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Surgical Treatment of Morbid Obesity: Options, Anatomy, Results and Complications

Extreme obesity is a complex chronic health disorder caused by a number of factors including family history (genetics), environment, eating habits, and food choices. This problem is becoming increasingly frequent in the United States, and it is estimated that over 2% of the population have extreme obesity. This causes an even greater burden of co-morbid diseases such as diabetes, high blood pressure, sleep apnea, heart disease and cancer. The additional costs for caring for these health problems exceeds $40 billion dollars in the U.S. each year and increases the costs of yearly health care for each individual by about 50%.

Rationale behind surgical therapy

Increasing degrees of obesity have been shown to be related to increasing risks of death compared with non obese individuals. In cases of extreme obesity, significant weight loss usually cannot be maintained with diet and exercise alone. Unfortunately, only 10% of individuals are able to successfully lose large amounts of weight and keep it off for more than one or two years. The remainder typically regains lost weight or even exceeds their starting weight when they enter a medical treatment program. There is no question that the most effective method for achieving long-term weight management in individuals who are extremely obese is surgery.

Indications for surgery: NIH consensus conference guidelines

Why shouldn't everyone who is obese have surgery? The answer lies in assessing the risks and benefits of surgery. Surgery for extreme obesity is a major and expensive procedure with significant risks involved including the risk of dying. Therefore, we insist that individuals have exhausted dietary attempts to achieve and maintain weight loss before considering surgery. Persons eligible for gastric bypass surgery must meet the following criteria:

- Body Mass Index (BMI) greater than 40 or greater than 35 with serious co-morbidities including diabetes, high blood pressure, sleep apnea or heart disease. BMI can be calculated 703 multiplied by weight in pounds and then divided by height in inches and divided again by height in inches.
- Patients must have attempted medical treatment of their weight and failed to maintain weight below the above guideline. The types of medical treatment programs vary, but it should include a behavioral component with frequent follow-up intervals as an integral part.
- Patients should be able to show understanding of the relative strengths and weaknesses of medical versus surgical treatment in order to make a decision regarding surgery competently. They must also be able to understand the dietary constraints and lifestyle changes that will be required after surgery. For this reason, behavioral and nutritional assessments and education are critical for the success of surgical therapy.

Mechanisms of surgical weight loss

Several different types of operations have been used since the 1950's to aid patients in losing weight. Many of these have been discarded over the years because of too many side effects or inadequate long-term weight reduction. Many patients have heard stories from friends or relatives regarding obesity operations in the past that have failed. It is important to realize that the exact procedure performed can make a huge difference in the results. The Roux-Y gastric bypass has been performed close to near its present day form since 1971. It and another procedure, vertical banded gastroplasty, have withstood the test of time and are accepted by the National Institutes of Health Consensus Conference in 1991 as acceptable treatments for extreme obesity. The Lap-band has been FDA approved since 2001 and over 200,000 bands have been placed worldwide. Although it does not have as long a track record and may not produce as much weight loss, the relative simplicity of the surgery and low-risk of complications has made it an increasingly popular choice.

Surgery does not alter the basic laws of energy balance in the body. The only way that weight loss will occur is if the ingestion and absorption of calories are less than the burning of calories by the body. Surgery does not generally affect the rate of calorie burning, so all effects of surgery relate to altering either the ingestion of calories or their

absorption by the intestine, or both. The gastric bypass works primarily by decreasing the amount of calories consumed per day. Not all calories consumed are absorbed; however, this is a relatively minor compared to the restriction of calorie intake. Another way that the operation works to affect calorie intake is by an effect called the dumping syndrome. Consuming foods that are high in sugar results in sensations of abdominal pain, lightheadedness, and palpitations in most patients. This leads to a loss of desire for these types of foods and aids in patients' sense of control over the diet. The Lap-band works entirely by restricting caloric intake and does not affect absorption or cause dumping.

Roux-en Y Procedure

Operation

The Roux-Y gastric bypass involves using a stapling device to completely separate the stomach into two compartments or pouches. A very small pouch is made immediately below the connection between the esophagus and the stomach. This leaves the vast majority of volume of the original stomach in the lower compartment. A portion of the mid small intestine is then attached to the upper, small pouch allowing for the passage of ingested material into the small intestine for absorption. Food and liquid that you swallow enters the upper, small compartment, but normally would never pass into the lower compartment (see figure1).

