss outcomes were better for patients treated with Roux-en-Y gastric bypass.^{38,42}

Complications

Short-term complication rates generally favored laparoscopic adjustable gastric banding (Table 3). Operative times were shorter by a median of 68 minutes, and hospitalization length of stay was approximately 2 days shorter. There were fewer deaths in the laparoscopic adjustable gastric banding group (0.06% vs 0.17%), although mortality was low in both groups. Rates of conversion to open procedures, perforation, bleeding, and anastomotic leaks were low in both groups. Overall, the reported difference in major early complications ranged between 1.1% and 6.3% in favor of laparoscopic adjustable gastric banding.

However, long-term complications were more commonly observed in those who underwent laparoscopic adjustable gastric banding (Figure 2); several studies reported large differences in the rates of long-term complications (Table 4). For instance, in the first trial with matched groups,⁴⁶ early complications occurred in 21 of 103 patients (20%) in the Roux-en-Y gastric bypass group and in 18 of 103 patients (17%) in the laparoscopic adjustable gastric banding group, whereas long-term complications were more common after laparoscopic adjustable gastric banding (14% vs 44%, *P* not reported). Longer follow-up in the laparoscopic adjustable gastric banding group may partially explain this difference, although reoperation rates were higher in the laparoscopic adjustable gastric banding group in another trial in which participants were matched not only by patient characteristics but also by date of surgery (19% in the Roux-en-Y gastric bypass group vs 24% in the laparoscopic

adjustable gastric banding group).³⁷ Long-term reoperation rates also were higher in the laparoscopic adjustable gastric banding group than the Roux-en-Y gastric bypass group in 3 of the 6 other comparative trials that reported reoperations.^{36,40,45} Port problems or band slippage with pouch dilation counted among the most common reasons for reoperation of patients who received laparoscopic adjustable gastric banding, whereas bowel obstruction was the most common problem among patients who underwent Roux-en-Y gastric bypass. Band erosion, gallbladder problems, and incisional hernias were relatively uncommon late complications.

The complication rates for each procedure differ markedly from study to study. This likely reflects different lengths of follow-up and different definitions of significant complications across studies. Most of the studies reported the prevalence of complications rather than the annual rate of complications over time. It is unclear whether complications associated with laparoscopic adjustable gastric banding are common in the first 1 to 2 years after surgery and then decrease, or whether the opposite is true as the port continues to be used and the materials age. Furthermore, it is difficult to weigh the tradeoffs between complications. For example, a port leak that requires minor reoperation is clearly less important than an anastomotic leak that causes peritonitis and sepsis.

Patient Satisfaction

Only 1 comparative study reported data on patient satisfaction.³⁶ Approximately 80% of the patients in the Roux-en-Y gastric bypass group reported being very satisfied with the procedure, and no patients in this group were unsatisfied or regretted having had the procedure. In contrast, only 46% of the patients in the laparoscopic adjustable gastric banding

Table 3 Percentage of Patients with Short-term Complications (30 Days)

