

Bariatric surgery

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Bariatric surgery (weight loss surgery) includes a variety of procedures performed on people who are obese. Weight loss is achieved by reducing the size of the stomach with a gastric band or through removal of a portion of the stomach (sleeve gastrectomy or biliopancreatic diversion with duodenal switch) or by resecting and re-routing the small intestines to a small stomach pouch (gastric bypass surgery).

Long-term studies show the procedures cause significant long-term loss of weight, recovery from diabetes, improvement in cardiovascular risk factors, and a reduction in mortality of 23% from 40%.^[1] However, a study in Veterans Affairs (VA) patients has found no survival benefit associated with bariatric surgery among older, severely obese people when compared with usual care, at least out to seven years.^[2]

The U.S. National Institutes of Health recommends bariatric surgery for obese people with a body mass index (BMI) of at least 40, and for people with BMI 35 and serious coexisting medical conditions such as diabetes.^[1] However, research is emerging that suggests bariatric surgery could be appropriate for those with a BMI of 35 to 40 with no comorbidities or a BMI of 30 to 35 with significant comorbidities. The most recent ASMBS guidelines suggest the position statement on consensus for BMI as indication for Bariatric SURgery. The recent guidelines suggest that any patient with a BMI of more than 30 with co morbidities is a candidate for Bariatric surgery.^[3]

Indications

A medical guideline by the American College of Physicians concluded:^{[4][5]}

- "Surgery should be considered as a treatment option for patients with a BMI of 40 kg/m² or greater who instituted but failed an adequate exercise and diet program (with or without adjunctive drug therapy) and who present with obesity-related comorbid conditions, such as hypertension, impaired glucose tolerance, diabetes mellitus, hyperlipidemia, and obstructive sleep apnea. A doctor–patient discussion of surgical options should include the long-term side effects, such as possible need for reoperation, gallbladder disease, and malabsorption."
- "Patients should be referred to high-volume centers with surgeons experienced in bariatric surgery."

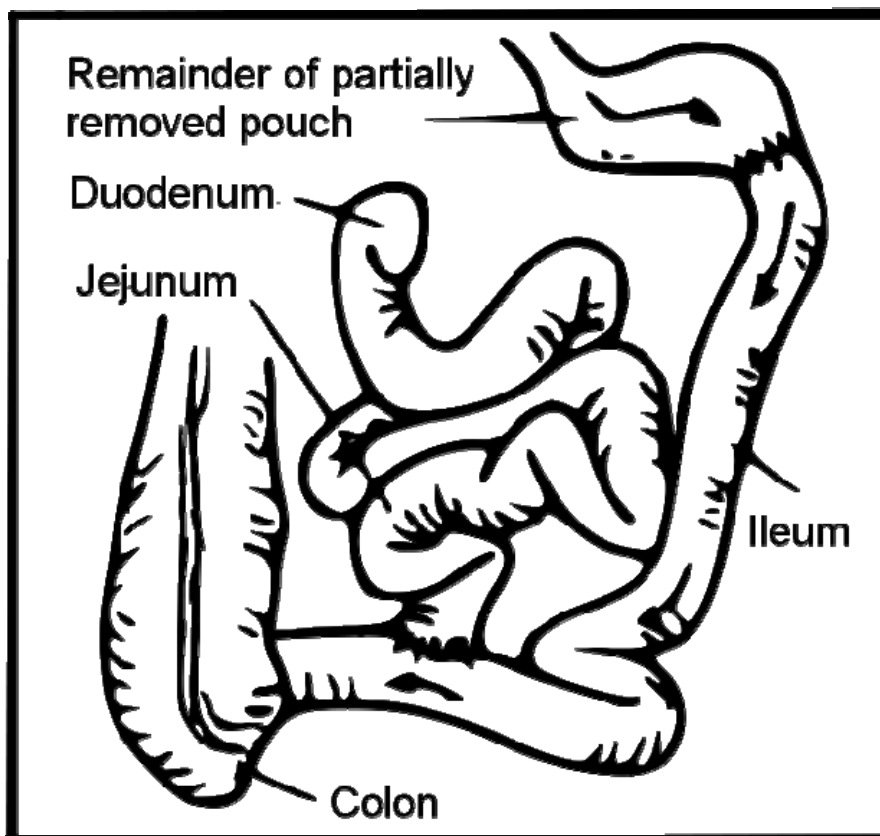
Recently the International Diabetes Federation issued a position statement in which "Under some circumstances people with a BMI 30–35 should be eligible for surgery."^[6] When determining eligibility for bariatric surgery for extremely obese patients, psychiatric screening is critical; it is also critical for determining postoperative success. In patients with a body mass index of 40 kg/m² or greater, there is a 5-fold risk of depression, and half of bariatric surgery candidates are depressed.^[7]


