



# CIGNA HEALTHCARE COVERAGE POSITION

Revised Date .....	5/15/2008
Original Effective Date .....	5/15/2004
Next Review Date.....	5/15/2009
Coverage Position Number .....	0051

Subject **Bariatric Surgery**

## Table of Contents

Coverage Position.....	1
General Background .....	3
Coding/Billing Information .....	23
References.....	25

## Hyperlink to Related Coverage Positions

Abdominoplasty and Panniculectomy  
 Gastric Pacing/Gastric Electrical Stimulation (GES)  
 Nutritional Counseling  
 Obstructive Sleep Apnea Diagnosis and Treatment Services  
 Redundant Skin Surgery

### INSTRUCTIONS FOR USE

Coverage Positions are intended to supplement certain **standard** CIGNA HealthCare benefit plans. Please note, the terms of a participant's particular benefit plan document [Group Service Agreement (GSA), Evidence of Coverage, Certificate of Coverage, Summary Plan Description (SPD) or similar plan document] may differ significantly from the standard benefit plans upon which these Coverage Positions are based. For example, a participant's benefit plan document may contain a specific exclusion related to a topic addressed in a Coverage Position. In the event of a conflict, a participant's benefit plan document **always supercedes** the information in the Coverage Positions. In the absence of a controlling federal or state coverage mandate, benefits are ultimately determined by the terms of the applicable benefit plan document. Coverage determinations in each specific instance require consideration of 1) the terms of the applicable group benefit plan document in effect on the date of service; 2) any applicable laws/regulations; 3) any relevant collateral source materials including Coverage Positions and; 4) the specific facts of the particular situation. Coverage Positions relate exclusively to the administration of health benefit plans. Coverage Positions are not recommendations for treatment and should never be used as treatment guidelines. Proprietary information of CIGNA. Copyright ©2008 CIGNA

## Coverage Position

**Bariatric surgery is specifically excluded under many CIGNA HealthCare benefit plans and may be governed by state and/or federal mandates. Please refer to the applicable benefit plan document to determine benefit availability and the terms and conditions of coverage.**

**Unless excluded from the benefit plan, this service is covered when the following medical necessity criteria are met.**

**CIGNA HealthCare covers bariatric surgery using a covered procedure outlined below as medically necessary when ALL of the following criteria are met:**

- The individual is  $\geq 18$  years of age or has reached full expected skeletal growth **AND** has evidence of one of the following:
  - BMI (Body Mass Index)  $\geq 40$  for at least the previous 24 months.
  - BMI (Body Mass Index) 35–39.9 for at least the previous 24 months with at least one clinically significant comorbidity, including but not limited to, cardiovascular disease, Type 2 diabetes, hypertension, coronary artery disease, or pulmonary hypertension
- Active participation within the last two years in one physician-supervised weight-management program for a minimum of six months without significant gaps. The weight-management program must include monthly documentation of **ALL** of the following components:

- weight
- current dietary program
- physical activity (e.g., exercise program)

Programs such as Weight Watchers<sup>®</sup>, Jenny Craig<sup>®</sup> and Optifast<sup>®</sup> are acceptable alternatives if done in conjunction with physician supervision and detailed documentation of participation is available for review. For individuals with long-standing, morbid obesity, participation in a program within the last five years is sufficient if reasonable attendance in the weight-management program over an extended period of time of at least six months can be demonstrated. However, physician-supervised programs consisting exclusively of pharmacological management are not sufficient to meet this requirement.

- Evaluation by a multidisciplinary team within the previous 12 months which includes the following:
  - an evaluation by a surgeon qualified to do bariatric surgery recommending surgical treatment
  - a separate medical evaluation recommending bariatric surgery
  - clearance for surgery by a mental health provider
  - a nutritional evaluation by a physician or registered dietician

#### **Bariatric Surgery Procedures:**

**When the specific medical necessity criteria noted above for bariatric surgery have been met, CIGNA HealthCare covers ANY of the following bariatric surgery procedures:**

- vertical banded gastroplasty
- Roux-en-Y gastric bypass
- adjustable silicone gastric banding (e.g., LAP-BAND<sup>®</sup>, REALIZE<sup>™</sup> )
- biliopancreatic diversion with duodenal switch (BPD/DS) for individuals with a BMI (Body Mass Index) > 50

**CIGNA HealthCare covers adjustment of a silicone gastric banding as medically necessary to control the rate of weight loss and/or treat symptoms secondary to gastric restriction following a medically necessary adjustable silicone gastric banding procedure.**

**CIGNA HealthCare does not cover the following bariatric surgery procedures, because they are considered experimental, investigational or unproven (this list may not be all-inclusive):**

- Fobi-Pouch (limiting proximal gastric pouch)
- intragastric balloon
- mini-gastric bypass
- sleeve gastrectomy (SG)
- Natural Orifice Transluminal Endoscopic Surgery<sup>™</sup> (NOTES<sup>™</sup>) (e.g., StomaphyX<sup>™</sup>)

#### **Reoperation and Repeat Bariatric Surgery:**

**CIGNA HealthCare covers surgical reversal (i.e., takedown) of bariatric surgery as medically necessary when the individual develops complications from the original surgery such as stricture or obstruction.**

**CIGNA HealthCare covers revision of a previous bariatric surgical procedure or conversion to another medically necessary procedure due to inadequate weight loss as medically necessary when ALL of the following are met:**

- Coverage for bariatric surgery is available under the participant's current health benefit plan.
- There is evidence of full compliance with the previously prescribed postoperative dietary and exercise program.
- Due to a technical failure of the original bariatric surgical procedure (e.g., pouch dilatation) documented on either upper gastrointestinal (UGI) series or esophagogastroduodenoscopy (EGD), the patient has failed to achieve adequate weight loss, which is defined as failure to lose at least 50% of excess body weight or failure to achieve body weight to within 30% of ideal body weight at least two years following the original surgery.
- The requested procedure is a regularly covered bariatric surgery (see above for specific procedures).

**NOTE: Inadequate weight loss due to individual noncompliance with postoperative nutrition and exercise recommendations is not a medically necessary indication for revision or conversion surgery and is not covered by CIGNA HealthCare.**

### Cholecystectomy and Liver Biopsy:

**CIGNA HealthCare covers cholecystectomy performed at the time of bariatric surgery as medically necessary when the bariatric surgery is determined to be medically necessary and EITHER of the following criteria is met:**

- Preoperative or intraoperative evidence of gallstones or biliary sludge.
- Recent history of cholecystitis.

**CIGNA HealthCare does not cover either prophylactic cholecystectomy (incidental removal of a nondiseased gallbladder) or routine liver biopsy at the time of bariatric surgery, because each is considered experimental, investigational or unproven.**

## General Background

Obesity and overweight are defined clinically using the body mass index (BMI). BMI is an objective measurement and is currently considered the most reproducible measurement of total body fat.

The National Heart, Lung and Blood Institute (NHLBI) (1998) defines the following classifications based on BMI. The NHLBI recommends that the BMI should be used to classify overweight and obesity and to estimate relative risk for disease compared to normal weight:

Classification	BMI
Underweight	< 18.5 kg/m <sup>2</sup>
Normal weight	18.5–24.9 kg/m <sup>2</sup>
Overweight	25–29.9 kg/m <sup>2</sup>
Obesity (Class 1)	30–34.9 kg/m <sup>2</sup>
Obesity (Class 2)	35–39.9 kg/m <sup>2</sup>
Extreme Obesity (Class 3)	≥ 40 kg/m <sup>2</sup>

BMI is a direct calculation based on height and weight, regardless of gender:

$$\text{BMI} = \frac{\text{weight (kg)}}{\text{height (m)}^2} \text{ OR } \left[ \frac{\text{weight (lb)}}{\text{height (in)}^2} \right] \times 703$$

Clinically severe or morbid obesity is defined as a BMI greater than or equal to 40 or a BMI 35–39.9 with comorbid conditions. Comorbidities of morbid obesity that need to be considered include any of the following:

- mechanical arthropathy (weight-related degenerative joint disease)
- type 2 diabetes
- clinically unmanageable hypertension (systolic blood pressure at least 140 mm Hg or diastolic blood pressure 90 mm Hg or greater, or if individual is taking antihypertensive agents)
- hyperlipidemia
- coronary artery disease
- lower extremity lymphatic or venous obstruction
- severe obstructive sleep apnea
- obesity-related pulmonary hypertension

Another group of individuals who have been identified are the super-obese. Super-obesity has recently been defined in the literature as a BMI greater than 50.

Treatment of obesity is generally described as a two-part process:

1. assessment, including BMI measurement and risk factor identification; and
2. treatment/management

Obesity management includes primary weight loss, prevention of weight regain and the management of associated risk. During the assessment phase, the individual needs to be prepared for the comprehensive nature of the program, including realistic timelines and goals.

### **Goals for Weight Loss**

According to the NHLBI Clinical Guidelines on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults (1998), the initial goal of weight-loss therapy should be to reduce body weight by approximately 10% from baseline. With success, further weight loss can be attempted, if indicated, through additional assessment. The NHLBI guidelines further state that, optimally, dietary therapy should last at least six months. The rationale for this initial goal is that even moderate weight loss (i.e., 10% of initial body weight) can significantly decrease the severity of obesity-associated risk factors. It can also set the stage for further weight loss, if indicated. Other interventions in obesity management include exercise/physical activity, behavior modification/therapy, pharmacotherapy and, in select individuals, bariatric surgery.

### **Strategies for Weight Loss**

Nonsurgical strategies for achieving weight loss and weight maintenance involve the following components:

- dietary therapy
- increased physical activity/exercise
- combined therapy (diet and physical activity)
- behavioral therapy
- pharmacotherapy

Weight-loss and weight-maintenance management should employ a program of low-calorie diets, increased physical activity and behavior therapy. Pharmacotherapy may be considered as an adjunct to these methods.

The NHLBI guidelines (1998) make the following recommendations regarding these methods:

- Dietary therapy:
  - Low-calorie diets are recommended for weight loss in overweight and obese persons. Reducing fat as part of a low-calorie diet is a practical way to reduce calories.

- Optimally, dietary therapy should last at least six months, as many studies suggest that the rate of weight loss decreases after about six months. Shorter periods of dietary therapy typically result in lesser weight reductions.
  - The literature suggests that weight-loss and weight-maintenance therapies that provide a greater frequency of contacts between the individual and the practitioner and are provided over the long term should be put in place. This can lead to more successful weight loss and weight maintenance.
- Physical activity is recommended as part of a comprehensive, weight-loss therapy and weight-maintenance program because it:
    - modestly contributes to weight loss in overweight and obese adults
    - may decrease abdominal fat
    - increases cardiorespiratory fitness
    - may help with maintenance of weight loss
  - The combination of a reduced-calorie diet and increased physical activity is recommended, since it produces weight loss, decreases abdominal fat and increases cardiorespiratory fitness.
  - Behavior therapy is a useful adjunct when incorporated into treatment for weight loss and weight maintenance.

In addition, the NHLBI recommends that weight-loss drugs approved by the U.S. Food and Drug Administration (FDA) only be used as part of a comprehensive weight-loss program, including diet and physical activity for individuals with a BMI greater than or equal to 30 with no concomitant obesity-related risk factors or diseases, or for individuals with a BMI greater than or equal to 27 with concomitant obesity-related risk factors or diseases.

Clinical supervision is an essential component of dietary management. According to the NHLBI, “frequent clinical encounters during the initial six months of weight reduction appear to facilitate reaching the goals of therapy. During the period of active weight loss, regular visits of at least once per month and preferably more often with a health professional for the purposes of reinforcement, encouragement, and monitoring will facilitate weight reduction” (NHLBI, 1998). Physicians can also provide clinical oversight and monitoring of what are often complex comorbid conditions and can select the optimal and most medically appropriate weight management, nutritional and exercise strategies. Some commercially available diet programs do not consistently provide counselors who are trained and certified as registered dietitians or with other equivalent clinical training. However, diet programs/plans, such as Weight Watchers<sup>®</sup>, Jenny Craig<sup>®</sup> or similar plans are acceptable methods of dietary management if there is concurrent documentation of at least monthly clinical encounters with a physician.

### **Surgical Intervention**

The NHLBI recommends weight-loss surgery as an option for carefully-selected adult patients with clinically severe obesity (BMI of 40 or greater; or BMI of 35 or greater with serious comorbid conditions) when less-invasive methods of weight loss have failed and the patient is at high risk for obesity-associated morbidity or mortality. Bariatric surgery in patients under 18 years of age or in those who have not reached full expected skeletal growth has not been well-studied; therefore, its safety and efficacy have not yet been established in this population. Surgical therapy for morbid obesity is not only effective in producing weight loss but is also effective in improving several significant complications of obesity, including diabetes, hypertension, dyslipidemia, and sleep apnea. The degree of benefit and the rates of morbidity and mortality of the various surgical procedures vary according to the procedure (Bouldin, et al., 2006). Bariatric surgery is not considered a first-line treatment. Even the most severely obese individuals (i.e., super-obese with BMI over 50) can be helped by a preoperative weight loss through a program of reduced-calorie diet and exercise therapy.

A study by Jamal et al. (2006) compared outcomes of gastric bypass patients undergoing a mandatory 13 weeks of preoperative dietary counseling (PDC) (n=72) to a group of patients without this requirement (n=252). The PDC group had a higher incidence of obstructive sleep apnea compared to the no-PDC group (p< 0.04). The two groups had similar incidences of obesity-related comorbidities. The dropout rate

prior to surgery was reported to be 50% higher in the PDC group than in the no-PDC group ( $p < 0.05$ ). The no-PDC patients had a statistically greater percentage of EWL ( $p < 0.0001$ ), lower BMI ( $p < 0.015$ ), and lower body weight ( $p < 0.01$ ) at one-year follow-up. Resolution of major comorbidities, complication rates, 30-day postoperative mortality, and postoperative compliance with follow-up were similar in the two groups (Jamal, et al., 2006). Limitations to this study include its lack of randomization and the relatively short-term follow-up of one year which may not have been long enough to demonstrate differences in outcomes.

Ali et al. (2007) reported on a series of 351 patients who had undergone LRYGB. The investigators hypothesized that weight loss prior to LRYGB is feasible, would not decrease the expected postoperative weight loss, and might enhance overall weight loss and maintenance. Patients were divided into four groups depending on the percentage of body weight loss achieved before surgery: group 1, none or gain; group 2,  $< 5\%$ ; group 3,  $5-10\%$ ; and group 4,  $> 10\%$ . Data were collected regarding the demographics, body mass index (BMI) change, and excess weight loss. The maximum follow-up was 36 months. Of the 351 patients enrolled in the study, follow-up data was available for 302 at six months, 246 at 12 months, 167 at 24 months and 71 at 36 months. Groups 3 and 4 had significantly greater initial excess weight and BMI ( $p < 0.05$ ) but these became similar after the preoperative weight loss. Most patients (74%) were able to lose weight before surgery, with 36% losing  $> 5\%$  body weight. Patients who lost weight preoperatively demonstrated more excess weight loss and BMI change from baseline that reached statistical significance at several points during follow-up ( $p < 0.05$ ). This study is limited by its retrospective design and loss to follow-up.

Alami et al. (2007) performed a prospective randomized trial to determine whether preoperative weight loss results in better outcomes after LRYGB. A total of 61 patients undergoing laparoscopic gastric bypass surgery were assigned preoperatively to either a weight loss group ( $n=26$ ) with a 10% weight loss requirement or a group that had no weight loss requirements ( $n=35$ ). The two groups were identical in terms of initial weight, BMI, and incidence of comorbidities. Perioperative complications, operative time, postoperative weight loss, and resolution of co-morbidities were analyzed. Of the 61 patients, data was available for 12 at one-year follow-up. Preoperative weight loss before LRYGB bypass was found to be associated with a decrease in the operating room time ( $p=0.0084$ ) and an improved percentage of excess weight loss in the short term ( $p=0.0267$ ). Complication rates were similar in both groups. Preoperative weight loss was also not shown to have a statistically significant impact on the resolution of comorbidities. Study limitations include small sample size and loss to follow-up.