Study	Arm	N	Operation time, min*	LOS, d†	Death	Perforation	Conversion	VTE	Bleed	Infection	Leak	Total
Hell 2000	LAGB	30										
	RYGB	30	—	—	—	—	—	—	—	—	—	—
Biertho 2003‡	LAGB	805		3	0	0.1	3.0	0.2	1.2	1.2	0	1.7
	RYGB	456	—	5	0.4	0	2.0	0.9	0.9	0.2	2.0	4.2‡
Weber 2004	LAGB	103	145	3	0	1.0	0	0	1.0	16	0	18
	RYGB	103	190	8	0	1.0	1.0	1.0	1.0	7.8	1.9	21
Jan 2005	LAGB	154	76	1	0.6	1.9	0.6	0.6	1.3	1.3	0	3.9
	RYGB	219	134	3	0.5	0.5	0.5	0	1.8	4.1	0.9	5.0
Mognol 2005	LAGB	179	70	2	0.6		0		0	1.7		0.0
	RYGB	111	180	8	0.9	—	3.6	—	3.6		0.9	0.1
Parikh 2005	LAGB	197	60	1	0	0	0.5	0	0.5	1.0	0	4.7
	RYGB	97	130	3	0	0	2.1	1.0	0	5.2	1.0	11
Bowne 2006	LAGB	60	75	2	0	0	1.7	—	1.7	1.7	0	18
	RYGB	46	121	4	0	0	0	—	2.2	2.2	2.2	17
Cottam 2006	LAGB	181			0	0						
	RYGB	181	—	—	0	0	—	—	—	—	—	—
Galvani 2006	LAGB	470	66	1	0	0.2	0.2	0.2	0	0	0	3.6
	RYGB	120	209	2	0.8	0	2.5	0	0.8	0.8	0.8	6.6
Kim 2006	LAGB	160			0	0	0	0	0	0.6	0	0.6
	RYGB	232	—	—	0	0	0	0	0	2.6	0.9	5.2
Parikh 2006	LAGB	480		1	0		0					3.3
	RYGB	235	—	3	0	—	0.9	—	—	—	—	9.4
Rosenthal 2006§	LAGB	152			0	1.3	—	—	—	—	—	4.6§
	RYGB	849	—	—	0	0	0.6	0.8	0.5	3.7	1.9	4.4
Angrisani 2007	LAGB	27	60	2	0	0	0	0	0	0	0	
	RYGB	24	220	4	0	4.2	4.2	0	0	0	4.2	—
Jan 2007	LAGB	406	68	1	0.2	0.5	—	0.5	0.5	2.5	0	7.9
	RYGB	492	134	2	0.2	0.6	—	0.6	2.2	4.7	0.8	15

LAGB = laparoscopic adjustable gastric banding; LOS = length of stay; RYGB = Roux-en-Y gastric bypass; VTE = venous thromboembolism.

*Mean.

†Median.

‡Major complications in the first postoperative week rather than 30 days.

§Major complications for Roux-en-Y gastric bypass and complications that required surgical correction for the laparoscopic adjustable gastric banding group.

group reported being very satisfied with the procedure, and 19% of the patients in the laparoscopic adjustable gastric banding group were unsatisfied or even regretted having undergone the procedure ($P = .006$ between the 2 groups).

Highest-quality Studies

The only randomized clinical trial that directly compared laparoscopic adjustable gastric banding with Roux-en-Y gastric bypass was the small Italian study by Angrisani et al.³² The excess body weight loss at 1 year was 51% for the 24 patients randomized to Roux-en-Y gastric bypass versus 35% for the 27 patients randomized to laparoscopic adjustable gastric banding. At 5 years, the excess body weight loss was 67% and 47% ($P < .001$), respectively; only 1 of 24 (4%) Roux-en-Y gastric bypass-treated patients failed to lose weight, whereas 9 of 26 (35%, $P < .001$) of the laparoscopic adjustable gastric banding-treated patients exhibited a failure to lose weight. Reoperation rates were 12% for patients in the Roux-en-Y gastric bypass arm, compared

with 15% for patients in the laparoscopic adjustable gastric banding arm. There were no deaths during follow-up.

The highest-quality observational study considered the outcomes of 181 patients matched for age, sex, BMI, and date of surgery.³⁷ The excess body weight loss at 1 year was 76% for Roux-en-Y gastric bypass versus 48% ($P < .001$) for laparoscopic adjustable gastric banding, and the results remained stable at 3 years ($P < .001$). Resolution of diabetes was observed in 78% of the patients treated with Roux-en-Y gastric bypass who had diabetes before surgery, compared with 50% resolution in previously diabetic patients who then received laparoscopic adjustable gastric banding. Reoperation rates were 19% for patients in the Roux-en-Y gastric bypass arm, compared with 24% for patients in the laparoscopic adjustable gastric banding arm. No deaths were reported in the study.