Classification of surgical procedures

Procedures can be grouped in three main categories:^[8] Standard of care in the United States and most of the industrialized world in 2009 is for laparoscopic as opposed to open procedures. Future trends are attempting to achieve similar or better results via endoscopic procedures.

Predominantly malabsorptive procedures

In predominantly malabsorptive procedures, although they also reduce stomach size, the effectiveness of these procedures are derived mainly from creating a physiological condition of malabsorption.



 Diagram of a biliopancreatic diversion.

Biliopancreatic diversion

This complex operation is termed *biliopancreatic diversion* (BPD) or the *Scopinaro procedure*. The original form of this procedure is now rarely performed because of problems with malnourishment. It has been replaced with a modification known as duodenal switch (BPD/DS). Part of the stomach is resected, creating a smaller stomach (however the patient can eat a free diet as there is no restrictive component). The distal part of the small intestine is then connected to the pouch, bypassing the duodenum and jejunum.

In around 2% of patients there is severe malabsorption and nutritional deficiency that requires restoration of the normal absorption. The malabsorptive effect of BPD is so potent that those who undergo the procedure must take vitamin and dietary minerals above and beyond that of the normal population. Without these supplements, there is risk of serious deficiency diseases such as anemia and osteoporosis.^[citation needed]

Because gallstones are a common complication of the rapid weight loss following any type of bariatric surgery, some surgeons remove the gallbladder as a preventive measure during BPD. Others prefer to prescribe medications to reduce the risk of post-operative gallstones.^[citation needed]

Far fewer surgeons perform BPD compared to other weight loss surgeries, in part because of the need for long-term nutritional follow-up and monitoring of BPD patients.^[citation needed]

Jejunioleal bypass

Main article: Jejunioleal bypass

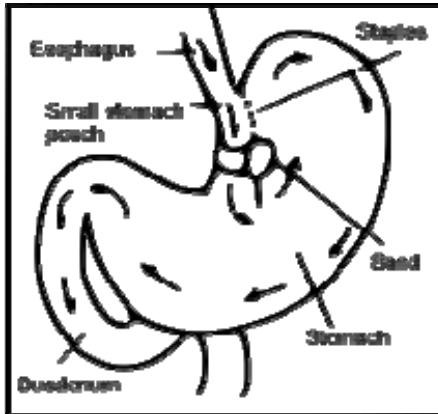
This procedure is no longer performed.


Endoluminal sleeve

A study on humans was done in Chile using the same technique^[9] however the results were not conclusive and the device had issues with migration and slipping. A study recently done in the Netherlands found a decrease of 5.5 BMI points in 3 months with an endoluminal sleeve.^[10]

Predominantly restrictive procedures

Procedures that are solely restrictive, act to reduce oral intake by limiting gastric volume, produces early satiety, and leave the alimentary canal in continuity, minimizing the risks of metabolic complications.^[11]

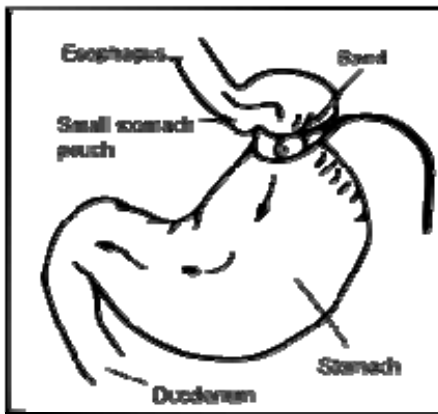



 Diagram of a vertical banded gastroplasty.