The role of preoperative weight loss remains controversial. However, some bariatric surgeons and centers have advocated for preoperative weight loss, as it is believed that patients who are able to achieve this weight loss are most likely to have successful outcomes after surgery. The benefits of a preoperative weight-loss program include all of the following:

- identification of those individuals who will be committed to and compliant with the short-term, long-term and lifelong medical management follow-up, behavioral changes, lifestyle changes, and diet and physical exercise regimen required to ensure the long-term success of this surgery
- reduction of operative morbidity and surgical risk
- improvement in surgical access with weight loss
- reduction of the severity of obesity-associated risk factors, such as blood pressure, glucose intolerance, cardiorespiratory function and pulmonary function

Access to a multidisciplinary team approach, involving a physician with a special interest in obesity; a surgeon with extensive experience in bariatric procedures, a dietitian or nutritionist; and a psychologist, psychiatrist or licensed mental health care provider interested in behavior modification and eating disorders, is optimal. A mental health evaluation should specifically address any mental health or substance abuse diagnoses, the emotional readiness and ability of the patient to make and sustain lifestyle changes, and the adequacy of their support system. Realistic expectations about the degree of weight loss, the compromises required by the patient and the positive effect on associated weight-related comorbidities and quality of life should be discussed and contrasted with the potential morbidity and operative mortality of bariatric surgery.

With current state-of-the-art bariatric surgery procedures, patients lose an average of 50–60% of excess body weight and have a decrease in BMI of about 10kg/m<sup>2</sup> during the first 12–24 postoperative months. Most long-term studies show a tendency for a modest weight gain (5–7 kg) after the initial postoperative years; long-term maintenance of an overall mean weight loss of about 50% of excess body weight can be expected.

All bariatric surgical procedures are technically challenging and should only be performed by specially trained individuals. This is especially true of the minimally invasive procedures. Many authors have reported that surgical technique and surgeon training and experience all have significant impact on surgical outcomes. The American Society for Metabolic and Bariatric Surgery (ASMBS) guidelines for granting bariatric surgery privileges include the following global credentialing requirements:

- credentials to perform gastrointestinal and biliary surgery at an accredited facility
- documentation of practice in an integrated program for the care of the morbidly obese patient that provides ancillary services such as specialized nursing care, dietary instruction, counseling, support groups, exercise training, and psychological assistance as needed
- documentation that there is a program in place to prevent, monitor and manage short-term and long-term complications
- documentation that of a system in place to provide and encourage follow-up for all patients

The ASMBS further states that to obtain open bariatric surgery privileges, the surgeon must document an operative experience of 15 open bariatric procedures with satisfactory outcomes. Surgeons who primarily perform laparoscopic bariatric surgery may obtain open bariatric surgery privileges after documentation of 50 laparoscopic cases and at least 10 open cases supervised by an experienced bariatric surgeon. Operative experience is defined broadly to include not only procedure performance but also global care of the bariatric patient that includes preoperative and postoperative management (ASMBS, 2005).

### **Types of Bariatric Surgery**

Bariatric surgery for morbid obesity involves reducing the size of the gastric reservoir, contributing to the establishment of an energy deficit by restricting caloric intake. The goal of bariatric surgery is to induce and maintain permanent loss of at least half of the preoperative, excess body weight. This amount of weight loss should bring the patient to a weight at which many or most weight-related comorbidities are reverted or markedly ameliorated. The NHLBI report (1998) has recognized two types of operations that have proven to be effective: restrictive procedures that limit gastric volume and malabsorptive procedures which in addition to limiting food intake also alter digestion.

**Vertical Banded Gastroplasty (VBG):** This restrictive procedure uses both a band and staples to create a small stomach pouch. The pouch limits the amount of food that can be eaten at one time and slows passage of the food into the remainder of the stomach and gastrointestinal tract. VBG may be performed using an open or laparoscopic approach. Complications of VBG include esophageal reflux, leaking or rupture along the staple line, stretching of the stomach pouch from overeating.

**VBG Literature Review:** Morino et al. (2003) conducted a prospective RCT to compare LASGB to laparoscopic VBG in 100 morbidly obese patients. Patients with a BMI range of 40–50 kg/m<sup>2</sup>, without compulsive eating, were randomized to either LASGB (n=49) or LVBG (n=51). The minimum follow-up was two years (mean 33.1 months). The mean operative time was significantly longer for LVBG than for LASGB (p<0.05). Early morbidity rate was lower for LASGB patients (6.1%) than for LVBG patients (9.8%) (p=0.754). The late complication rate in the LVBG group was 14% and 32.7% in LASGB group (p<0.05), with the most frequent complication being band slippage (18%). The late reoperation rate was 24.5% (12 of 49) in the LASGB group and 0% in LVBG group (p<0.001). There were no deaths or conversions in either group. The excess weight loss at two and three years for patients who underwent LVBG was 63.5% and 58.9%, respectively. At the same follow-up interval, the mean BMI for these patients was 29.7 kg/m<sup>2</sup> and 30.7 kg/m<sup>2</sup>, respectively. Patients who received LASGB had a 41.4% EWL with a BMI of 34.8 kg/m<sup>2</sup> at two years and 39% EWL with a BMI of 35.7 kg/m<sup>2</sup> at three years.

Lee et al. (2004) conducted a prospective RCT of 80 patients with morbid obesity (mean BMI 43.2 kg/m<sup>2</sup>), range 36–59.8) who were assigned to undergo either LVBG or laparoscopic gastric bypass

(LGB). Changes in quality of life were assessed using the Gastro-Intestinal Quality of Life Index (GIQLI). Surgical time was significantly longer for LGBP ( $p<0.001$ ). The early complication rate was higher in the LGBP group (17.8% versus 2.5%,  $p<0.001$ ). Major complications that occurred in the LGBP group included anastomotic leakage ( $n=2$ ) and abdominal abscess ( $n=1$ ). Late complications such as upper gastrointestinal bleeding, anastomotic stenosis and reflux esophagitis were observed in four LGBP patients (10%) and two LVBG patients (5%). The conversion rate was 0% for LVBG and 2.5% (1/40) for LGBP. At a mean follow-up of 20 months, BMI decreased significantly in both groups, with significant improvement of obesity-related co-morbidities. EWL was 62.9% at one year and 71.4% at two years for LGBP patients versus 55.4% at one year and 53.1% at two years for LVBG patients. BMI was also lower for LGBP patients than LVBG patients (29.6 versus 31.1 at one year; 28.5 versus 31.9 at two years). Preoperative GIQLI scores were similar between the groups, but at one year, LGBP patients had better GIQLI scores than LVBG patients ( $p<0.01$ ).

Olbers et al. (2005) conducted an RCT of 83 patients who underwent LRYGB ( $n=37$ ) and LVBG ( $n=46$ ). Patients were followed for two years after surgery with regard to weight change and the need for remedial surgery. There were no conversions to open surgery. The mean operating time was longer for LRYGB than LVBG (138 versus 105 minutes). Early reoperations were performed in five LRYGB patients due to hemorrhage ( $n=3$ ), ileus ( $n=1$ ) and suspected leak ( $n=1$ ) and one LVBG patient because of a suspected leak. There were no differences in postoperative respiratory function or mobilization. Weight reduction was greater after LRYGB at both one-year ( $p=0.009$ ) and two-year ( $p<0.001$ ) follow-up. Conversion to RYGB was required in eight LVBG patients. No remedial surgical intervention was required for the LRYGB group).

Nocca et al. (2007) conducted a multicenter prospective study ( $n=200$ ) to assess the efficacy of LVBG in terms of weight loss and complication rates for morbidly obese patients who had indications for a restrictive procedure. The mean BMI of these patients was 43.2 kg/m<sup>2</sup>. The median follow-up period was 30 months (range, 1–72 months). Gastric perforation occurred in one case requiring conversion to open surgery. There was one death secondary to peritonitis of unknown etiology. The morbidity rate was 24% and included the following complications: gastric outlet stenosis (8%); staple line leak (2.5%); food trapping (1.5%); peritonitis (1%); thrombophlebitis (1.5%); pulmonary embolism (0.5%); and gastroesophageal reflux (9%). The EWL achieved was 56.7% at one year, 68.3% at two years, and 65.1% at three years.

In a prospective nonrandomized comparative trial, Miller et al. (2007) reported long term outcomes of 563 VBG and 554 AGB procedures performed by two surgeons. The mean BMI was 46.9 +/- 09.9 kg/m<sup>2</sup> for VBG patients and 46.7 +/- 07.8 kg/m<sup>2</sup> for AGB patients. VBG was performed by laparotomy and AGB using laparoscopy. The Bariatric Analysis and Reporting Outcome System (BAROS) was used to evaluate postoperative health status and quality of life. The mean duration of follow-up was 92 months (range 60-134), with a minimum of 5 years. The overall follow-up rate was 92%. The 30-day mortality rate was 0.4% for VBG and 0.2% for AGB. The overall reintervention rate in the long term was 49.7% for VBG and 8.6% for AGB ( $p<0.0001$ ). The reoperation rate was 39.9% for VBG and 7.5% for AGB ( $p<0.0001$ ). The EWL was significantly greater in the VBG group (58%) than the AGB group (42%) after 12 months ( $p<0.05$ ). At 92-month follow-up, no significant difference in weight loss was found between the two study groups (59% for VBG and 62% for AGB,  $p=0.923$ ). The BAROS score was significantly in favor of the AGB group ( $p<0.0001$ ). The overall resolution rate of co-morbidities was 80% in both groups.

Although reoperation rates have been reported to be higher for VBG, the available evidence suggests that substantial weight loss can be achieved with this restrictive procedure. VBG has been largely replaced by adjustable silicone gastric banding however, and is now rarely performed (Centers for Medicare and Medicaid Services [CMS], 2006).

**Gastric Banding:** In this restrictive procedure, a band made of special material (e.g., silicone, polypropylene mesh, Dacron vascular graft) is placed around the stomach near its upper end, creating a small pouch and a narrow passage into the larger remainder of the stomach. Adjustable gastric banding refers to bands in which the pressure can be changed without an invasive procedure. The open approach to gastric banding is considered obsolete in practice and has largely been replaced by laparoscopic techniques.

**Laparoscopic Adjustable Silicone Gastric Banding (LASGB):** LASGB is a minimally invasive gastric restrictive procedure that involves the wrapping of a saline-filled band around an area of the stomach with the goal of limiting food consumption. The adjustable band can be inflated or deflated percutaneously via an access port (reservoir) attached to the band by connection tubing, based on weight changes. The access port is placed in or on the rectus muscle, allowing for noninvasive band adjustment. This adjustment process helps determine the rate of weight loss and is an essential part of LASGB therapy. Appropriate adjustments, made up to six times annually, are critical for successful outcomes (Buchwald, 2005). Currently, adjustable gastric banding devices approved for marketing in the U.S. include the Bioenterics® LAP-BAND® Adjustable Gastric Banding (LAGB®) System (INAMED Health, Santa Barbara, CA), and the REALIZE™ Adjustable Gastric Band (Ethicon Endo-Surgery, Inc., Cincinnati, OH).

**LAP-BAND:** The LAP-BAND received premarket approval (PMA) from the U.S. Food and Drug Administration (FDA) in June 2001. The FDA- approval letter states that the LAP-BAND is indicated for use in weight reduction for severely obese patients with a BMI of at least 40; with a BMI of at least 35 with one or more severe comorbid conditions; or who are 100 lbs. or more over their estimated ideal weight according to the 1983 Metropolitan Life Insurance Tables. The letter further states that the device is indicated for use only in severely obese patients who have failed more conservative weight reduction alternatives, such as supervised diet, exercise and behavior modification programs (FDA, 2001).

According to patient information provided by the manufacturer of the LAP-BAND, when the band is initially placed, it is usually left empty or only slightly inflated to allow time for adjustment to the device and healing. The first band adjustment is typically done approximately four to six weeks after the initial placement. There is no set schedule for adjustments, as the surgeon decides when it is appropriate to adjust the band based on weight loss, amount of food the individual can eat, exercise and amount of fluid currently in the band. Adjustments can be done either in the hospital or in a doctor's office. Fluoroscopy may be used to assist in locating the access port, or to guide the needle into the port. It is also used after the band has been adjusted to evaluate the pouch size and stoma size. During each adjustment, a very small amount of saline will be added to or removed from the band. The exact amount of fluid required to make the stoma the right size is unique for each person. More than one adjustment may be needed to achieve an ideal fill that will result in gradual weight loss. If a band is too loose, this may cause a patient to feel hungry or dissatisfied with small meals. A band that is too tight may result in dysphagia, regurgitation or maladaptive eating.

**REALIZE:** The REALIZE Adjustable Gastric Band received a PMA from the U.S. FDA in September 2007. The Band has been registered and marketed in Europe since 1996 and became available to other countries excluding the U.S. in 2004. Similar to the LAP-BAND, the REALIZE is indicated for weight reduction in morbidly obese patients with a BMI of at least 40 or a BMI of at least 35 combined with one or more comorbid conditions. The Band is also indicated for use only in morbidly obese adult patients who have failed more conservative weight-reduction alternatives such as supervised diet, exercise and behavior modification programs. The Band comes in one size and the fit is customized by increasing or decreasing the amount of saline in the balloon. The balloon is designed to hold up to nine milliliters of saline. Contraindications for the Band are also similar to those of the LAP-BAND and include inflammatory diseases of the gastrointestinal tract, severe cardiopulmonary disease, portal hypertension, and cirrhosis of the liver.

The clinical data submitted to the FDA as part of the FDA-approval process for The Band are from a prospective, multicenter, single-arm trial (n=276) in which each patient served as his or her own control. At three years post-implantation the % EWL in the 228 patients who completed the study was 42% with 77% of patients having at least a 25% EWL. A statistically significant decrease from baseline was seen in glycosylated hemoglobin, total cholesterol, LDL cholesterol and triglyceride levels at three-year follow-up. A statistically significant increase in HDL cholesterol levels was also found. Adverse events included injection port site pain (6%), port disconnection (4.3%), pouch dilatation (3.6%), esophageal dilatation (3.3%), and band slippage (3.3%). A total of 43 patients re-operations such as port revisions (n=22), band revisions (n=10), and port replacements (n=5). As part of the U.S. FDA PMA-approval, the manufacturer is required to conduct a post-approval study to evaluate the longer-term safety and effectiveness of the device five years post-implantation.

**LASGB Literature Review:** Evidence in the published, peer-reviewed scientific literature suggests that laparoscopic adjustable gastric banding is a safe and effective surgical treatment option for patients with morbid obesity. Although a large number of studies have reported on the effectiveness of this technique, available evidence supporting the use of adjustable gastric banding is primarily in the form of retrospective and prospective case series. Numerous case series have been published, with several studies including over 500 patients each. A limited number of randomized trials have been published, with few studies comparing adjustable gastric banding with established surgical approaches, such as gastric bypass.

Well-designed comparative clinical trials comparing adjustable banding with established bariatric surgical procedures are limited. While a number of these studies and case series report a substantial weight loss following laparoscopic banding, the percentage of excess weight loss (EWL) after one year appears to be less than the percentage of EWL associated with gastric bypass procedures (O'Brien, et al., 2003; BCBSA, 2003). According to the BCBSA TEC Assessment (2003), "more limited evidence on three-year weight loss suggests that this difference may lessen over time" (BCBSA, 2003). Reported success rates and results have been highly variable across studies.