DISCUSSION

Current data clearly demonstrate that weight loss at 1 year is greater among patients treated with Roux-en-Y gastric

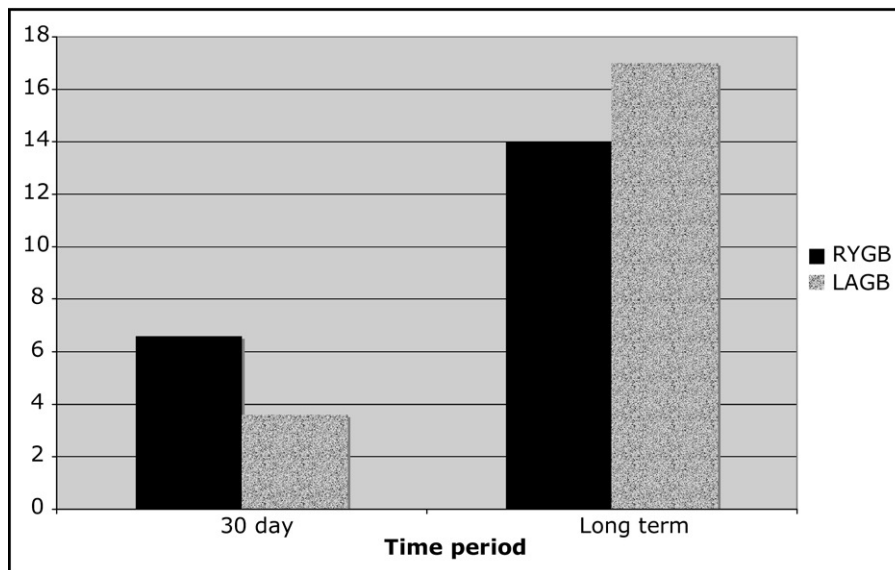


Figure 2 Comparison of the short- and long-term serious complication rates* after Roux-en-Y gastric bypass or laparoscopic adjustable gastric banding. LAGB = laparoscopic adjustable gastric banding; RYGB = Roux-en-Y gastric bypass. *Median value from comparative studies reporting complication rates.

bypass than among those treated with laparoscopic adjustable gastric banding. The best studies show that this difference in weight loss is preserved for at least 5 years. The data regarding measures other than weight loss are less robust, but the findings suggest that more patients would be cured of their diabetes, obstructive sleep apnea, hypertension, and other obesity-associated comorbidities if treated with Roux-en-Y gastric bypass rather than laparoscopic adjustable gastric banding. When asked, patients who underwent Roux-en-Y gastric bypass generally appeared more satisfied than those who underwent laparoscopic adjustable gastric banding. However, early complications (reflected in longer initial hospitalizations and greater early reoperation rates) were observed more commonly in the Roux-en-Y gastric bypass groups; long-term complication rates were more common in the laparoscopic adjustable gastric banding group. It remains difficult to precisely assess the relative risks and benefits of the 2 procedures, because the quality of the studies is generally low and the sample sizes in higher-quality studies are small.

Between 1998 and 2004, the number of bariatric surgeries performed in the United States increased from approximately 13,000 annually to 121,000.²⁶ During the same period, inpatient mortality associated with bariatric surgery decreased from 0.89% to 0.19%, and the average length of stay decreased from 5 to 3.1 days.²⁶ The majority of these procedures were Roux-en-Y gastric bypasses. The improvements in outcomes over a relatively short time illustrate why contemporary rather than historical controls must be used when comparing surgical treatments for obesity.

Compared with Roux-en-Y gastric bypass, laparoscopic adjustable gastric banding is a technically less-demanding procedure with shorter operating time, shorter length of hospital stay, and fewer initial complications. There-

fore, laparoscopic adjustable gastric banding has great appeal for surgeons, who could treat more patients with laparoscopic adjustable gastric banding than with Roux-en-Y gastric bypass over the same time period. There is a risk that commercial sponsorship of laparoscopic adjustable gastric banding may promote the use of these devices over Roux-en-Y gastric bypass, which has no commercial sponsor. The complex mixture of early and late complications and benefits after both procedures, as well as the impact of patient characteristics on outcomes, requires randomized trials to carefully compare the relative merits of Roux-en-Y gastric bypass and laparoscopic adjustable gastric banding. Given the rapid increase in the number of patients interested in bariatric surgery, such clinical trials are feasible. The publication of such studies will enable patients and surgeons to determine whether the possible lower rates of early complications with laparoscopic adjustable gastric banding outweigh the benefits of greater weight loss and fewer long-term complications with Roux-en-Y gastric bypass.