Vertical banded gastroplasty

Main article: [Vertical banded gastroplasty surgery](#)

In the vertical banded gastroplasty, also called the Mason procedure or stomach stapling, a part of the stomach is permanently stapled to create a smaller pre-stomach pouch, which serves as the new stomach. ^{[[citation needed](#)]}



 Diagram of an adjustable gastric banding.

Adjustable gastric band

Main article: [Adjustable gastric band](#)

The restriction of the stomach also can be created using a silicone band, which can be adjusted by addition or removal of saline through a port placed just under the skin. This operation can be performed laparoscopically, and is commonly referred to as a "lap band". Weight loss is predominantly due to the restriction of nutrient intake that is created by the small gastric pouch and the narrow outlet. ^{[[12](#)]} It is considered one of the safest procedures performed today with a mortality rate of 0.05%. ^{[[13](#)]}

Sleeve gastrectomy

Main article: [Sleeve gastrectomy](#)

Sleeve gastrectomy, or gastric sleeve, is a surgical weight-loss procedure in which the stomach is reduced to about 15% of its original size, by surgical removal of a large portion of the stomach, following the major curve. The open edges are then attached together (typically with surgical staples, sutures, or both) to leave the stomach shaped more like a tube, or a sleeve, with a banana shape. The procedure permanently reduces the size of the stomach. The procedure is performed laparoscopically and is not reversible.

This combined approach has tremendously decreased the risk of weight loss surgery for specific groups of patients, even when the risk of the two surgeries is added. Most patients can expect to lose 30 to 50% of their excess body weight over a 6–12 month period with the sleeve gastrectomy alone. The timing of the second procedure will vary according to the degree of weight loss, typically 6 – 18 months.

- Stomach volume is reduced, but it tends to function normally so most food items can be consumed in small amounts.
- Removes the portion of the stomach that produces the hormones that stimulates hunger (Ghrelin), although the durability of this removal has yet to be confirmed.^[14]
- Dumping syndrome is less likely due to the preservation of the pylorus (although dumping can occur anytime stomach surgery takes place).
- Minimizes the chance of an ulcer occurring.
- By avoiding the intestinal bypass, the chance of intestinal obstruction (blockage), anemia, osteoporosis, protein deficiency and vitamin deficiency are significantly reduced.
- Very effective as a first stage procedure for high BMI patients (BMI >55 kg/m²).
- Limited results appear promising as a single stage procedure for low BMI patients (BMI 35–45 kg/m²).
- Appealing option for people with existing anemia, Crohn's disease, irritable bowel syndrome, and numerous other conditions that make them too high risk for intestinal bypass procedures.

Intragastric balloon (gastric balloon)

Intragastric balloon involves placing a deflated balloon into the stomach, and then filling it to decrease the amount of gastric space. The balloon can be left in the stomach for a maximum of 6 months and results in an average weight loss of 5–9 BMI over half a year.^[15] While not yet approved by the FDA the intragastric balloon is approved in Australia, Canada, Mexico, India and several European and South American countries.^[16] The intragastric balloon may be used prior to another bariatric surgery in order to assist the patient to reach a weight which is suitable for surgery, further it can also be used on several occasions if necessary.^[17]