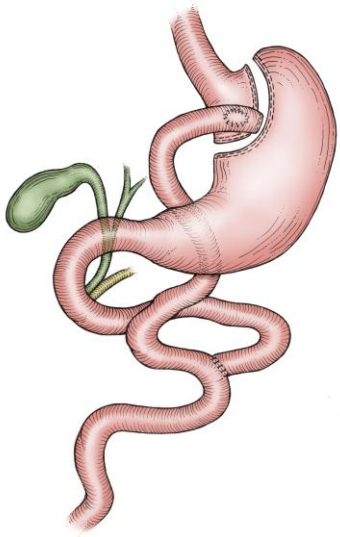


Figure 1. The Roux-Y Gastric Bypass

The small pouch serves as your new stomach, or reservoir, for food. As you eat, the food enters your pouch and is slowly emptied into your intestine. Because you have a very small stomach pouch, you will feel very full very quickly. Overeating can cause distention of the pouch, pain and vomiting. It can also potentially cause the staple line to disrupt or separate. Because of the small size of the pouch your eating habits will change drastically. You will never be able to eat the quantity of food you can currently eat. For example, most patients can eat about half a sandwich and a piece of fruit for lunch.

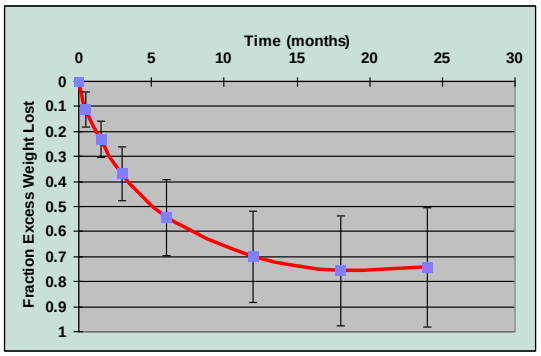
In addition to the effect on the size of your meals, the operation also results in nutrients bypassing the lower part of the stomach and the upper part of the small intestine. Although the percentage of nutrients that pass through into the stool without being absorbed is small, this does contribute to weight loss. In those patients with a BMI greater than 50, the bypassed segment of intestine is made slightly longer to help increase the amount of weight loss achieved.

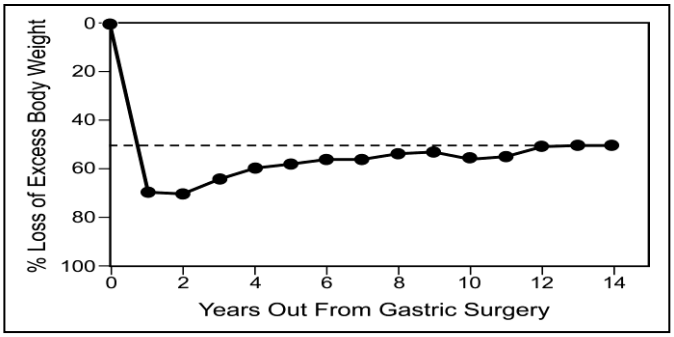
Initially, after surgery, patients can only eat very small quantities of food, and the average daily intake is only 500-700 calories. Over time, the body adapts to the new anatomy, and caloric intake will rise to around 1200-1400 calories per day after one to two years. Although some of this increase is due to an increase in the size of the pouch ("stretching"), most is probably due to adaptation of the sensory nerves of the stomach and small intestine.

Although the principle of the gastric bypass is simple, it is a technically demanding procedure in the obese patient. Access to the abdominal cavity is gained through a single incision from just below the breastbone to the belly button. Since the middle 1990's, certain centers have started performing the operation using a laparoscopic approach. This involves using five or six small incisions across the upper abdomen. A small telescope, thin instruments, and thin stapling devices are used to achieve the same anatomical result as with the open approach. Although the laparoscopic approach has appeal, it has not been proven to be safer or more effective than the open approach. Early results show that the weight loss effects and decrease in co-morbidities are the same with the laparoscopic approach. Hernias, wound infections, and stomal stenosis problems may be less common with the laparoscopic approach. There may be a slightly higher rate of leak after the laparoscopic gastric bypass (see below under complications). At Washington University, we have offered the laparoscopic approach to selected individuals since April 1999 and our results confirm that this is a safe alternative.

Beneficial Outcomes

After gastric bypass, patients can expect to lose 70% of their excess body weight within a one to two year time span (figure 2). Those with a BMI over 55 will likely lose more pounds but a smaller percentage of their excess weight compared to those with a BMI under 55. Weight is lost most rapidly in the first few weeks and months with half of the weight loss occurring in the first three to four months. Long-term studies with high rates of follow-up have shown excellent long-term weight stability. There is on average slow weight gain after the first one to two years, but patients maintain loss of 50% of initial excess weight up to at least 15 years after surgery (figure 3). Figure 2: Fraction of Excess Weight Lost after Roux Y Gastric Bypass at Washington University Figure 3: Long term weight loss results after gastric bypass: From Pories, et al, 1994.