CONCLUSIONS

Current evidence, although predominantly observational, consistently demonstrates greater weight loss and improvements in obesity-related conditions with Roux-en-Y gastric bypass compared with laparoscopic adjustable gastric banding. Both procedures have acceptable morbidity and mortality when performed in appropriate patients at experienced centers. Randomized, controlled comparative trials with larger sample sizes are needed to determine whether there are subgroups of patients who may benefit from the lower short-term complication rates of laparoscopic adjustable

Table 4 Percentage of Patients with Long-term Complications (>30 Days Postprocedure)

Study	Arm	N	Total	Death	Reoperation	Obstruction (Stricture)	Marginal Ulcer	Incisional Hernia	Gallbladder	LAGB-specific Complications		
										Slippage/ Dilation	Erosion	Port
Hell 2000	LAGB	30										
	RYGB	30	—	—	—	—	—	—	—	—	—	—
Biertho* 2003	LAGB	805	9.1	0	—	0.2	0	0.4	0	2.5	0	2.9
	RYGB	456	8.1	0	1.3	3.3	0	0.2	0			
Weber 2004	LAGB	103	45	0	27	0	0	0	0	36	5.8	1.0
	RYGB	103	14	0	11	11	2.9	1.0	0	1.0	1.9	0
Jan 2005	LAGB	154	1.9	0	20	0	0	1.9	0	16	0	6.5
	RYGB	219	2.3	0.2	9.6	4.6	1.4	3.2	0			
Mognol 2005	LAGB	179		0	20.1	0	0	0	0	20.1	0.6	3.4
	RYGB	1	—	0	1.8	1.8	3.6	0.9	0			
Parikh 2005	LAGB	197										
	RYGB	97	—	—	—	—	—	—	—	—	—	—
Bowne 2006	LAGB	60	78	0	25	3.3	0	0	0	1.7	0	18
	RYGB	46	28	0	6.5	11	4.3	0	0			
Cottam 2006	LAGB	181		0	24	0	0	0	0	7.2	0	9.4
	RYGB	181	—	0	19	1.7	0	0	0			
Galvani 2006	LAGB	470	17	0	8.1	0	0	0	0	14	0.2	2.8
	RYGB	120	14	0	8.3	5.8	0	0	0.8			
Kim 2006	LAGB	160	3.8	0	0	0	0	0.6	0	0	0	3.8
	RYGB	232	0.4	0	0	0	0	0	0			
Parikh 2006	LAGB	480	5.4	0								
	RYGB	235	14	0.4	—	—	—	—	—	—	—	—
Rosenthal† 2006	LAGB	152	9.2	0	14	2.6	0	0	0	1.3	1.3	0
	RYGB	849	7.7	0	0	1.4	1.4	0.2	0			
Angrisani 2007	LAGB	27		0	15.2	0	0	0	0	7.6	0	0
	RYGB	24	—	0	12.5	4.2	0	0	0			
Jan 2007	LAGB	406	19	0.2	17	0.7	0	0.2	1.7	8.1	0.7	4.9
	RYGB	492	23	0.6	17	1.6	2.4	2.2	2.0			

LAGB = laparoscopic adjustable gastric banding; RYGB = Roux-en-Y gastric banding.

*Major complications in the first postoperative week rather than 30 days.

†Major complications for Roux-en-Y gastric bypass and complications that required surgical correction for the laparoscopic adjustable gastric banding group.

gastric banding. Essential outcomes to evaluate in future trials would be surgical and long-term mortality, surgical complications, weight loss, change in comorbidities, quality of life, and long-term complications. Until trials demonstrate the advantages of laparoscopic adjustable gastric banding in clearly defined subgroups of patients, Roux-en-Y gastric bypass should remain the bariatric procedure of choice in the United States.

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