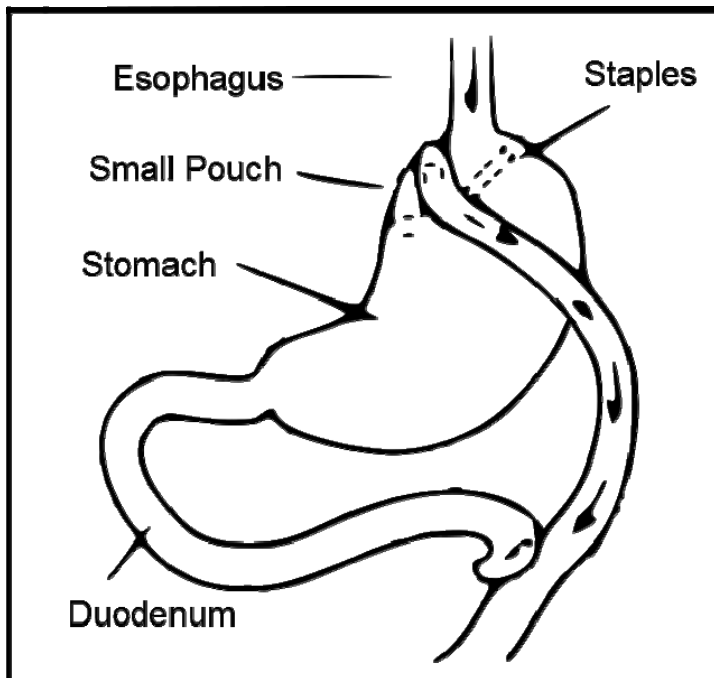
Gastric Plication


Basically, the procedure can best be understood as a version of the more popular gastric sleeve or gastrectomy surgery where a sleeve is created by suturing rather than removing stomach tissue thus preserving its natural nutrient absorption capabilities. Gastric Plication significantly reduces the volume of the patient's stomach, so smaller amounts of food provide a feeling of satiety.^[18] The procedure is producing some significant results that were published in a recent study in *Bariatric Times* and are based on post-operative outcomes for 66 patients (44 female) who had the gastric sleeve plication procedure between January 2007 and March 2010. Mean patient age was 34, with a mean BMI of 35. Follow-up visits for the assessment of safety and weight loss were scheduled at regular intervals in the postoperative period. No major complications were reported among the 66 patients. Weight loss outcomes are comparable to gastric bypass.

The study describes gastric sleeve plication (also referred to as gastric imbrication or laparoscopic greater curvature plication) as a restrictive technique that eliminates the complications associated with adjustable gastric banding and vertical sleeve gastrectomy—it does this by creating restriction without the use of implants and without gastric resection (cutting) and staples.

Mixed procedures

Mixed procedures apply both techniques simultaneously.



 Roux-en-Y gastric bypass.

Gastric bypass surgery

Main article: [Gastric bypass surgery](#)

A common form of [gastric bypass surgery](#) is the Roux-en-Y gastric bypass. Here, a small stomach pouch is created with a stapler device, and connected to the distal small intestine. The upper part of the small intestine is then reattached in a Y-shaped configuration.^[19]

The gastric bypass had been the most commonly performed operation for weight loss in the United States, and approximately 140,000 gastric bypass procedures were performed in 2005. Its market share has decreased since then and by 2011, the frequency of gastric bypass was thought to be less than 50% of the weight loss surgery market.^[11]

A factor in the success of any bariatric surgery is strict post-surgical adherence to a healthier pattern of eating.

There are certain patients who cannot tolerate the malabsorption and dumping syndrome associated with Gastric bypass. In such patients, although earlier considered to be a irreversible procedure, there are instances where Gastric bypass procedure can be partially reversed.

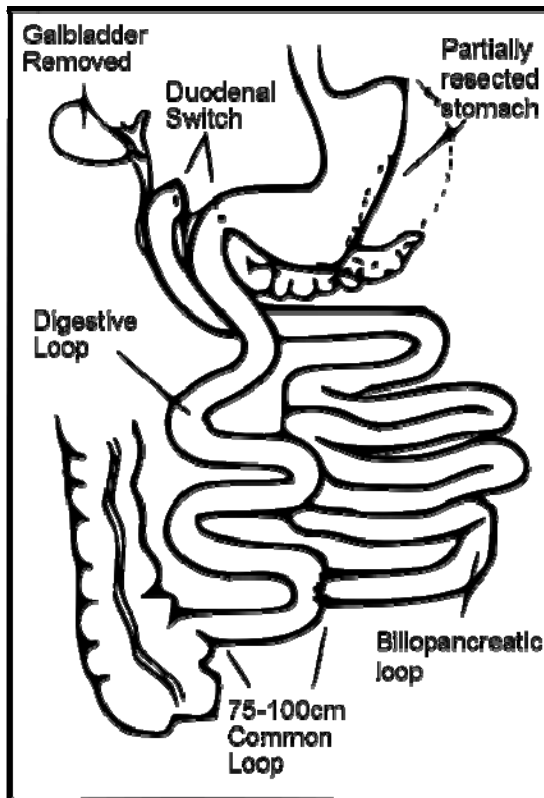


 Diagram of a sleeve gastrectomy with duodenal switch.