Several earlier studies report high failure and complication rates associated with the banding procedure. Reported complications include both operative complications (splenic or esophageal injury) and late complications (band slippage, gastric erosion of the band, dilatation, reservoir deflation/leak, persistent vomiting, long-term failure to lose weight and gastric reflux) (Gustavsson, et al., 2002; Victorzon and Tolonen, 2001; Holeczy, et al., 2001). Jan et al. (2005) studied a consecutive series of patients who underwent either laparoscopic RYGB or LAGB over a three-year period by a single surgeon. The authors reported that the LAGB group had shorter operative times, less blood loss and shorter hospital stays as compared to the LRYGB group. The incidence of minor and major complications was reported to be similar in the two groups, with the morbidity after LRYGB potentially greater and the reoperation rate greater in the LAGB group. Early weight loss was greater in the bypass group; however, it was noted that the difference appeared to diminish over time (Jan, et al., 2005).

More recently, Angrisani et al. (2007) performed a prospective, randomized comparison (n= 51) of LAGB with the LAP-BAND system and LRYGB. The mean BMI was 43.4 for patients who underwent LAGB (n=27), and 43.4 for those who had LRYGB. Outcome measures included operative time, complications, reoperations with hospital stay, weight, BMI, percentage of excess weight loss, and co-morbidities. Failure was considered a BMI >35 at five years postoperatively. One patient in the LAGB group was lost to follow-up. There was a statistically significant difference between the two groups in mean operative time (p<0.001). Conversion to laparotomy was performed in one of 24 LRYGB patients (4.2%) because of a posterior leak of the gastrojejunal anastomosis. Reoperations were required in four of 26 LAGB patients (15.2%) due to gastric pouch dilation (n=2) and unsatisfactory weight loss (n=2). Reoperations were needed for three of the 24 LRYGB patients (12.5%) because of early complications. At five-year follow-up, the LRYGB patients had significantly lower weight and BMI and a greater percentage of excess weight loss than those in the LAGB group (p<0.001). Weight loss failure was observed in nine of 26 LAGB patients and in one of 24 LRYGB patients (p<0.001). These study results suggest that LRYGB results in a higher percentage of weight loss compared to LAGB.

While short-term complication rates have been low relative to those for other procedures, such as gastric bypass, it is difficult to draw conclusions about the incidence of long-term adverse events due to the lack of available data. Data supporting the use of laparoscopic gastric banding comes primarily from a large number of clinical series. There is evidence to suggest that laparoscopic adjustable gastric banding is safe and effective and may be a surgical option for those obese individuals with a BMI of less than 50 who are not candidates for Roux-en-Y gastric bypass (Chapman, et al., 2004).

**Gastric Bypass:** Gastric bypass procedures combine the creation of a small stomach pouch to restrict food intake and construction of a bypass of the duodenum and other segments of the small intestine to produce malabsorption. The Roux-en-Y gastric bypass (RYGB) is the most commonly performed gastric bypass procedure. A small stomach pouch is created by stapling or by vertical banding to restrict food intake. Next, a Y-shaped section of the small intestine consisting of two limbs and a common channel is attached to the pouch to allow food to bypass the duodenum and jejunum. This causes reduced calorie and nutrient absorption. The degree of intended malabsorption is determined by the length of the Roux

limb or common channel and varies as follows: standard (short-limb), 40 cm; long-limb, 75 cm; and very long-limb, 150 cm (Hayes, 2007). Complications of the RYBP include anastomotic leaking and strictures, nutritional deficiencies, and the dumping syndrome. The dumping syndrome occurs when a large amount of undigested food passes rapidly from the stomach into the small intestine and is characterized by abdominal pain, nausea, vomiting and weakness.

RYGB can be performed via open and laparoscopic approaches. A systematic review of the scientific literature on open and laparoscopic surgery for morbid obesity (Gentileschi, et al., 2002) concluded that laparoscopic Roux-en-Y is as safe as open RYGB. The overall body of evidence indicates that, in general, laparoscopic RYGB has been shown to achieve significant sustained weight loss with resolution of obesity-related comorbidities (Jan, et al., 2005; Schauer, et al., 2000; DeMaria, et al., 2002; Wittgrove and Clark, 2000). Evidence suggests that weight-loss outcomes are comparable to open gastric bypass at one year (BCBSA, 2003). In comparative trials, RYGB has been reported to be associated with substantially greater weight loss and reduction of comorbidities following surgery. It continues to be the surgical treatment of choice for morbid obesity (Weber, et al., 2004; BCBSA, 2003; Lee, et al., 2004).

**Biliopancreatic Diversion with and without Duodenal Switch:** As described originally by Scopinaro, the biliopancreatic diversion (BPD) is principally a malabsorptive procedure in which the distal two-thirds of the stomach is removed. The small pouch that remains is connected directly to the final segment of the small intestine, diverting bile and pancreatic juice into the distal ileum. Increased malabsorption and greater EWL occur, but at the expense of a higher incidence of both surgical and metabolic complications. These complications include: anastomotic ulceration, diarrhea, protein caloric malnutrition, metabolic bone disease and deficiencies in the fat-soluble vitamins, vitamin B<sub>12</sub>, iron and calcium.

Hess adapted the procedure to include the duodenal switch (DS). The biliopancreatic diversion with duodenal switch (BPD/DS) incorporates both malabsorptive and restrictive mechanisms to minimize complications while still producing significant therapeutic weight loss (Hayes, 2002). The procedure involves vertical subtotal gastrectomy with preservation of the pylorus. The first part of the duodenum is divided and attached to the terminal ileum. Sparing the pylorus significantly reduces the incidence of dumping syndrome, obstruction and stricture. Preservation of the early part of the duodenum results in a reduction in the incidence of vitamin and iron deficiencies. The majority of surgeons who perform BPD now incorporate DS (Neligan and Williams, 2005). In some centers, BPD/DS has been proposed as the procedure of choice for a subset of patients with a BMI > 50 or the super morbidly obese. The procedure is considered technically demanding with an operative mortality of 2% and major perioperative morbidity of 10% (Clegg, et al., 2001). Postoperative EWL is reported to range between 70% and 80%.

Evidence evaluating the use of BPD/DS has been limited to numerous uncontrolled case series and patient registry data. Many studies are retrospective in design with significant loss to follow-up. It is also difficult to compare studies due to variations of the procedure(s) performed by open and/or laparoscopic approach. O'Rourke et al. (2006) analyzed postoperative morbidity and mortality in a retrospective review of 452 patients who underwent either open or laparoscopic gastric bypass or BPD/DS. The mean BMI of all patients was 55. The overall mean follow-up time was 419 days. The mortality rate was found to be 0.9%. Major and minor morbidity rates were reported to be 10% and 13%, respectively. BPD/DS was reported to be associated with higher risk of major morbidity than gastric bypass (P=0.05). Anastomotic leak was analyzed separately and also occurred at a higher rate with BPD/DS than with gastric bypass. EWL was 54% at one-year follow-up for all patients and did not differ significantly among procedure type or approach. The authors propose that older patients (i.e., ≥ 60 years) should be counseled regarding the higher risk associated with BPD/DS, as age was found to be a significant predictor of postoperative complications in this study.

In a comparative series, Prachand et al. (2006) reported on 350 super-obese patients who underwent open DS (n=198) or RYGB (n=152). Successful weight loss was defined as achieving at least 50% loss of excess body weight. At 36 months, the follow-up rate was approximately 50% for each group. The percentage EWL at this point continued to be greater for DS than RYGB, 68.9% vs. 54.9% respectively (p < 0.05). The 30-day mortality rate was found to be equal (i.e., one of 198 for DS patients, zero of 152 for RYGB patients). The authors concluded that direct comparison of DS to RYGB demonstrates superior weight loss outcomes for DS. Limitations of the study include its nonrandomized design and loss to follow-up.

In a review of their experience with open BPD/DS, Hess et al. (2005) reported 10-year follow-up data on 167 (92%) of a cohort of 182 patients. The average EWL was reported to be 75%. Type 2 diabetics have had a 98% cure rate (i.e., normal plasma glucose a few weeks after surgery). Hypercholesterolemia and other comorbidities were also reportedly improved. There were eight reversals typically due to excessive weight loss and protein malnutrition. A total of 37 revisions were necessary for the same two reasons, in addition to inadequate weight loss and uncontrolled diarrhea. The investigators maintain that BPD/DS has proven to be a safe and effective procedure for the treatment of morbid obesity with low rates of complications and sustained long-term weight loss.

Parikh et al. (2005) conducted a retrospective review of super-obese patients who underwent laparoscopic adjustable gastric banding (LAGB) (n=192), RYGB (n=97) or BPD with or without DS (n=43). The mean BMI for these patients was 55.3. There were no mortalities. The perioperative complication rate for LAGB, RYGB and BPD was 4.7%, 11.3% and 16.3%, respectively. The LAGB had a statistically significant lower complication rate compared with the other groups (P=0.02). The difference in complication rate between RYGB and BPD was not statistically significant. BPD patients had the highest percentage of EWL at three-year follow-up, but these patients also had the highest complication rate. It was concluded that LAGB is the safest of the three bariatric procedures for super-obese patients.

In another retrospective review, Rabkin et al. (2003) reported results of 345 laparoscopic BPD/DS procedures for patients with a mean BMI of 50. Overall perioperative morbidity, including reoperations, was 10%. There were no deaths. The mean percentages of EWL at six, 18 and 24 months were 51%, 89% and 91%, respectively. The authors note that while the laparoscopic technique for BPD/DS is technically feasible with acceptable morbidity, there is a steep learning curve for this procedure. Also, longer-term data as well as comparison between open and laparoscopic BPD/DS patients are needed.

Kim et al. (2003) examined the safety and efficacy of the laparoscopic BPD/DS procedure compared to open BPD/DS in super-obese patients (BMI>60). In this small retrospective study, laparoscopic BPD/DS was performed in 26 patients, and 28 patients underwent open BPD/DS. Median BMI was 66.9 in the laparoscopic group and 68.9 in the open group. Major morbidity occurred in six patients (23%) in the laparoscopic BPD/DS group and in five patients (17%) in the open BPD/DS group (P=0.63). There were two deaths in the laparoscopic BPD/DS group (7.6% mortality) and one death (3.5% mortality) in the open BPD/DS group (P=0.51). The authors concluded that although laparoscopic BPD/DS is a technically feasible procedure that results in effective weight loss similar to the open approach, both procedures are associated with appreciable morbidity and mortality in the super-obese population. Additional studies are needed to determine the best surgical treatment for super-obesity.

Anthone and colleagues (2003) conducted a review of data collected prospectively from 701 patients who underwent open BPD/DS as the primary surgical treatment of morbid obesity at a single institution. Preoperative BMI was 50 or more for 58% of patients, and 22% had a preoperative BMI of 60 or greater. There were 10 (1.4%) perioperative deaths. Significant morbidity occurred in 21 patients (2.9%). Complications included nonfatal leaks, rhabdomyolysis, wound dehiscence and bleeding requiring surgical intervention. Revisional surgery was needed in 40 patients (5.7%) due to malnutrition, persistent diarrhea or chronic, unexplained abdominal pain. EWL at one-, three- and five-year follow-up was 69% of 333 patients, 73% of 71 patients and 66% of 50 patients, respectively. At follow-up of three years (n=71) or more, patients reported and maintained a mean restriction of 63% of their preoperative intake with no specific food intolerances. Normal levels of serum albumin were reported in 98% of patients, hemoglobin in 52% and calcium in 71%. The authors noted that compared to procedures that severely restrict intake, BPD/DS allows patients to eat a wide variety of foods and approximately half of their preoperative intake without the associated dumping symptoms.

Baltasar et al. (2001) reported on 125 patients with a mean BMI of 50 who underwent open BPD/DS. Of these patients, 35% were morbidly obese (i.e., BMI 40–50), and 65% were super-obese. BPD/DS was the primary procedure for 102 patients and a conversion from a previous VBG in 23 patients. The overall mortality rate was 1.6%, with two perioperative deaths in the conversion group. The major complications occurred in conversion patients with two cases of obstruction and five leaks. At three-year follow-up, a 75% EWL was reported in the 64 patients available. For 32 patients at five years of follow-up, the EWL

was 81.4%. The authors believe BPD/DS to be an effective procedure to control weight in morbid and super-obese patients.

The available data suggests that BPD/DS is safe and technically feasible, can be accomplished in patients who are considered candidates for bariatric surgery, and can produce significant long-term weight loss. Additional well-designed randomized trials comparing BPD/DS to other procedures are needed to further define the role of open or laparoscopic BPD/DS in the treatment of morbid obesity.

**Fobi-Pouch:** The Fobi-Pouch has been proposed by one investigator as an alternative to traditional bariatric surgery. The limiting proximal gastric pouch procedure involves a small (less than 25 ml) vertical banded pouch, a Silastic<sup>®</sup> ring around the stomach creating a stoma, and a gastroenterostomy to a Roux-en-Y limb. Published evidence supporting the use of this procedure is in the form of one descriptive article (Fobi and Lee, 1998) and one case series (Fobi, et al., 2002; n=50), both authored by the developers of the technique, along with anecdotal information. Current evidence available in the published, peer-reviewed scientific literature indicates that the safety and efficacy of this procedure have not been established.

**Mini-Gastric Bypass:** The mini-gastric bypass has been proposed as a bariatric surgery method. The controversial procedure is performed laparoscopically and is similar to the Roux-en-Y technique except that, after the division of the stomach, a jejunal loop is created and anastomosed to the gastric pouch. Complications include biliary reflux and esophagitis. Evidence supporting the use of the mini-gastric bypass is in the form of small case series (Rutledge, 2001) and one small randomized open comparison of the procedure to LRYGB (Lee, et al., 2005). The authors reported similar efficacy in terms of EWL at two years. However, longer-term follow-up with regard to the risk of complications is recommended by the investigators.

There is insufficient evidence in the published, peer-reviewed scientific literature to support the safety and efficacy of the mini-gastric bypass.

**Intra-gastric Balloon (IGB):** Treatment with the IGB has been proposed as a temporary aid for obese patients who have had unsatisfactory results in their clinical treatment for obesity and for super-obese patients with higher surgical risk. The IGB technique allows the reduction of the gastric reservoir capacity, causing a premature sensation of satiety, facilitating the consumption of smaller amounts of food (Fernandes, et al., 2007). The balloon is typically removed within six months of insertion. Adverse effects associated with the intra-gastric balloon include gastric erosion, reflux, and obstruction.

Much of the literature evaluating the safety and efficacy of the intra-gastric balloon includes retrospective studies with relatively small sample sizes. Doldi et al. (2000) reported on intra-gastric balloon placement in 132 obese and morbidly obese patients. Mean BMI was 41.0 (29–81). The balloon was removed in the majority of patients four months after insertion. Mean weight loss was 14.4 kg, and mean reduction in BMI was 5.2. The weight loss produced an improvement of the complications associated with the obesity. Complications observed included balloon intolerance necessitating early removal from nine patients and two cases of gastric ulcer at balloon removal. The authors of this early study stated that the indications for intra-gastric balloon placement should be patients with a BMI > 40 in preparation for a bariatric operation; patients with BMI 30–35 with a chronic disease otherwise unresolved; patients with BMI < 30 in a multidisciplinary approach.

A larger retrospective study conducted by Genco et al. (2005) evaluated 2515 patients with a mean BMI of 44.4 who underwent intra-gastric balloon placement. The balloon was removed after six months. Mortality, complications, BMI, percentage EWL, BMI loss and comorbidities were evaluated. The overall complication rate was reported to be 2.8%, including the death of two patients. Gastric perforation occurred in five patients (0.19%), four of whom had undergone previous gastric surgery: A total of 19 gastric obstructions (0.76%) presented in the first week after balloon positioning and were successfully treated by balloon removal. Preoperative comorbidities resolved in 617 (44.3%) of 1394 patients. After six months, mean BMI was 35.4 and the EWL was 33.9%. BMI loss was reported to be 4.9 (range 0–25). Despite the complications noted, it was concluded that intra-gastric balloon is an effective procedure with reduced comorbidities and satisfactory weight loss within a follow-up period of six months. Previous gastric surgery was noted to be a contraindication to intra-gastric balloon placement.