Sleeve gastrectomy with duodenal switch

A variation of the biliopancreatic diversion includes a duodenal switch. The part of the stomach along its greater curve is resected. The stomach is "tubulized" with a residual volume of about 150 ml. This volume reduction provides the food intake restriction component of this operation. This type of gastric resection is anatomically and functionally irreversible. The stomach is then disconnected from the duodenum and connected to the distal part of the small intestine. The duodenum and the upper part of the small intestine are reattached to the rest at about 75–100 cm from the colon.^[citation needed]

Implantable gastric stimulation

This procedure where a device similar to a heart pacemaker is implanted by a surgeon, with the electrical leads stimulating the external surface of the stomach, is being studied in the USA. Electrical stimulation is thought to modify the activity of the enteric nervous system of the stomach, which is interpreted by the brain to give a sense of satiety, or fullness. Early evidence suggests that it is less effective than other forms of bariatric surgery.^[20]

Eating after bariatric surgery

Immediately after bariatric surgery, the patient is restricted to a clear liquid diet, which includes foods such as clear broth, diluted fruit juices or sugar-free gelatin desserts. This diet is continued until the gastrointestinal tract has recovered somewhat from the surgery. The next stage provides a blended or pureed sugar-free diet for at least two weeks. This may consist of skimmed milk, cream of wheat, a small pat of margarine, protein drinks, cream soup, pureed fruit and mashed potatoes with gravy.

Post-surgery, overeating is curbed because exceeding the capacity of the stomach causes nausea and vomiting. Diet restrictions after recovery from surgery depend in part on the type of surgery. Many patients will need to take a daily multivitamin pill for life to compensate for reduced absorption of essential nutrients.^[21] Because patients cannot eat a large quantity of food, physicians typically recommend a diet that is relatively high in protein and low in fats and alcohol.

Fluid recommendations

It is very common, within the first month post-surgery, for a patient to undergo volume depletion and dehydration. Patients have difficulty drinking the appropriate amount of fluids as they adapt to their new gastric volume. Limitations on oral fluid intake, reduced calorie intake, and a higher incidence of vomiting and diarrhea are all factors that have a significant contribution to dehydration. In order to prevent fluid volume depletion and dehydration, a minimum of 48–64 fl oz should be consumed by repetitive small sips all day.^[22]

Effectiveness of surgery

Weight loss

In general, the malabsorptive procedures lead to more weight loss than the restrictive procedures; however, they have a higher risk profile. A meta-analysis from University of California, Los Angeles, reports the following weight loss at 36 months:^[51]

- Biliopancreatic diversion — 117 Lbs / 53 kg
- Roux-en-Y gastric bypass (RYGB) — 90 Lbs / 41 kg
 - Open — 95 Lbs/ 43 kg
 - Laparoscopic — 84 Lbs / 38 kg
- Vertical banded gastroplasty — 71 Lbs / 32 kg

The maximum weight loss occurs in the first 12 months after Surgery More recent studies have demonstrated that the medium (3–8 years) and long term (> 10 years) weight loss results for RYGB and LAGB become very similar.^[23] However, the range of excess weight loss for LAGB patients (25% to 80%) is much broader than that of RYGB patients (50% to 70%). Data (beyond 5 years) for sleeve gastrectomy indicates weight loss statistics similar to RYGB.

Reduced mortality and morbidity

Several recent studies report decrease in mortality and severity of medical conditions after bariatric surgery.^{[24][25][26]} But long term effects are not clear.^[27] In the Swedish prospective matched controlled trial, patients with a body mass index (BMI) of 34 or more for men and 38 or more for women underwent various types of bariatric surgery and were followed for an average of 11 years. Surgery patients had a 23.7% reduction in mortality (5.0% vs. 6.3% control, adjusted hazard ratio 0.71). This means 75 patients must be treated to avoid one death after 11 years (number needed to treat is 77).^[24]

In a Utah retrospective cohort study that followed patients for an average of 7 years after various types of gastric bypass, surgery patients had 0.4% mortality while control patients had 0.6% mortality.^[25] Death rates were lower in the gastric bypass patients for all diseases combined, as well as for diabetes, heart disease and cancer. Deaths from accident and suicide were 58% higher in the surgery group.