In a Cochrane review of the evidence for intragastric balloon, Fernandes et al. (2007) included nine randomized, controlled clinical trials (n=395) spanning the years 1988 to 1999. One study was performed in 2005. In these trials, intragastric balloon was compared to no treatment, diet and a combination of balloon placement and diet. According to the authors, results indicated that compared with conventional management, intragastric balloon did not show convincing evidence of a greater weight loss. Although few serious complications of intragastric balloon placement occurred, the relative risks for minor complications like gastric ulcers and erosions were significantly raised (Fernandes, et al., 2007).

A technology assessment of the intragastric balloon from the Canadian Coordinating Office for Health Technology Assessment (CCOHTA) concluded that moderate weight loss may be achieved with intragastric balloon placement if patients are compliant with a weight-reduction program. Weight gain has been found to recur when the balloon is removed after six months. More data are needed before the intragastric balloon can be compared to other short-term interventions such as low-calorie diets (CCOHTA, 2006).

Currently, the available evidence in the published, peer-reviewed scientific literature is insufficient to establish the safety and efficacy of this procedure.

**Sleeve Gastrectomy:** Sleeve gastrectomy, also known as partial or vertical gastrectomy, is a less common restrictive procedure that has been proposed for severely obese patients (i.e., BMI > 60). Sleeve gastrectomy can be an open or laparoscopic procedure and involves the resection of the greater curvature of the stomach with the remainder resembling a tube or sleeve. The resulting decrease in stomach size inhibits distention of the stomach so that early satiety is achieved. Preservation of the pyloric sphincter prevents the dumping syndrome. Sleeve gastrectomy may be performed as a one-stage procedure or as the first of a two-stage procedure prior to gastric bypass or duodenal switch. Weight loss following sleeve gastrectomy is thought to reduce the risk of a subsequent, more extensive procedure, such as BPD, in very high-risk patients.

A number of retrospective and prospective studies have evaluated the safety and efficacy of sleeve gastrectomy. Milone et al. (2005) compared laparoscopic sleeve gastrectomy (LSG) and the intragastric balloon as a first-stage procedure for effective initial weight loss before more definitive surgery. LSG was performed in 20 patients and intragastric balloon placed in 57 patients. No complications were reported for patients who underwent LSG. For patients who had intragastric balloon placement, four patients (7%) had the balloon removed due to intolerance. The mean weight loss for patients undergoing LSG and intragastric balloon placement at six months was 45.5 and 22.3 kg, respectively, and the EWL was 35% for LSG versus 24% for the intragastric balloon. BMI decreased respectively from 69 to 53 for the LSG group and from 59 to 51 for the intragastric balloon group. Weight loss decreased comorbidities in 90% of patients after both procedures. According to the authors, study results suggest that LSG may be superior to the intragastric balloon procedure as a first stage for super-obesity.

Roa et al. (2006) assessed the safety and short-term efficacy of LSG as a treatment option for weight reduction. The data of 62 patients who underwent LSG and completed the three- and six-month follow-up visits were retrospectively reviewed. Mean preoperative BMI was 41.4. The mean hospital stay was 3.2 days (i.e., range 2–25). The mean weight loss was reported to be 22.7 kg at three-month follow-up and 30.5 kg at six months. The mean percentage of EWL was 40.7% and 52.8%, respectively. Three patients were considered to have mild complications, and one patient had a major complication that required surgical intervention. The authors concluded that LSG is a safe and effective treatment option in the short-term.

Himpens and colleagues (2006) conducted a prospective randomized study to compare the results of laparoscopic adjustable gastric banding (GB) and SG after one and three years of surgery. Median BMI was 37 for GB patients (n=40) versus 39 for SG patients (n=40). Weight loss, feeling of hunger, sweet eating, gastroesophageal reflux disease (GERD), complications and reoperations were assessed in both groups. Median weight loss after one year was 14 kilograms (kg) for GB patients and 26 kg for those who underwent SG (p<0.0001). After three years, the median weight loss for SG patients continued to be greater than for GB patients (p<0.0001). At three years, the median percentage EWL was 48% after GB and 66% after SG (p=0.0025). Loss of feeling of hunger after three years was reported in 2.9% of patients

with GB and 46.7% of patients with SG ( $p < 0.0001$ ). Postoperative complications requiring reoperation occurred in two patients after SG. Late complications requiring reoperation affected seven patients after GB. It was concluded that weight loss and loss of feeling of hunger were greater for those who underwent SG. Although the number of reoperations was found to be important in both groups, the severity of complications appears higher in SG (Himpens, et al., 2006).

Hamoui et al. (2006) presented the results of SG performed in a series of 118 patients. Median BMI was 55, with 73% of patients having a BMI  $\geq 50$ . The procedure was performed by laparotomy in all but three cases, which were performed laparoscopically. Median hospital stay was six days. There was one perioperative death (0.85%), and 18 patients (15.3%) had postoperative complications. Median follow-up was 13 months. The median percentage EWL was 37.8% at six months, 49.4% at 12 months, and 47.3% at 24 months. According to the investigators, "Although the SG does not result in as much weight loss as the duodenal switch or gastric bypass, it can be used as a stand-alone operation or as a bridge to more complex procedures in the high-risk super-obese patient" (Hamoui, et al., 2006).

Silecchia et al. (2006) evaluated the effect of LSG on major comorbidities such as hypertension, type 2 diabetes and the American Society of Anesthesiologists (ASA) operative risk score in high-risk super-obese patients ( $n=41$ ) undergoing two-stage laparoscopic BPD-DS. Patient selection criteria included a BMI  $\geq 60$  or BMI  $\geq 50$  with at least two severe comorbidities. In 10 patients, at least one intragastric balloon had been positioned and four had undergone LAGB, all with unsatisfactory results. At the time of surgery, 41.5% were classified as ASA 4 and 58.5% as ASA 3. Patients were evaluated every three months postoperatively and were restaged at 12 months and/or before the second procedure. The average BMI after six and 12 months was 44.5 and 40.8, respectively. After 12 months, 57.8% of the patients were free of comorbidities, and 31.5% had only one major comorbid condition. At the time of restaging, 20% of patients were still classified as ASA score 4. In the opinion of the authors, LSG represents a safe and effective procedure to achieve significant weight loss and reduction of major obesity-related comorbidities. It was also noted that the procedure reduced the operative risk (i.e., ASA score) in super-obese patients undergoing two-stage laparoscopic BPD-DS.

Cottam et al. (2006) presented 126 patients with a mean BMI of 65.3 who underwent LSG as a first-stage procedure. It was determined that 42% of these patients were ASA 3 and 52% were ASA 4. The mean number of comorbid conditions per patient was 9.3 with a median of 10 (range 3–17%). At one year after LSG, the mean EWL was 46%. A total of 36 patients with a mean BMI of 49.1 had the second-stage LRYGB. The mean number of comorbidities in this group was 6.4, reduced from 9. The ASA class of the majority of patients had been down-staged at the time of LRYGB. The mean time interval between the first and second stages was 12.6  $\pm$  0.8 months. The mean and median hospital stays were 3  $\pm$  1.7 and 2.5 (range 2–7) days, respectively. The incidence of major complications was 8%, and no deaths were reported. It was concluded that "the staging concept of LSG followed by LRYGBP is a safe and effective surgical approach for high-risk patients seeking bariatric surgery" (Cottam, et al., 2006).

In a 2007 position statement, the ASMBS notes that sleeve gastrectomy has been utilized as a first-stage bariatric procedure to reduce surgical risk in high-risk patients by induction of weight loss and that this may currently be its most useful application. It is further stated that sleeve gastrectomy appears to be a technically easier and/or faster laparoscopic procedure than RYGB or malabsorptive procedures in complex or high risk patients including the super-super-obese patient (BMI  $> 60$  kg/m<sup>2</sup>). However, long-term data demonstrating weight loss and comorbidity resolution have not been reported at this time (ASMBS, 2007).

Although promising, the available evidence is insufficient to support the use of sleeve gastrectomy as a stand-alone procedure or as the first of a two-stage procedure. Additional randomized controlled studies are needed to further define the role of this procedure in the surgical treatment of obesity.

**Natural Orifice Transluminal Endoscopic Surgery™ (NOTES™):** NOTES, also referred to as endoluminal surgery, is a new technique currently being investigated for use in a range of procedures including gastric bypass. The NOTES technique involves the use of natural orifice access (e.g., mouth, anus) to perform a surgical procedure which potentially reduces or eliminates the trauma of access incisions (Schauer, et al., 2007). Devices used in this type of endoscopic surgery include the StomaphyX™ endoluminal fastener and delivery system (EndoGastric Solutions, Inc., Redmond, WA).

The StomaphyX was granted marketing approval by the FDA via the 510(k) process on March 9, 2007 because it is considered to be substantially equivalent to another device already on the market. Under the FDA 510(k) approval process, the manufacturer is not required to supply to the FDA evidence of the effectiveness of the StomaphyX prior to marketing the device. The 510(k) summary stated that the StomaphyX is substantially equivalent to LSI Solutions Flexible Suture Placement Device and the Bard Endoscope Suturing System/Bard Endocinch. According to the FDA, the StomaphyX system is indicated for use in endoluminal trans-oral tissue approximation and ligation in the gastrointestinal tract. StomaphyX is popularly described as a non-invasive weight loss procedure to reduce the size of a patient's stomach without any incisions and has reportedly been used in patients who were regaining weight due to pouch expansion after laparoscopic gastric bypass surgery. Currently there is insufficient evidence in the peer-reviewed medical literature to support the use of transluminal endoscopic surgery using devices such as StomaphyX for the management of severe obesity.

There is insufficient evidence in the published, peer-reviewed scientific literature to support the use of any of the following bariatric procedures in the treatment of clinically severe/morbid obesity, as they have not been proven to achieve equivalent or improved patient outcomes relative to available alternatives:

- Fobi-Pouch
- intragastric balloon (IGB)
- mini-gastric bypass (jejunum is anastomosed to the stomach, as in the Billroth II procedure)
- sleeve gastrectomy (SG)
- Natural Orifice Transluminal Endoscopic Surgery™ (NOTES™) (e.g., StomaphyX™)

#### **Systematic Reviews on Bariatric Surgery**

**California Technology Assessment Forum (CTAF):** Tice (2004) conducted a systematic review of evidence for the use of BPD/DS. Uncontrolled and case series describing several variations of the procedure were identified. There were no trials using randomized controls that compared BPD/DS to RYGB. The author concluded that, while case series indicate the degree of weight loss achieved with BPD/DS is comparable to that of RYGB, it is not possible to draw any firm conclusions regarding the relative benefits and harms of the two procedures. It was recommended that BPD/DS does not meet the technology assessment criteria for safety, effectiveness and improvement in health outcomes.

**Cochrane Review:** In their systematic review, Colquitt and colleagues (2005) assessed the effects of surgery for morbid obesity on weight, comorbidities and quality of life. The group reviewed randomized controlled trials comparing different surgical procedures and randomized controlled trials and nonrandomized controlled trials comparing surgery with nonsurgical obesity management. The authors concluded, "The limited evidence suggests that surgery for morbid obesity results in greater weight loss than conventional treatment, and that the results are maintained at least up to eight years. Furthermore, the weight loss is associated with reductions in comorbidities such as diabetes and hypertension. However, surgery is associated with adverse effects and the possibility of postoperative mortality. There are a number of procedures available. However, due to the limited evidence and poor quality of the trials, the comparative safety and effectiveness of these procedures are uncertain" (Colquitt, et al., 2005).

**National Institute for Clinical Excellence (NICE):** The NICE systematic review (2002) concluded, "jejunoileal bypass is effective in achieving weight loss but is associated with serious complications, including liver disease. Gastric bypass appears to be more effective than gastroplasty in terms of achieving weight loss. However, it is a technically demanding operation with potentially serious metabolic complications. Vertical banded gastroplasty appears to be more effective than horizontal gastroplasty. Gastric banding is associated with more long-term weight loss, fewer reoperations and greater patient satisfaction than vertical banded gastroplasty, although the difference in the results is not statistically significant. It is the least invasive of the procedures, involving no permanent alteration of the anatomy. Laparoscopic surgery is as effective as open surgery, but results in fewer complications and a reduced length of hospital stay" (NICE, 2002).

**Blue Cross Blue Shield Technology Evaluation Center (TEC):** The TEC (2003) conducted a review to determine whether less invasive procedures (e.g., laparoscopic gastric bypass, laparoscopic gastric banding) improve outcomes as compared to open gastric bypass, and whether variations of gastric

bypass (e.g., biliopancreatic diversion, long-limb gastric bypass) improve outcomes for patients with super-obesity. The TEC report concluded, "There is insufficient evidence to conclude whether these procedures (i.e., laparoscopic gastric bypass, laparoscopic gastric banding, biliopancreatic diversion, long-limb gastric bypass) either improve net health outcomes or whether they are as beneficial as current established surgery, open gastric bypass with Roux-en-Y anastomosis" (BCBSA TEC, 2003).

The TEC conducted a more recent evaluation of the evidence on LAGB and concluded that the procedure "meets the TEC criteria when performed in appropriately selected patients, by surgeons who are adequately trained and experienced in the specific techniques used, and in institutions that support a comprehensive bariatric surgery program, including a long-term monitoring and follow-up post-surgery" (BCBSA TEC, 2007).

**Buchwald and colleagues:** Buchwald et al. (2004) conducted a systematic review and meta-analysis to determine the impact of bariatric surgery on weight loss, operative mortality outcome, and four obesity comorbidities (diabetes, hyperlipidemia, hypertension and obstructive sleep apnea). The authors concluded, "Bariatric surgery in morbidly obese individuals reverses, eliminates, or significantly ameliorates diabetes, hyperlipidemia, hypertension, and obstructive sleep apnea. These benefits occur in the majority of patients who undergo surgery" (Buchwald, et al., 2004). The authors further state that resolution of diabetes was found to be more prevalent in patients who underwent malabsorptive procedures and mixed malabsorptive/restrictive gastric bypass than in those who had restrictive-only procedures, gastroplasty and gastric banding.

**Chapman and colleagues (The Australian Safety and Efficacy Register of New Interventional Procedures-Surgical Review Group, 2003):** This group conducted a systematic review of the literature to compare the safety and efficacy of laparoscopic adjustable gastric banding with vertical banded gastroplasty and gastric bypass. The authors identified six studies that reported comparative results for gastric banding and other procedures and one study reporting results for all three procedures. The authors concluded, "The evidence base was of average quality up to four years for LAGB. Laparoscopic gastric bypass is safer than VBG and RYGB, in terms of short-term mortality rates. LAGB is effective, at least up to four years, as are the comparator procedures. Up to two years, LAGB results in less weight loss than RYGB; from two to four years there is no significant difference between LAGB and RYGB, but the quality of data is only moderate. The long-term efficacy of LAGB remains unproven, and evaluation by randomized controlled trials is recommended to define its merits relative to the comparator procedures" (Chapman, et al., 2004).

**Agency for Healthcare Research and Quality (AHRQ) Evidence Report:** In October 2004, the Agency for Healthcare Research and Quality of the U.S. Department of Health and Human Services released an evidence report on the surgical and pharmacological treatment of obesity.

The press release on the AHRQ Evidence Report stated:

"The AHRQ review did not find enough evidence to draw conclusions about differences in the safety of different types of weight-loss surgery, which include adjustable gastric banding, vertical-banded gastroplasty, and biliopancreatic diversion procedures. Less than 1% of patients operated on by experienced bariatric surgeons die as a result of the surgery or from complications, but the rate may be higher for less-experienced surgeons."

In addition, the detailed report drew the following conclusions regarding surgery:

- "Bariatric surgical treatment results in greater sustained weight loss than nonsurgical treatments in very obese individuals (BMI  $\geq$  40), resulting in improved health outcomes (reduction in diabetes and sleep apnea, improved quality of life). While not conclusive, the data suggest greater sustained weight loss for bariatric surgical treatment than for nonsurgical treatment in patients with BMI between 35 and 40.
- RYGB, VBG, and adjustable banding procedures all result in substantial weight loss.
- RYGB results in greater weight loss than VBG in severely obese individuals.

- Postoperative mortality rates of less than one percent have been achieved by a number of surgeons and bariatric surgical centers. The postoperative mortality rate in other settings may be higher.
- Few clinical trials have compared outcomes among different bariatric surgical procedures. The existing data suggest the possibility of clinically important differences in the proportion of patients reporting various complications and adverse events among those treated with RYGB, VBG, and adjustable banding procedures.
- Laparoscopic procedures result in fewer wound complications or incisional hernias than open procedures.
- The actual proportions of patients who experience some complications of bariatric surgery may be quite substantial, greater than 20 percent (although most are minor in severity)” (Shekelle, et al., 2004).

### **The Centers for Medicare and Medicaid Services (CMS)**

In February 2006, CMS issued an updated coverage decision for bariatric surgery. Based on their analysis of the medical literature, it was determined that the evidence is adequate to conclude that open and laparoscopic RYGB, laparoscopic adjustable gastric banding (LAGB), and open and laparoscopic biliopancreatic diversion with duodenal switch (BPD/DS) are reasonable and necessary for Medicare beneficiaries who have a BMI  $\geq$  35, have at least one comorbidity related to obesity, and have been previously unsuccessful with medical treatment for obesity. According to CMS, medical treatment which includes dietary manipulation, behavior modification and medication, should be routinely attempted either individually or in combination and shown to be unsuccessful prior to considering a patient for bariatric surgery. There are no consistent standards in the literature regarding the optimal length of a medical treatment trial; however, 6–12 months is believed to be a reasonable time frame.

Reanalysis of the data on surgical volume identified surgical experience as a significant factor in safety for bariatric surgery at both facility and surgeon levels. Based on this finding, CMS modified their proposed decision to now provide coverage for patients age 65 and older as long as the bariatric procedures are performed in facilities that are most likely to achieve better outcomes. CMS has determined that covered bariatric surgery procedures are reasonable and necessary only when performed at facilities that are certified by the American College of Surgeons (ACS) or by the ASBS as a Bariatric Surgery Center of Excellence (BSCOE).

**O’Brien and colleagues:** O’Brien et al. (2006) conducted a systematic review of studies evaluating medium-term weight loss after bariatric surgical procedures. Procedures examined in the 43 studies included LAGB (n=18), BPD with and without DS (n=7), and RYGBP (n=18). Of the LAGB reports, 12 provided data on the LAP-BAND, five on the Obtech<sup>®</sup> band (Ethicon Endo-Surgery, Inc., Cincinnati, OH), and one study included both devices. Pooled data for all procedures showed a mean EWL in the range of 54–67% with no evidence of loss of effect at 10 years. It was concluded that all current bariatric operations lead to major weight loss in the medium term. BPD and banded RYGBP appear to be more effective than both RYGBP and LAGB, which are equal in the medium term (O’Brien, et al., 2006).

### **Bariatric Surgery: Impact on Health Outcomes**

Current literature regarding the potential benefits of bariatric surgery on health outcomes includes the following:

- The increase in reported morbidity associated with obesity is thought to be mediated primarily by insulin resistance, diabetes, hypertension and lipid disturbances (Sjöstrom, et al., 2004).
- Diet therapy alone in the absence of surgery is relatively ineffective in treating obesity over the long term (Buchwald, et al., 2004).
- Severely obese patients who undergo bariatric surgery achieve greater short-, intermediate- and long-term (i.e., 10 years) weight loss, more physical activity and lower energy intake than severely obese patients treated with conventional medical interventions, such as very low-calorie diets and pharmacotherapy (Sjöstrom, et al., 2004; Buchwald, et al., 2004).
- Intermediate- and long-term (i.e., 10 years) incidence rates of recovery from risk factors such as diabetes, hypertriglyceridemia, low levels of high-density lipoprotein cholesterol, hypertension,

hyperlipidemia and hyperuricemia are more favorable in surgically-treated patients than in nonsurgical, severely obese patients (Sjöström, et al., 2004; Buchwald, et al., 2004).

- Bariatric surgery reverses, eliminates or significantly improves risk factors of diabetes, hyperlipidemia, hypertension and obstructive sleep apnea (Buchwald, et al., 2004).
- Severely obese diabetic individuals treated with bariatric surgery have shown an 80% reduction in mortality (Sjöström, et al., 2004).
- Weight-loss surgery has been reported to reduce the relative risk of death by 89% with an absolute mortality reduction of 5.49% (Christou, et al., 2004).
- Gastric bypass has been reported to result in more favorable overall health outcomes (i.e., weight loss, risk factor recovery/reduction) relative to other surgical interventions, such as banding procedures (Buchwald, et al., 2004).

Adams et al. (2007) conducted a retrospective cohort study to compare long-term rates of death from any cause and from specific causes in subjects who had undergone gastric bypass surgery compared to a group of severely obese controls. A total of 7925 surgical patients and 7925 severely obese control subjects were matched for age, sex, and BMI. The mean BMI differed significantly between the surgery group and the control group ( $p < 0.001$ ). During a mean follow-up of 7.1 years, adjusted long-term mortality from any cause in the surgery group decreased by 40%, as compared to the control group ( $p < 0.001$ ). Cause-specific mortality in the surgery group decreased by 56% for coronary artery disease ( $p = 0.006$ ), by 92% for diabetes ( $p = 0.005$ ), and by 60% for cancer ( $p < 0.001$ ). The estimated number of lives saved after a mean follow-up of 7.1 years was 136 per 10,000 gastric bypass surgeries. Rates of death not caused by disease (e.g., accidents, suicide), were reported to be 58% higher in the surgery group than in the control group ( $p = 0.04$ ). Acknowledged limitations to the study include the unknown baseline health status of patients seeking bypass surgery compared to that of control subjects. Also, the risk of death according to the amount of weight lost could not be analyzed as data on weight at time of death was unavailable (Adams, et al., 2007).

Sjöström et al. (2007) conducted a prospective, matched, surgical interventional trial, referred to as the Swedish Obese Subjects study, which involved 4047 obese subjects. Of these subjects, 2010 underwent bariatric surgery (surgery group) and 2037 received conventional treatment (matched control group). A total of 376 subjects underwent nonadjustable or adjustable banding, 1369 underwent vertical banded gastroplasty, and 265 received gastric bypass. For adjustable banding, the Swedish adjustable Gastric Band was used. Outcome measures included weight change and overall mortality during an average of 10.9 years of follow-up. Vital status was known for all but three subjects at the time of the analysis. In the surgery group, participation rates of subjects at follow-up examination at two, 10, and 15 years were 94%, 84%, and 66%, respectively. Corresponding rates for subjects in the control group were 83%, 75% and 87%. The average weight change in control subjects was less than  $\pm 2\%$  during the period of up to 15 years during which weights were recorded. At 10 years, the weight losses from baseline were stabilized at 25% after gastric bypass, 16% after vertical-banded gastroplasty, and 14% after banding. There were 129 deaths in the control group and 101 deaths in the surgery group. The most common causes of death were myocardial infarction which occurred in 25 subjects in the control group and 13 subjects in the surgery group. Cr was the most common cause of death from noncardiovascular causes (control group [ $n = 47$ ]; surgery group [ $n = 29$ ]). The main limitation of the study is the lack of randomization, however it is questionable whether randomization is feasible in bariatric surgery trials designed to study mortality. Although study results indicate that bariatric surgery is associated with a reduction in overall mortality, it is undetermined whether the favorable survival effect is explained by weight loss or by other beneficial effects of the surgical procedure (Sjöström, et al., 2007).

Dixon et al. (2008) conducted an unblinded RCT to determine if surgically induced weight loss results in better glycemic control and less need for diabetes medications than conventional approaches to weight loss and diabetes control. This study included 60 obese patients with a BMI range of 30–40, recently diagnosed (i.e.,  $< 2$  years) type 2 diabetes, and with no evidence of renal impairment or diabetic retinopathy. The surgical group ( $n = 30$ ) underwent LAGB along with conventional diabetes care and the conventional-therapy group received diabetes therapy with a focus on weight loss by lifestyle change. The primary outcome measure was remission of type 2 diabetes demonstrated by a fasting glucose level  $< 126$  mg/dL [ $7.0$  mmol/L] and glycated hemoglobin [HbA1c] value  $< 6.2\%$  while taking no glycemic therapy. Secondary measures included weight and components of the metabolic syndrome. Of the 60

patients enrolled, 55 (92%) completed the two-year follow-up. Remission of type 2 diabetes was achieved by 22 (73%) in the surgical group (n=30) and four (13%) in the conventional-therapy group ( $p<0.001$ ). Relative risk of remission for the surgical group was 5.5 (95% confidence interval, 2.2-14.0). The surgical group achieved a mean 20% body weight loss at two years compared to a 1.4% body weight loss among the conventional-therapy group ( $p<0.001$ ). The reduction in metabolic syndrome was significant in the surgical group ( $p<0.001$ ), but not in the conventional-therapy group ( $p=0.23$ ). It was noted that although study results suggest that patients who received surgical intervention were more likely to achieve remission of type 2 diabetes through greater weight loss, these results need to be confirmed in a larger study with a more diverse population and an assessment of long-term efficacy (Dixon, et al., 2008).

The National Institutes of Diabetes and Digestion and Kidney Disease (NIDDK) has sponsored the Longitudinal Assessment of Bariatric Surgery (LABS) program. This program involves six clinical centers that have expertise in relevant fields including bariatric surgery, obesity research, endocrinology, epidemiology, and outcomes research. The purpose of the LABS program is to plan and conduct studies that will analyze the risks and benefits of bariatric surgery and its impact on the health and well-being on patients with severe obesity as well as to identify the types of patients who are most likely to benefit from bariatric surgery (NIDDK, 2007).

### **Reoperation/Repeat Bariatric Surgery**

Previous bariatric operative approaches may fail for functional or technical reasons, causing inadequate weight loss or severe complications. The literature indicates that reoperative procedures may be required for metabolic complications of jejunioileal bypass, obstruction, alkaline or acid reflux esophagitis, band erosion, stricture, anastomatic ulcer, or gastric pouch dilatation (may occur following gastric restrictive procedures). In addition, it has been reported that many patients do not achieve adequate weight loss with certain gastric restrictive procedures, such as vertical banded gastroplasty, even when fully compliant with postoperative nutritional and exercise recommendations. In general, up to two years may be required for patients to reach their maximum weight loss following bariatric surgery. Follow-up bariatric surgery, such as conversion to Roux-en-Y, may be proposed when adequate weight loss has not occurred after one to two years following the initial surgery. Although there is no consensus on the definition of "adequate weight loss," bariatric surgery is considered by some experts to be successful when a patient loses at least 50% of excess weight or achieves body weight that is within 30% of ideal. Inadequate weight loss due to patient noncompliance with the postoperative nutrition and exercise program is not considered a medically necessary indication to undergo revision surgery or conversion to another procedure.

In general, revision surgery due to inadequate weight loss is reserved for those individuals in whom the original surgery was initially successful in achieving weight loss and who, due to the technical failure of the original procedure (e.g., pouch dilatation), have failed to achieve adequate weight loss in the two years following the original surgery. These patients should also have demonstrated that they have been fully compliant with their prescribed postoperative diet and exercise programs.

Reoperation by surgical reversal (i.e., "takedown") or surgical revision of bariatric surgery is generally considered to be medically necessary at any time following the original surgery when the patient experiences complications from the original surgery, such as stricture, obstruction, pouch dilatation, erosion or band slippage. In addition, reoperation for inadequate weight loss is generally considered to be medically necessary if the original procedure was performed at least one year prior to the reoperation date and the patient has not achieved adequate weight loss despite being compliant with postoperative nutritional and exercise recommendations. Conversion from a gastric restrictive procedure to a Roux-en-Y is a common reoperative technique.

### **Cholecystectomy at the Time of Bariatric Surgery**

It has been shown that there is a moderate correlation between obesity and the development of gallstones, with the risk of cholelithiasis rising as BMI increases. Furthermore, evidence in the scientific literature suggests that the rapid weight loss which occurs following certain bariatric surgical procedures increases cholesterol load, thereby increasing the risk for gallstone formation. For these reasons, some surgeons advocate the routine removal of asymptomatic normal gallbladders at the time of bariatric surgery (specifically gastric bypass procedures). It has been suggested that patients undergoing gastric bypass are at a greater risk than with other procedures, such as gastric banding, due to the

malabsorption and early and rapid postoperative weight loss associated with this procedure. The issue of performing routine prophylactic cholecystectomy concurrently with bariatric surgery continues to be debated, however. Many experts contend that performing cholecystectomy on nondiseased, normal-appearing gallbladders is not recommended and places unnecessary risk on the patient (Sreenarasimhaiah, 2004; Villegas, et al., 2004). Combining procedures increases operative time and has been reported to lengthen hospital stay significantly (Hamad, et al., 2003). Additionally, many of these individuals who do form gallstones do not develop symptoms that will ultimately lead to the need to remove the gallbladder. O'Brien and Dixon (2003) reported that only 6.8% of patients undergoing laparoscopic adjustable gastric banding developed symptomatic gallstones necessitating cholecystectomy. Rather than surgical removal of the nonsymptomatic gallbladder, some surgeons support the prophylactic use of ursodiol, a bile acid which prevents gallstone formation.

Villegas et al. (2004) attempted to determine the incidence of gallstone formation requiring cholecystectomy following laparoscopic Roux-en-Y. Of the 289 patients studied, 189 patients had no stone formation when examined intraoperatively. Of these 189 individuals, 151 patients had postoperative ultrasounds at six-month follow-up. A total of 33 patients developed gallstones (22%), and 8% had biliary sludge. Only 11 patients experienced gallstone-related symptoms requiring cholecystectomy (Villegas, et al., 2004).

Caruana et al. (2005) reported on a series of 125 patients who underwent RYGB and were not treated with ursodiol postoperatively. These patients had no palpable gallstones at the time of surgery and were followed for at least 16 months (range 16–48 months) after RYGB. Cholecystectomy for symptomatic stones was performed in 4.9% of patients during the first year of follow-up and in an additional 5% of patients within the second year of follow-up. There were no serious complications from the stones or the cholecystectomy. It was noted that prophylactic cholecystectomy would have been unnecessary in 115 of the 125 patients in this particular study group (Caruana, et al., 2005).

Fuller et al. (2007) reported on 144 consecutive patients undergoing RYGB who were routinely screened for cholelithiasis by ultrasound. The mean age was 43 years and the mean BMI was 46 kg/m<sup>2</sup>. A total of 29 patients had a history of prior cholecystectomy. Cholelithiasis was diagnosed preoperatively in 22 of the remaining 115 patients. Of those 22 patients, nine (41%) were symptomatic and underwent concurrent cholecystectomy and RYGB. The remaining 13 patients (59%) had asymptomatic cholelithiasis preoperatively but did not undergo cholecystectomy at the time of surgery. Patients who did not have cholecystectomy were managed with ursodiol for 6 months postoperatively. Only one of these asymptomatic patients subsequently developed symptoms requiring cholecystectomy at up to one-year follow-up. This incidence did not reach statistical significance ( $p=0.59$ ), suggesting that the relative risk of requiring a cholecystectomy after RYGB in the absence of preoperative symptoms is small (Fuller, et al., 2007).

The published, peer-reviewed scientific literature indicates that the prophylactic removal of a normal gallbladder (i.e., no evidence of gallstones or biliary sludge demonstrated on ultrasound or other diagnostic testing) is not considered medically necessary when performed concurrently with bariatric surgery, including gastric bypass. The impact on health outcomes has not been established through well-designed studies. Cholecystectomy performed concurrently with bariatric surgery is considered medically necessary when there is preoperative or intraoperative evidence of gallstones or biliary sludge on diagnostic study or when there is a recent history of cholecystitis.