A randomized, controlled trial in Australia compared laparoscopic adjustable gastric banding ("lap banding") with non-surgical therapy in 80 moderately obese adults (BMI 30–35). At 2 years, the surgically treated group lost more weight (21.6% of initial weight vs. 5.5%) and had statistically significant improvement in blood pressure, measures of diabetic control, and high-density lipoprotein cholesterol.^[26] Post surgical complications included 1 patient with an infected surgical site, 4 with lap band malpositioning requiring laparoscopic revision, and 1 patient with cholecystitis. In the non-surgical group, 12 patients declined or did not tolerate orlistat or diet restrictions, and 4 patients developed acute cholecystitis.^[citation needed]

Bariatric surgery not only reduces obesity but manipulates the metabolism of patients, referring to the common term "metabolic syndrome". Improvements in blood chemistry and chemical conditions such as diabetes, high cholesterol, and hypertension are noted after surgery. Three essential branched-chain amino acids - leucine, isoleucine, and valine, found in foods like fish, eggs, and legumes - decrease dramatically after gastric bypass surgery. The surgery delivers structural and hormonal changes which can potentially cure diabetes.^[28]

Bariatric surgery in older patients has also been a topic of debate, centered on concerns for safety in this population. One study of elderly patients undergoing laparoscopic bariatric surgery at Mount Sinai Medical Center, however, reported 0% conversion to open surgery, 0% 30-day mortality, 7.3% complication rate, and average hospital stay of 2.8 days.^[29] Post operative mortality from 0.1–2 %.

Given the remarkable rate of diabetes remission with bariatric surgery, there is considerable interest in offering this intervention to type 2 diabetes patients with a BMI of <35 kg/m². Until high-quality, controlled trials are completed, appropriateness criteria (based on age, BMI, and the severity of eight obesity-related comorbidities) may be used to guide the careful selection of diabetes patients who may potentially benefit from bariatric surgery.^[30]

Laparoscopic bariatric surgery requires a hospital stay of only one or two days. Short-term complications from laparoscopic adjustable gastric banding are reported to be lower than laparoscopic Roux-en-Y surgery, and complications from laparoscopic Roux-en-Y surgery are lower than conventional (open) Roux-en-Y surgery.^{[1][31][32]}

Adverse effects

Complications from weight loss surgery are frequent. A study of insurance claims of 2522 who had undergone bariatric surgery showed 21.9% complications during the initial hospital stay and a total of 40% risk of complications in the subsequent six months. This was more common in those over 40 and led to an increased health care expenditure. Common problems were gastric dumping syndrome in about 20% (bloating and diarrhea after eating, necessitating small meals or medication), leaks at the surgical site (12%), incisional hernia (7%), infections (6%) and pneumonia (4%) where the Mortality was 0.2%.^[33] As the rate of complications appears to be reduced when the procedure is performed by an experienced surgeon, guidelines recommend that surgery be performed in dedicated or experienced units.^[4] It has been observed that leaks were higher in low volume centres whereas high volume centres showed a lesser leak rate. Leak rates have now globally decreased to a mean of 1-5%.

Metabolic bone disease manifesting as osteopenia and secondary hyperparathyroidism have been reported after Roux-en-Y gastric bypass surgery due to reduced calcium absorption. The highest concentration of calcium transporters is in the duodenum. Since the ingested food will not pass through the duodenum after a bypass procedure, calcium levels in the blood may decrease, causing secondary hyperparathyroidism, increase in

bone turnover, and a decrease in bone mass. Increased risk of fracture has also been linked to bariatric surgery.^[34]

Rapid weight loss after obesity surgery can contribute to the development of gallstones as well by increasing the lithogenicity of bile. Adverse effects on the kidneys have been studied. Hyperoxaluria that can potentially lead to oxalate nephropathy and irreversible renal failure is the most significant abnormality seen on urine chemistry studies. Rhabdomyolysis leading to acute kidney injury, and impaired renal handling of acid and base has been reported after bypass surgery.^[citation needed]

Nutritional derangements due to deficiencies of micronutrients like iron, vitamin B12, fat soluble vitamins, thiamine, and folate are especially common after malabsorptive bariatric procedures. Seizures due to hyperinsulinemic hypoglycemia have been reported. Inappropriate insulin secretion secondary to islet cell hyperplasia, called pancreatic nesidioblastosis, might explain this syndrome.^[35]