### **Routine Liver Biopsy at the Time of Bariatric Surgery**

Nonalcoholic fatty liver disease (NAFLD), generally considered a clinically benign finding, is common in the general adult population, with a reported prevalence of approximately 23% in the U.S. It has been estimated that NAFLD can be found in 65% of obese patients (Beymer, et al., 2003). A variant of NAFLD, nonalcoholic steatohepatitis (NASH), has been reported to predispose individuals to liver fibrosis, and ultimately, cirrhosis. Often clinically hidden, NASH can be present despite liver function studies within acceptable parameters. Few studies, however, have reported on the role of NASH in obese patients. There is very little information available on the prevalence of asymptomatic liver disease in morbidly obese patients (Beymer, et al., 2003). The exact role of NASH as an independent predictor in advanced liver disease has not been clearly established. It has been suggested that there may be several clinical triggers needed for NASH to progress to advanced liver disease including, but not limited to, type 2

diabetes, high BMI, liver toxins, and alcohol consumption. Liver biopsy is currently used to confirm the diagnosis of NAFLD and to differentiate between NAFLD and NASH. However there are no clear guidelines as to when and in whom liver biopsy is necessary (Duvnjak, et al., 2007).

Shalhub et al. (2004) analyzed prospective data on 242 patients who underwent open and laparoscopic RYGB to determine the role of routine liver biopsy in managing bariatric patients. The same pathologist graded all liver biopsies as mild, moderate or severe steatohepatitis. NASH was defined as steatohepatitis without alcoholic or viral hepatitis. Consecutive liver biopsies were compared to those liver biopsies selected because of grossly fatty livers. Selective liver biopsies were performed in 86 of the first 174 patients and routine liver biopsies were done in the remaining 68 consecutive patients. The two groups were reported to have to have similar findings of steatosis, but more patients were categorized as having moderate and severe NASH based on routine liver biopsy compared to selective biopsy ( $p < 0.05$ ). Both groups had a similar prevalence of cirrhosis. There was no correlation found between BMI, abnormal liver tests, and the severity of NASH. Study results indicate that liver biopsy is the gold standard for diagnosing NASH. However, additional data from well-designed RCTs are needed to support the need for routine liver biopsy during bariatric surgical procedures.

Some surgeons support the use of concurrent routine liver biopsy in all patients undergoing bariatric surgery. Like prophylactic cholecystectomy, routine liver biopsy in the absence of clinical findings at the time of bariatric surgery continues to be debated. Just what role routine liver biopsy plays in patients undergoing bariatric surgery is not known. Impact on health outcomes has not been established through well-designed clinical trials. At this time, there is not sufficient evidence to support routine liver biopsy in patients undergoing bariatric surgery.

#### **Professional Societies/Organizations**

The North American Society for Pediatric Gastroenterology, Hepatology and Nutrition states that until more data are available in children, gastric bypass surgery should be considered only for well-informed and motivated adolescents who meet the following criteria:

- severe obesity (BMI  $\geq$  40)
- failure of  $\geq$  6 months of organized attempts at weight loss
- near-complete skeletal maturity
- significant comorbidities that would be responsive to sustained weight loss

Extensive counseling, education, and support are required both before and after gastric bypass. Only a surgeon with extensive experience with bariatric surgery should perform gastric bypass surgery. Finally, adolescents undergoing gastric bypass require lifelong medical and nutritional surveillance, especially during pregnancy (Baker, et al., 2005).

The European Association for Endoscopic Surgery (EAES) issued evidence-based guidelines for obesity surgery in 2004. According to the EAES, adjustable gastric banding (AGB), VBG, RYGB and BPD/DS are all effective in the treatment of morbid obesity. There is evidence that the laparoscopic approach is advantageous for LAGB, VBG, and RYGB. Preliminary data suggest that the laparoscopic approach may also be preferable for BPD/DS if surgical expertise is available, but further studies are needed. The report concluded that in terms of EWL percentages, BPD/DS is superior to RYGB which, in turn, yields greater EWL than VBG and AGB. However, the greater degree of EWL resulting from BPD/DS is at the expense of other outcomes (Sauerland, et al., 2005).

According to the Society of American Gastrointestinal Endoscopic Surgeons' (SAGES) guidelines for the clinical application of laparoscopic bariatric surgery, virtually all bariatric operations can be performed with laparoscopic technique. Although the indications for laparoscopic treatment of obesity are the same as for open surgery, not all patients are suitable for laparoscopic weight reduction surgery. Since conversion to an open procedure is sometimes necessary, surgeons performing these procedures laparoscopically must have the skills, experience and equipment necessary to convert to and perform open bariatric operations (SAGES, 2003).

The American Gastroenterological Association (AGA) medical position statement on obesity states that surgical therapy is the most effective approach for achieving long-term weight loss. Patients with class III obesity (i.e., BMI  $\geq 40$ ), or class II obesity (i.e., BMI 35.0–39.9) with one or more severe obesity-related medical complications, should be considered for surgery if they have been unable to achieve or maintain weight loss with conventional therapy, have acceptable operative risks, and are able to comply with long-term treatment and follow-up. According to the AGA, data from several prospective, randomized controlled trials demonstrate that weight loss is greater with the gastric bypass procedure than with vertical-banded gastroplasty. The laparoscopic approach is associated with fewer postoperative complications, shorter hospital stay, and earlier return to functional life. Therefore, the laparoscopic approach is preferred in appropriate patients when it can be performed by an experienced surgeon. Malabsorptive procedures, such as BPD/DS or long-limb gastric bypass, usually cause more weight loss than generally observed after gastric bypass. Therefore, malabsorptive procedures should be considered as potential options for very obese patients (i.e., BMI  $> 50$ ). However, the weight loss efficacy of malabsorptive and restrictive operations has never been compared in a prospective randomized trial (AGA, 2002).

The American Association of Clinical Endocrinologists/American College of Endocrinology (AAACE/ACE) states that all obese patients should undergo basic treatment which includes counseling, caloric restriction, behavior therapy, and physical activity. The goal of any basic treatment program is to integrate positive eating and physical activity behaviors into the patient's life. The AAACE/ACE recommends programs that actively encourage lifestyle changes and require participation in an ongoing, well-supervised weight-maintenance program. According to the AAACE/ACE, surgical treatment of obesity may be considered only in carefully selected patients who are between 18 and 65 years of age with a very high medical risk (BMI  $>40$  or BMI of 35 to 39 with life-threatening or disabling comorbid conditions such as diabetes mellitus, dyslipidemia, hypertension, or serious cardiopulmonary disorders). Suitable candidates should also have no history of alcoholism or a major psychiatric disorder and have a history of obesity for at least five years (AAACE/ACE, 1998).

### Summary

Certain bariatric surgical procedures have been shown to achieve significant weight loss, as well as to reverse or significantly improve obesity-related comorbidities in a carefully selected subset of morbidly/clinically severe obese individuals, when nonsurgical methods have failed.

---

## Coding/Billing Information

**Note:** This list of codes may not be all-inclusive.

### Covered when medically necessary:

CPT <sup>®</sup> * Codes	Description
43644	Laparoscopy, surgical, gastric restrictive procedure; with gastric bypass and Roux-en-Y gastroenterostomy (roux limb 150 cm or less)
43645	Laparoscopy, surgical, gastric restrictive procedure; with gastric bypass and small intestine reconstruction to limit absorption
43770	Laparoscopy, surgical, gastric restrictive procedure; placement of adjustable gastric band (gastric band and subcutaneous port components) Roux-en-Y gastroenterostomy (roux limb 150 cm or less)
43771	Laparoscopy, surgical, gastric restrictive procedure; revision of adjustable gastric band component only
43772	Laparoscopy, surgical, gastric restrictive procedure; removal of adjustable gastric band component only
43773	Laparoscopy, surgical, gastric restrictive procedure; removal and replacement of adjustable gastric band component only
43774	Laparoscopy, surgical, gastric restrictive procedure; removal of adjustable gastric band and subcutaneous port components

43842	Gastric restrictive procedure, without gastric bypass, for morbid obesity; vertical banded gastroplasty
43843	Gastric restrictive procedure, without gastric bypass, for morbid obesity; other than vertical banded gastroplasty
43845	Gastric restrictive procedure, with partial gastrectomy, pylorus-preserving duodenoileostomy (50 to 100 cm common channel) to limit absorption (biliopancreatic diversion with duodenal switch)
43846	Gastric restrictive procedure, with gastric bypass for morbid obesity; with short limb(less than 100 cm) Roux-en-Y gastroenterostomy
43847	Gastric restrictive procedure, with gastric bypass for morbid obesity with small bowel reconstruction to limit absorption
43848	Revision, open, of gastric restrictive procedure for morbid obesity, other than adjustable gastric band (separate procedure)
43886	Gastric restrictive procedure, open; revision of subcutaneous port component only
43887	Gastric restrictive procedure, open; removal of subcutaneous port component only
43888	Gastric restrictive procedure, open; removal and replacement of subcutaneous port component only
47562	Laparoscopy, surgical; cholecystectomy
47600	Cholecystectomy

<b>HCPCS Codes</b>	<b>Description</b>
S2083	Adjustment of gastric band diameter via subcutaneous port by injection or aspiration of saline

<b>ICD-9-CM Diagnosis Codes</b>	<b>Description</b>
250.00	Diabetes mellitus without mention of complication, type II or unspecified type, not stated as uncontrolled
250.02	Diabetes mellitus without mention of complication, type II or unspecified type, uncontrolled
278.01	Morbid obesity
401.0 – 401.9	Essential hypertension
414.01	Coronary atherosclerosis of native coronary artery
416.0	Primary pulmonary hypertension
416.8	Other chronic pulmonary heart diseases
574.00-574.91	Cholelithiasis
575.10	Cholecystitis, unspecified
997.4	Digestive system complication
V45.3	Intestinal bypass or anastomosis status
V85.35	Body Mass Index 35.0-35.9, adult
V85.36	Body Mass Index 36.0-36.9, adult
V85.37	Body Mass Index 37.0-37.9, adult
V85.38	Body Mass Index 38.0-38.9, adult
V85.39	Body Mass Index 39.0-39.9, adult
V85.4	Body Mass Index 40 and over, adult

**Experimental/Investigational/Unproven/Not Covered:**

<b>CPT* Codes</b>	<b>Description</b>
43659 <sup>†</sup>	Unlisted laparoscopy procedure, stomach
43999 <sup>†</sup>	Unlisted procedure, stomach

HCPCS Codes	Description
	No specific codes

ICD-9-CM Diagnosis Codes	Description
	All codes

† **Note:** CPT codes 43659 and 43999 may be used to describe bariatric surgical procedures that are not otherwise described by other codes. These procedures are not covered when used to report any of the bariatric surgical procedures indicated as experimental, investigational, or unproven.

\*Current Procedural Terminology (CPT®) ©2007 American Medical Association: Chicago, IL.

---

## References

1. Adams TD, Gress RE, Smith SC, Halverson RC, Simper SC, Rosamond WD, et al. Long-term mortality after gastric bypass surgery. *N Engl J Med*. 2007 Aug 23;357(8):753-61.
2. Alami RS, Morton JM, Schuster R, Lie J, Sanchez BR, Peters A, et al. Is there a benefit to preoperative weight loss in gastric bypass patients? A prospective randomized trial. *Surg Obes Relat Dis*. 2007 Mar-Apr;3(2):141-5; discussion 145-6. Epub 2007 Feb 27.
3. Ali MR, Baucom-Pro S, Broderick-Villa GA, Campbell JB, Rasmussen JJ, Weston AN, et al. Weight loss before gastric bypass: feasibility and effect on postoperative weight loss and weight loss maintenance. *Surg Obes Relat Dis*. 2007 Sep-Oct;3(5):515-20. Epub 2007 Aug 8.
4. Ali MR, Fuller WD, Choi MP, Wolfe BM. Bariatric surgical outcomes. *Surg Clin North Am*. 2005 Aug;85(4):835-52, vii.
5. American Association of Clinical Endocrinologists/American College of Endocrinology (AACE/ACE). Position Statement on the Prevention, Diagnosis, and Treatment of Obesity (1998 Revision). Revised 1998 Sep. Accessed April 18, 2008. Available at URL address: <http://www.aace.com/pub/pdf/guidelines/obesityguide.pdf>
6. American Gastroenterological Association. American Gastroenterological Association medical position statement on Obesity. *Gastroenterology*. 2002 Sep;123(3):879-81.
7. American Society for Metabolic and Bariatric Surgery. Guidelines for granting privileges in bariatric surgery. Established 2003 Jan; revised 2005. Accessed Apr 18, 2005. Available at URL address: [http://www.asbs.org/Newsite07/resources/asbs\\_granting\\_privileges.htm](http://www.asbs.org/Newsite07/resources/asbs_granting_privileges.htm)
8. American Society for Metabolic and Bariatric Surgery (ASMBS). Position Statement on Sleeve Gastrectomy as a Bariatric Procedure. 2007 Jun 17. Accessed Feb 2, 2008. Available at URL address: [http://www.asbs.org/Newsite07/resources/sleeve\\_statement.pdf](http://www.asbs.org/Newsite07/resources/sleeve_statement.pdf)
9. Angrisani L, Lorenzo M, Borrelli V. Laparoscopic adjustable gastric banding versus Roux-en-Y gastric bypass: 5-year results of a prospective randomized trial. *Surg Obes Relat Dis*. 2007 Mar-Apr;3(2):127-32; discussion 132-3. Epub 2007 Feb 27.
10. Angrisani L, Di Lorenzo N, Favretti F, Furbetta F, Iuppa A, Doldi SB, et al. The Italian Group for LAP-BAND: predictive value of initial body mass index for weight loss after 5 years of follow-up. *Surg Endosc*. 2004 Oct;18(10):1524-7. Epub 2004 Aug.

11. Angrisani L, Furbetta F, Doldi SB, Basso M, Lucchese F, Giacomelli M, et al. Lap Band<sup>®</sup> adjustable gastric banding system. *Surg Endosc.* 2003;17:409-12.
12. Anthone GJ. The duodenal switch operation for morbid obesity. *Surg Clin North Am.* 2005 Aug;85(4):819-33, viii.
13. Anthone GJ, Lord RV, DeMeester TR, Crookes PF. The duodenal switch operation for the treatment of morbid obesity. *Ann Surg.* 2003 Oct;238(4):618-27; discussion 627-8.
14. Azagra JS, Goergen M, Ansay J, De Simone P, Vanhaverbeek M, Devuyst L, et al. Laparoscopic gastric reduction surgery. Preliminary results of a randomized, prospective trial of laparoscopic vs. open vertical banded gastroplasty. *Surg Endosc.* 1999 Jun;13(6):555-8.
15. Baker S, Barlow S, Cochran W, Fuchs G, Klish W, Krebs N, et al. Overweight children and adolescents: a clinical report of the North American Society for Pediatric Gastroenterology, Hepatology and Nutrition. *J Pediatr Gastroenterol Nutr.* 2005 May;40(5):533-43.
16. Balsiger BM, Murr MM, Poggio JL, Sarr MG. Bariatric surgery: surgery for weight control in patients with morbid obesity. *Med Clin North Am.* 2000 Mar;84(2):477-89.
17. Baltasar A, Bou R, Bengochea M, Arlandis F, Escrivá C, Miró J, et al. Duodenal switch: an effective therapy for morbid obesity-intermediate results. *Obes Surg.* 2001 Feb;11(1):54-8.
18. Baltasar A, Serra C, Perez N, Bou R, Bengochea M, Ferri L. Laparoscopic sleeve gastrectomy: a multi-purpose bariatric operation. *Obes Surg.* 2005 Sep;15(8):1124-8.
19. Beymer C, Kowdley KV, Larson A, Edmonson P, Dellinger EP, Flum DR. Prevalence and predictors of asymptomatic liver disease in patients undergoing gastric bypass surgery. *Arch Surg.* 2003 Nov; 138(11):1240-4.
20. Biertho L, Steffen R, Ricklin T, Horber FF, Pomp A, Inabnet WB, et al. Laparoscopic gastric bypass versus laparoscopic adjustable gastric banding: a comparative study of 1,200 cases. *J Am Coll Surg.* 2003 Oct;197(4):536-44.
21. BlueCross BlueShield Association (BCBSA) Technology Evaluation Center (TEC). Newer techniques in bariatric surgery. TEC Assessment Program. Vol. 18, No. 10. Chicago, IL: BCBSA; 2003 Sep. Accessed Apr 16, 2005. Available at URL address: [http://www.bcbs.com/tec/vol18/18\\_10.html](http://www.bcbs.com/tec/vol18/18_10.html)
22. BlueCross BlueShield Association (BCBSA) Technology Evaluation Center (TEC). Special report: the relationship between weight loss and changes in morbidity following bariatric surgery for morbid obesity. TEC Assessment Program. Vol. 18, No. 9. Chicago, IL. BCBSA; 2003 Sep. Accessed Apr 16, 2005. Available at URL address: [http://www.bcbs.com/tec/vol18/18\\_09.html](http://www.bcbs.com/tec/vol18/18_09.html)
23. BlueCross BlueShield Association (BCBSA) Technology Evaluation Center (TEC). Laparoscopic Gastric Bypass Surgery for Morbid Obesity. TEC Assessment Program. Vol. 20, No. 15. Chicago, IL. BCBSA; 2006 Feb. Accessed Mar 31, 2006. Available at URL address: [http://www.bcbs.com/tec/vol20/20\\_15.html](http://www.bcbs.com/tec/vol20/20_15.html)
24. BlueCross BlueShield Association (BCBSA) Technology Evaluation Center (TEC). Newer Techniques in Bariatric Surgery for Morbid Obesity: Laparoscopic Adjustable Gastric Banding, Biliopancreatic Diversion, and Long-Limb Gastric Bypass. TEC Assessment Program Vol 20, No. 5. Chicago, IL. BCBSA; 2005 Aug. Accessed Apr 14, 2007. Available at URL: [http://www.bcbs.com/betterknowledge/tec/vols/20/20\\_05.html](http://www.bcbs.com/betterknowledge/tec/vols/20/20_05.html)

25. BlueCross BlueShield Association (BCBSA) Technology Evaluation Center (TEC). Laparoscopic Adjustable Gastric Banding for Morbid Obesity. TEC Assessment Program. Vol. 21, No. 13. Chicago, IL. BCBSA; 2007 Feb. Accessed Apr 14, 2007. Available at URL: <http://www.bcbs.com/betterknowledge/tec/vols/21/laparoscopic-adjustable.html>
26. Bouldin MJ, Ross LA, Sumrall CD, Loustalot FV, Low AK, Land KK. The effect of obesity surgery on obesity comorbidity. *Am J Med Sci*. 2006 Apr;331(4):183-93.
27. Brolin RE. Bariatric surgery and long-term control of morbid obesity. *JAMA*. 2002 Dec 11;288(22):2793-6.
28. Buchwald H, Avidor Y, Braunwald E, Jensen MD, Pories W, Fahrbach K, et al. Bariatric surgery: a systematic review and meta-analysis. *JAMA*. 2004 Oct 13;292(14):1724-37.
29. Buchwald H; Consensus Conference Panel. Consensus conference statement bariatric surgery for morbid obesity: health implications for patients, health professionals, and third-party payers. *Surg Obes Relat Dis*. 2005 May-Jun;1(3):371-81.
30. Canadian Coordinating Office for Health Technology Assessment (CCOHTA). Issues in Emerging Health Technologies. Issue 79. January 2006. Intra-gastric Balloons: A Temporary Treatment for Obesity. Accessed Apr 11, 2007. Available at URL address: [http://www.cadth.ca/media/pdf/401\\_balloons\\_cetap\\_e.pdf](http://www.cadth.ca/media/pdf/401_balloons_cetap_e.pdf)
31. Capella JF, Capella R. An assessment of vertical banded gastroplasty-Roux-en-Y gastric bypass for the treatment of morbid obesity. *Am J Surg*. 2002 Feb;183(2):117-23.
32. Ceelen W, Walder J, Cardon A, Van Renterghem K, Hesse U, El Malt M, et al. Surgical treatment of severe obesity with a low-pressure adjustable gastric band: experimental data and clinical results in 625 patients. *Ann Surg*. 2003 Jan;237(1):10-6.
33. Centers for Medicare and Medicaid Services (CMS). Coverage Decision Memorandum for Bariatric Surgery for Treatment of Co-morbidities Associated with Morbid Obesity. February 21, 2006. Accessed Mar 31, 2006. Available at URL address: <http://www.cms.hhs.gov/mcd/viewdecisionmemo.asp?id=160>
34. Chapman AE, Kiroff G, Game P, Foster B, O'Brien P, Ham J, et al. Laparoscopic adjustable gastric banding in the treatment of obesity: a systematic literature review. *Surgery*. 2004 Mar;135(3):326-51.
35. Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA, Izzo JL Jr. The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. *JAMA*. 2003 May 21;289(19):2560-72.
36. Christou NV, Sampalis JS, Liberman M, Look D, Auger S, McLean AP, MacLean LD. Surgery decreases long-term mortality, morbidity, and health care use in morbidly obese patients. *Ann Surg*. 2004 Sep;240(3):416-23.
37. Clegg A, Sidhu MK, Colquitt J, Royle P, Loveman E, Walker A. Clinical and cost effectiveness of surgery for people with morbid obesity. The National Institute for Clinical Excellence (NICE). 2001 Dec. Accessed Apr 2, 2004. Available at URL address: <http://www.nice.org.uk/Docref.asp?d=28703>
38. Colquitt J, Clegg A, Loveman E, Royle P, Sidhu MK. Surgery for morbid obesity. *Cochrane Database Syst Rev*. 2005 Oct 19;(4):CD003641.
39. Cottam D, Qureshi FG, Mattar SG, Sharma S, Holover S, Bonanomi G, et al. Laparoscopic sleeve gastrectomy as an initial weight-loss procedure for high-risk patients with morbid obesity. *Surg Endosc*. 2006 Jun;20(6):859-63. Epub 2006 Apr 22.

40. DeMaria EJ, Sugerman HJ, Kellum JM, Meador JG, Wolfe LG. Results of 281 consecutive total laparoscopic Roux-en-Y gastric bypasses to treat morbid obesity. *Ann Surg.* 2002 May;235(5):640-5.
41. DeMaria EJ, Sugerman HJ, Meador JG, Doty JM, Kellum JM, Wolfe L, et al. High failure rate after laparoscopic adjustable silicone gastric banding for treatment of morbid obesity. *Ann Surg.* 2001 Jun;233(6):809-18.
42. DeWald T, Khaodhjar L, Donahue MP, Blackburn G. Pharmacological and surgical treatments for obesity. *Am Heart J.* 2006 Mar;151(3):604-24.
43. de Wit LT, Mathus-Vliegen L, Hey C, Rademaker B, Gouma DJ, Obertop H. Open versus laparoscopic adjustable silicone gastric banding: a prospective randomized trial for treatment of morbid obesity. *Ann Surg.* 1999 Dec;230(6):800-7.
44. Dixon JB, O'Brien PE, Playfair J, Chapman L, Schachter LM, Skinner S, et al. Adjustable gastric banding and conventional therapy for type 2 diabetes: a randomized controlled trial. *JAMA.* 2008 Jan 23;299(3):316-23.
45. Doldi SB, Micheletto G, Di Prisco F, Zappa MA, Lattuada E, Reitano M. Intra-gastric balloon in obese patients. *Obes Surg.* 2000 Dec;10(6):578-81.
46. Elder KA, Wolfe BM. Bariatric surgery: a review of procedures and outcomes. *Gastroenterology.* 2007 May;132(6):2253-71.
47. Fernandes M, Atallah AN, Soares BG, Humberto S, Guimaraes S, Matos D, et al. Intra-gastric balloon for obesity. *Cochrane Database Syst Rev.* 2007 Jan 24;(1):CD004931.
48. Fielding GA. Laparoscopic adjustable gastric banding for massive superobesity (greater than 60 body mass index kg/m<sup>2</sup>). *Surg Endosc.* 2003 Oct;17(10):1541-5. Epub 2003 Aug 15.
49. Fielding GA, Ren CJ. Laparoscopic adjustable gastric band. *Surg Clin North Am.* 2005 Feb;85(1):129-40.
50. Fielding GA, Rhodes M, Nathanson LK. Laparoscopic gastric banding for morbid obesity: surgical outcome in 335 cases. *Surg Endosc.* 1999 Jun;13(6):550-4.
51. Fobi MA, Lee H, Igwe D Jr, Felahy B, James E, Stanczyk M, et al. Gastric bypass in patients with BMI < 40 but > 32 without life-threatening co-morbidities: preliminary report. *Obes Surg.* 2002 Feb;12(1): 52-6.
52. Fobi M, Lee H, Igwe D Jr, Felahy B, James E, Stanczyk M, et al. Prophylactic cholecystectomy with gastric bypass operation: incidence of gallbladder disease. *Obes Surg.* 2002 Jun;12(3):350-3.
53. Fobi MA, Lee H, Igwe D Jr, Felahy B, James E, Stanczyk M, et al. Revision of failed gastric bypass to distal Roux-en-Y gastric bypass: a review of 65 cases. *Obes Surg.* 2001 Apr;11(2):190-5.
54. Fobi MA, Lee H. The surgical technique of the Fobi-Pouch operation for obesity (the transected silastic vertical gastric bypass). *Obes Surg.* 1998 Jun;8(3):283-8.
55. Gagner M, Matteotti R. Laparoscopic biliopancreatic diversion with duodenal switch. *Surg Clin North Am.* 2005;85:141-9.
56. Gagner M, Gumbs AA. Gastric banding: conversion to sleeve, bypass, or DS. *Surg Endosc.* 2007 Nov;21(11):1931-5. Epub 2007 Aug 20.

57. Gastrointestinal surgery for severe obesity. NIH Consensus Statement Online. 1991 Mar 25-27;9(1):1-20. Accessed Apr 2, 2004. Available at URL address: [http://consensus.nih.gov/cons/084/084\\_statement.htm](http://consensus.nih.gov/cons/084/084_statement.htm)
58. Genco A, Bruni T, Doldi SB, Forestieri P, Marino M, Busetto L, et al. BioEnterics Intra-gastric Balloon: The Italian Experience with 2,515 Patients. *Obes Surg*. 2005 Sep;15(8):1161-4.
59. Gentileschi P, Kini S, Catarci M, Gagner M. Evidence-based medicine: open and laparoscopic bariatric surgery. *Surg Endosc*. 2002 May;16(5):736-44.
60. Gravante G, Araco A, Araco F, Delogu D, De Lorenzo A, Cervelli V. Laparoscopic adjustable gastric bandings: a prospective randomized study of 400 operations performed with 2 different devices. *Arch Surg*. 2007 Oct;142(10):958-61.
61. Guidelines for laparoscopic and conventional surgical treatment of morbid obesity. *Surg Endosc*. 2001 Oct;15(10):1251-2.
62. Gustavsson S, Westling A. Laparoscopic adjustable gastric banding: complications and side effects responsible for the poor long-term outcome. *Semin Laparosc Surg*. 2002 Jun;9(2):115-24.
63. Hamad GG, Ikramuddin S, Gourash WF, Schauer PR. Elective cholecystectomy during laparoscopic Roux-en-Y gastric bypass: is it worth the wait? *Obes Surg*. 2003 Feb;13(1):76-81.
64. Hamoui N, Anthone GJ, Kaufman HS, Crookes PF. Sleeve gastrectomy in the high-risk patient. *Obes Surg*. 2006 Nov;16(11):1445-9.
65. Hamoui N, Chock B, Anthone GJ, Crookes PF. Revision of the duodenal switch: indications, technique, and outcomes. *J Am Coll Surg*. 2007 Apr;204(4):603-8.
66. HAYES Medical Technology Directory™. Pediatric Bariatric Surgery for Morbid Obesity. Lansdale, PA: HAYES, Inc.; ©2007 Winifred S. Hayes, Inc. 2007 Jun.
67. HAYES Medical Technology Directory™. Open Malabsorptive Bariatric Surgery: Roux-en-Y Gastric Bypass. Lansdale, PA: HAYES, Inc.; ©2007 Winifred S. Hayes, Inc. 2007 Jun.
68. HAYES Medical Technology Directory™. Laparoscopic Bariatric Surgery: Roux-en-Y Gastric Bypass, Vertical Banded Gastroplasty and Adjustable Gastric Banding. Lansdale, PA: HAYES, Inc.; ©2007 Winifred S. Hayes, Inc. 2007 Jun.
69. HAYES Medical Technology Directory™. Malabsorptive Bariatric Surgery: Open and Laparoscopic Biliopancreatic Diversion. Lansdale, PA: HAYES, Inc.; ©2007 Winifred S. Hayes, Inc. 2007 Jun.
70. HAYES Medical Technology Directory™. Open Restrictive Bariatric Surgery: Gastroplasty and Gastric Banding. Lansdale, PA: HAYES, Inc.; ©2007 Winifred S. Hayes, Inc. 2007 Jun.
71. HAYES Health Technology Brief™. Laparoscopic Mini-Gastric Bypass for Morbid Obesity. Lansdale, PA: HAYES, Inc.; ©2006 Winifred S. Hayes, Inc. 2006 Aug.
72. Hell E, Miller KA, Moorehead MK, Norman S. Evaluation of health status and quality of life after bariatric surgery: comparison of standard Roux-en-Y gastric bypass, vertical banded gastroplasty and laparoscopic adjustable silicone gastric banding. *Obes Surg*. 2000 Jun;10(3):214-9.

73. Hess DS, Hess DW. Biliopancreatic diversion with a duodenal switch. *Obes Surg.* 1998 Jun;8(3):267-82.
74. Hess DS, Hess DW, Oakley RS. The biliopancreatic diversion with the duodenal switch: results beyond 10 years. *Obes Surg.* 2005 Mar;15(3):408-16.
75. Himpens J, Dapri G, Cadiere GB. A prospective randomized study between laparoscopic gastric banding and laparoscopic isolated sleeve gastrectomy: results after 1 and 3 years. *Obes Surg.* 2006 Nov;16(11):1450-6.
76. Holeczy P, Novak P, Kralova A. 30% complications with adjustable gastric banding: what did we do wrong? *Obes Surg.* 2001 Dec;11(6):748-51.
77. Iglezias Brandao de Oliveira C, Adami Chaim E, Borges da Silva B. Impact of rapid weight reduction on risk of cholelithiasis after bariatric surgery. *Obes Surg.* 2003 Aug;13(4):625-8.
78. Inge TH, Krebs NF, Garcia VF, Skelton JA, Guice KS, Strauss RS, et al. Bariatric surgery for severely overweight adolescents: concerns and recommendations. *Pediatrics.* 2004 Jul;114(1):217-23.
79. Institute for Clinical Systems Improvement (ICSI). Healthcare Guideline. Prevention and Management of Obesity (Mature Adolescents and Adults). November 2006. Accessed May 12, 2007. Available at URL address: [http://www.icsi.org/obesity/prevention\\_and\\_management\\_of\\_obesity\\_\\_mature\\_adolescents\\_and\\_adults\\_\\_2.html](http://www.icsi.org/obesity/prevention_and_management_of_obesity__mature_adolescents_and_adults__2.html)
80. Jan JC, Hong D, Periera N, Patterson EJ. Laparoscopic adjustable gastric banding versus laparoscopic gastric bypass for morbid obesity: a single-institution comparison study of early results. *J Gastrointest Surg.* 2005 Jan;9(1):30-9.
81. Jones KB Jr. Revisional bariatric surgery: safe and effective. *Obes Surg.* 2001 Apr;11(2):183-9.
82. Karason K, Lindroos AK, Stenlof K, Sjöstrom L. Relief of cardiorespiratory symptoms and increased physical activity after surgically induced weight loss: results from the Swedish Obese Subjects Study. *Arch Intern Med.* 2000 Jun 26;160(12):1797-802.
83. Kim WW, Gagner M, Kini S, Inabnet WB, Quinn T, Herron D, et al. Laparoscopic vs. open biliopancreatic diversion with duodenal switch: a comparative study. *J Gastrointest Surg.* 2003 May-Jun;7(4):552-7.
84. Korenkov M, Sauerland S, Junginger T. Surgery for obesity. *Curr Opin Gastroenterol.* 2005 Nov;21(6):679-83.
85. Lee WJ, Huang MT, Yu PJ, Wang W, Chen TC. Laparoscopic vertical banded gastroplasty and laparoscopic gastric bypass: a comparison. *Obes Surg.* 2004 May;14(5):626-34.
86. Lee CW, Kelly JJ, Wassef WY. Complications of bariatric surgery. *Curr Opin Gastroenterol.* 2007 Nov;23(6):636-43.
87. Livingston EH. Complications of bariatric surgery. *Surg Clin North Am.* 2005 Aug;85(4):853-68, vii.
88. Malik A, Mellinger JD, Hazey JW, Dunkin BJ, MacFadyen BV Jr. Endoluminal and transluminal surgery: current status and future possibilities. *Surg Endosc.* 2006 Aug;20(8):1179-92. Epub 2006 Jul 24.

89. Mason EE, Renquist KE. Gallbladder management in obesity surgery. *Obes Surg*. 2003 Apr;12(2): 222-9.
90. McNatt SS, Longhi JJ, Goldman CD, McFadden DW. Surgery for obesity: a review of the current state of the art and future directions. *J Gastrointest Surg*. 2007 Mar;11(3):377-97.
91. Miller K, Pump A, Hell E. Vertical banded gastroplasty versus adjustable gastric banding: prospective long-term follow-up study. *Surg Obes Relat Dis*. 2007 Jan-Feb;3(1):84-90. Epub 2006 Nov 20.
92. Morino M, Toppino M, Bonnet G, del Genio G. Laparoscopic adjustable silicone gastric banding versus vertical banded gastroplasty in morbidly obese patients: a prospective randomized controlled clinical trial. *Ann Surg*. 2003 Dec;238(6):835-41.
93. National Heart, Lung, and Blood Institute (NHLBI). Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults. The Evidence Report. NIH Pub. No. 98-4083. 1998 Sep. Accessed Apr 16, 2005. Available at URL address: [http://nhlbi.nih.gov/guidelines/obesity/ob\\_home.htm](http://nhlbi.nih.gov/guidelines/obesity/ob_home.htm)
94. National Heart, Lung, and Blood Institute (NHLBI). The Practical Guide: Identification, Evaluation, and Treatment of Overweight and Obesity in Adults. 2000 Oct. Accessed Apr 16, 2007. Available at URL address: [http://www.nhlbi.nih.gov/guidelines/obesity/prctgd\\_c.pdf](http://www.nhlbi.nih.gov/guidelines/obesity/prctgd_c.pdf)
95. National Institute for Clinical Excellence (NICE). Guidance on the use of surgery to aid weight reduction for people with morbid obesity. Technology Appraisal Guidance No. 46. 2002 Jul. Accessed Apr 16, 2005. Available at URL address: <http://www.nice.org.uk/page.aspx?o=20>
96. National Institute for Clinical Excellence (NICE). CG43 Obesity: Full guideline, section 5b - Management of obesity in clinical settings (adults): evidence statements and reviews. Dec 13, 2006. Accessed Apr 12, 2007. Available at URL address: <http://guidance.nice.org.uk/CG43/niceguidance/word/English>
97. National Institutes of Diabetes and Digestion and Kidney Disease (NIDDK). Longitudinal Assessment of Bariatric Surgery (LABS). January, 2007. Accessed Feb 2, 2008. Available at URL address: <http://win.niddk.nih.gov/publications/labs.htm>
98. Neligan PJ, Williams N. Nonsurgical and surgical treatment of obesity. *Anesthesiol Clin North America*. 2005 Sep;23(3):501-23, vii.
99. O'Brien PE, Dixon JB. A rational approach to cholelithiasis in bariatric surgery: its application to the laparoscopically placed gastric band. *Arch Surg*. 2003 Aug;138(8):908-12.
100. O'Brien PE, McPhail T, Chaston TB, Dixon JB. Systematic review of medium-term weight loss after bariatric operations. *Obes Surg*. 2006 Aug;16(8):1032-40.
101. O'Rourke RW, Andrus J, Diggs BS, Scholz M, McConnell DB, Deveney CW. Perioperative morbidity associated with bariatric surgery: an academic center experience. *Arch Surg*. 2006 Mar;141(3):262-8.
102. Parikh MS, Laker S, Weiner H, Hajiseyedjavadi O, Ren CJ. Objective comparison of complications resulting from laparoscopic bariatric procedures. *Am Coll Surg*. 2006 Feb;202(2):252-61. Epub 2005 Dec 19.
103. Parikh MS, Shen R, Weiner M, Siegel N, Ren CJ. Laparoscopic bariatric surgery in super-obese patients (BMI>50) is safe and effective: a review of 332 patients. *Obes Surg*. 2005 Jun-Jul;15(6):858-63.

104. Pasanisi F, Contaldo F, DeSimone G, Mancini M. Benefits of sustained moderate weight loss in obesity. *Nutr Metab Cardiovascular Dis.* 2001 Dec;11(6):401-6.
105. Pontiroli AE, Pizzocri P, Librenti MC, Vedani P, Marchi M, Cucchi E, et al. Laparoscopic adjustable gastric banding for the treatment of morbid (grade 3) obesity and its metabolic complications: a three-year study. *J Clin Endocrinol Metab.* 2002 Aug;87(8):3555-61.
106. Prachand VN, Davee RT, Alverdy JC. Duodenal switch provides superior weight loss in the super-obese (BMI > or =50 kg/m<sup>2</sup>) compared with gastric bypass. *Ann Surg.* 2006 Oct;244(4):611-9.
107. Rabkin RA, Rabkin JM, Metcalf B, Lazo M, Rossi M, Lehman-Becker LB. Laparoscopic technique for performing duodenal switch with gastric reduction. *Obes Surg.* 2003 Apr;13(2):263-8.
108. Ren CJ, Horgan S, Ponce J. U.S experience with the LAP-BAND system. *Am J Surg.* 2002;184:46S-50S.
109. Ren CJ, Weiner M, Allen JW. Favorable early results of gastric banding for morbid obesity. *Surg Endosc.* 2004;18:543-6.
110. Rendon SE, Pories WJ. Quality assurance in bariatric surgery. *Surg Clin North Am.* 2005 Aug;85(4):757-71, vi-vii.
111. Roa PE, Kaidar-Person O, Pinto D, Cho M, Szomstein S, Rosenthal RJ. Laparoscopic sleeve gastrectomy as treatment for morbid obesity: technique and short-term outcome. *Obes Surg.* 2006 Oct;16(10):1323-6.
112. Rubenstein RB. Laparoscopic adjustable gastric banding at a U.S. center with up to 3-year follow-up. *Obes Surg.* 2002 Jun;12(3):380-4.
113. Rutledge R. The mini-gastric bypass: experience with the first 1,274 cases. *Obes Surg.* 2001 Jun;11(3):276-80.
114. Safadi BY. Trends in insurance coverage for bariatric surgery and the impact of evidence-based reviews. *Surg Clin North Am.* 2005 Aug;85(4):665-80, v.
115. Sauerland S, Angrisani L, Belachew M, Chevallier J, Favretti F, Finer N, et al. Obesity surgery: evidence-based guidelines of the European Association for Endoscopic Surgery (EAES). *Surg Endosc.* 2005 Feb;19(2):200-21. Epub 2004 Dec 2.
116. Schauer P, Chand B, Brethauer S. New applications for endoscopy: the emerging field of endoluminal and transgastric bariatric surgery. *Surg Endosc.* 2007 Mar;21(3):347-56. Epub 2006 Dec 16.
117. Schauer PR, Burguera B, Ikramuddin S, Cottam D, Gourash W, Hamad W, et al. Effect of laparoscopic Roux-en-Y gastric bypass on type 2 diabetes mellitus. *Ann Surg.* 2003 Oct;238(4):467-85.
118. Schauer PR, Ikramuddin S, Gourash W, Ramanathan R, Luketich J. Outcomes after laparoscopic Roux-en-Y gastric bypass for morbid obesity. *Ann Surg.* 2000 Oct;232(4):515-29.
119. Schweitzer M, Lidor A, Magnuson T. Bariatric surgery. *Adv Psychosom Med.* 2006;27:53-60.
120. Shalhub S, Parsee A, Gallagher SF, Haines KL, Willkomm C, Brantley S, et al. The importance of routine liver biopsy in diagnosing nonalcoholic steatohepatitis in bariatric patients. *Obes Surg.* 2004 Jan;14(1):54-9.

121. Shekelle PG, Morton SC, Maglione MA, Suttrop M, Tu W, Li Z, et al. Pharmacological and surgical treatment of obesity. Evidence Report/Technology Assessment No. 103. Pub. No. 04-E028-2. Rockville, MD: Agency for Healthcare Research and Quality; 2004 Jul.
122. Silecchia G, Boru C, Pecchia A, Rizzello M, Casella G, et al. Effectiveness of laparoscopic sleeve gastrectomy (first stage of biliopancreatic diversion with duodenal switch) on co-morbidities in super-obese high-risk patients. *Obes Surg*. 2006 Sep;16(9):1138-44.
123. Sjöström L, Lindroos AK, Peltonen M, Torgerson J, Bouchard C, Carlsson B, et al. Lifestyle, diabetes, and cardiovascular risk factors 10 years after bariatric surgery. *N Engl J Med*. 2004 Dec 23;351(26):2683-93.
124. Sjöström L, Narbro K, Sjöström CD, Karason K, Larsson B, Wedel H, et al. Effects of bariatric surgery on mortality in Swedish obese subjects. *N Engl J Med*. 2007 Aug 23;357(8):741-52.
125. Society of American Gastrointestinal Endoscopic Surgeons (SAGES). Guidelines for the clinical application of laparoscopic bariatric surgery. 2003 Jul. Accessed Mar 31, 2006. Available at URL address: [http://www.guideline.gov/summary/pdf.aspx?doc\\_id=4383&stat=1&string=bariatric+AND+surgery](http://www.guideline.gov/summary/pdf.aspx?doc_id=4383&stat=1&string=bariatric+AND+surgery)
126. Spivak H, Anwar F, Burton C, Guerrero C, Onn A. The Lap-Band system in the United States: one surgeon's experience with 271 patients. *Surg Endosc*. 2004;18:198-202.
127. Spivak H, Hewitt MF, Onn A, Half E. Weight loss and improvement of obesity-related illness in 500 U.S. patients following laparoscopic adjustable gastric banding procedure. *Am J Surg*. 2005 Jan;189(1):27-32.
128. Spyropoulos C, Katsakoulis E, Mead N, Vagenas K, Kalfarentzos F. Intra-gastric balloon for high-risk super-obese patients: a prospective analysis of efficacy. *Surg Obes Relat Dis*. 2007 Jan-Feb;3(1):78-83.
129. Sreenarasimhaiah J. Prevention or surgical treatment of gallstones in patients undergoing gastric bypass surgery for obesity. *Curr Treat Options Gastroenterol*. 2004 Apr;7(2):99-104.
130. Still CD, Benotti P, Wood GC, Gerhard GS, Petrick A, Reed M, et al. Outcomes of preoperative weight loss in high-risk patients undergoing gastric bypass surgery. *Arch Surg*. 2007 Oct;142(10):994-8; discussion 999.
131. Sugerman HJ, Wolfe LG, Sica DA, Clore JN. Diabetes and hypertension in severe obesity and effects of gastric bypass-induced weight loss. *Ann Surg*. Jun 2003;237(6):751-8.
132. Suter M, Giusti V, Heraief E, Zysset F, Calmes JM. Laparoscopic Roux-en-Y gastric bypass: initial 2-year experience. *Surg Endosc*. 2003 Apr;17(4):603-9.
133. Thomusch O, Keck T, Dobschutz EV, Wagner C, Ruckauer KD, Hopt UT. Risk factors for the intermediate outcome of morbid obesity after laparoscopically placed adjustable gastric banding. *Am J Surg*. 2005 Feb;189(2):214-8.
134. Tice JA. California Technology Assessment Forum. Duodenal Switch Procedure for the Treatment of Morbid Obesity. 2004, Feb. Accessed April 3, 2006. Available at URL address: <http://www.ctaf.org/ass/viewfull.ctaf?id=6071375849>
135. U. S. Food and Drug Administration (FDA). Center for Devices and Radiological Health (CDRH). LAP-BAND® Adjustable Gastric Banding (LAGB®) System - P000008. June 5, 2001. Accessed Mar 21, 2003. Available at URL address: <http://www.fda.gov/cdrh/pdf/P000008c.pdf>

136. U. S. Food and Drug Administration (FDA). Center for Devices and Radiological Health (CDRH). Summary of Safety and Effectiveness Data. REALIZE™ Adjustable Gastric Band. - P070009. September 28, 2007. Accessed Feb 2, 2008. Available at URL address: <http://www.fda.gov/cdrh/pdf7/p070009b.pdf>
137. U. S. Food and Drug Administration (FDA). FDA approves implanted stomach band to treat severe obesity [FDA Talk Paper]. U.S. Food and Drug Administration (FDA). Accessed Mar 21, 2003. Available at URL address: <http://www.fda.gov>
138. van Gemert WG, van Wersch MM, Greve JW, Soeters PB. Revisional surgery after failed vertical banded gastroplasty: restoration of vertical banded gastroplasty or conversion to gastric bypass. *Obes Surg.* 1998 Feb;8(1):21-8.
139. Victorzon M, Tolonen P. Bariatric Analysis and Reporting Outcome System (BAROS) following laparoscopic adjustable gastric banding in Finland. *Obes Surg.* 2001 Dec;11(6):740-3.
140. Victorzon M, Tolonen P. Intermediate results following laparoscopic adjustable gastric banding for morbid obesity. *Dig Surg.* 2002;19(5):354-7.
141. Villegas L, Schneider B, Provost D, Chang C, Scott D, Sims T, et al. Is routine cholecystectomy required during laparoscopic gastric bypass? *Obes Surg.* 2004 Jan;14(1):60-6.
142. Weber M, Muller MK, Bucher T, Wildi S, Dindo D, Horber F, et al. Laparoscopic gastric bypass is superior to laparoscopic gastric banding for treatment of morbid obesity. *Ann Surg.* 2004 Dec;240(6):975-82.
143. Weiner R, Blanco-Engert R, Weiner S, Matkowitz R, Schaefer L, Pomhoff I. Outcome after laparoscopic adjustable gastric banding-8 years experience. *Obes Surg.* 2003 Jun;13(3):427-34.
144. Weiner R, Bockhorn H, Rosenthal R, Wagner D. A prospective randomized trial of different laparoscopic gastric banding techniques for morbid obesity. *Surg Endosc.* 2001 Jan;15(1):63-8.
145. Westling A, Bjurling K, Ohrvall M, Gustavsson S. Silicone-adjustable gastric banding: disappointing results. *Obes Surg.* 1998 Aug;8(4):467-74.
146. Westling A, Ohrvall M, Gustavsson S. Roux-en-Y gastric banding after previous unsuccessful gastric restrictive surgery. *J Gastrointest Surg.* 2002 Mar-Apr;6(2):206-11.
147. Wittgrove AC, Clark GW. Laparoscopic gastric bypass, Roux-en-Y-500 patients: technique and results, with 3-60 month follow-up. *Obes Surg.* 2000 Jun;10(3):233-9.
148. Zinzindohoue F, Chevallier J-M, Douard R, Elian N, Ferraz J-M, Blanche P, et al. Laparoscopic gastric banding: a minimally invasive surgical treatment for morbid obesity: prospective study of 500 consecutive patients. *Ann Surg.* 2003 Jan;237(1):1-9.