Although the effect of surgery on weight is dramatic, the majority of patients ultimately plateau at a weight where they are classified as obese or overweight. The most compelling reason to argue in favor of surgical treatment of obesity is the dramatic improvements in obesity related co-morbidities. Over two thirds of patients being treated for diabetes will have normalization of their blood sugars and come off of all diabetic medication, essentially cured of their diabetes. Obese patients who do not have diabetes at the time of surgery have reduced incidence of developing diabetes by a factor of 30 compared to patients who do not have surgery. One half of the patients being treated for high blood pressure will be able to come off their blood pressure medication in the years after surgery, and a quarter will have reduction in their dosages. It also reduces the risk of new onset high blood pressure by a factor of 10 compared to those not having surgery. Finally, those patients suffering from sleep apnea or other respiratory disturbances related to obesity will have dramatic improvements in their sleep quality, and 80% of those treated with CPAP are able to come off of that treatment.

Many of these co-morbidities directly affect the risk of heart disease. There is evidence that surgical treatment improves the chances of long-term survival in obese patients compound to those who do not have surgery. In diabetic obese patients, surgery reduced the risk of dying by a factor of five compared to those who were eligible for surgery but did not receive it because they were turned down or were denied authorization by their insurance company.

Adverse Outcomes (risks)

As with all surgical procedures, risk is involved. This is a major surgical procedure performed on patients who in general are not a healthy group. Our average patient has two co-morbidities in addition to their obesity. Obesity itself is associated with increased risks of surgery. Approximately 30% of our patients will suffer some form of complication, although the vast majority is minor. It is important that you understand the potential risks.

The following table describes the frequency of various complications at Washington University from July 1997 through May 2008. During that time, gastric bypass was done in XXXX cases, YYY as a primary procedure and ZZZ as revisions of prior obesity operations:

	Primary Overall	**Primary Open**	**Primary Laparoscopic**	**Re-visional**
Average weight	343.0	402.0	309.6	293.3
Average BMI	55.0	63.6	50.1	49.2
Complication %	**Primary Overall**	**Primary Open**	**Primary Laparoscopic**	**Re-visional**
Death (within three months of surgery)	1.1	2.4	0.4	0
Leak	2.0	1.7	2.1	5.7
Pulmonary embolism	2.3	3.7	1.5	0
Heart Attack	0.6	0.7	0.6	0
Wound infection requiring oral antibiotics	7.9	15.9	3.4	12.5
Wound infection requiring IV Abx	3.8	5.7	2.7	4.5
Incisional Hernia	7.7	17.6	2.1	8.0
Stomal stenosis	5.4	8.4	3.6	0
Blockage of the bowels	3.5	2.4	4.2	2.3
Bleeding or anemia requiring transfusion	3.3	2.0	4.0	6.8
Fistula	1.0	2.0	0.3	3.4
Conversion of lap to open GB	N/A	N/A	2.0	N/A
Any complication	31.4	48.3	21.8	35.2

Death. Among all patients who have gastric bypass, 1-2% die within three months of surgery. The three most common causes of death are heart attack, pulmonary embolism (blood clot going to the lungs), and a leak at the connection of the stomach and the small intestine. The risk of death seems to be higher in heavier patients and those patients who have severe respiratory problems associated with their obesity, but even patients with no co-morbidities have died from this operation. It is not possible to accurately predict who will die from surgery, and you must be willing to accept this risk, or you should not have surgery.

Leak. One of most serious complications is a leak from an anastomosis or hook up. This can cause a serious condition known as peritonitis and result in the formation of pockets of infection called abscesses. Leak is rare (2-4%) and can be minor, but it can be extremely serious and potentially fatal. Leaks typically occur in the first few days to a week after surgery. All patients are checked for leaks 5-10 days after surgery with an upper GI test. If a leak occurs, emergency surgery may be necessary. Leaks are around 2 - 3 times as common when gastric bypass is done as a revision of previous gastric obesity surgery.

Heart Attack. Risk is low but increases with age, smoking and number of co-morbidities.

Blood clots. As with other types of surgery blood clots can form. These typically form in the blood vessels of the arms and legs and can break off and flow to the lungs where they may block the flow of blood to the lung- a pulmonary embolism. You will be given a blood thinner called heparin before and after surgery, and special boots will be placed on your feet to help pump blood back from the veins in your legs to your heart. Even with all these precautions, it is not possible to completely eliminate the risk of blood clots.

Stenosis. The opening formed by the attachment of the intestine to the stomach pouch may become smaller as healing occurs in the first 4-8 weeks. This is known as stenosis. As a result, solid food cannot pass through the opening, resulting in severe nausea and vomiting after eating. If this occurs, the opening can be enlarged to its original size by passing a tube called an endoscope into the stomach and stretching the opening with a small balloon

Hernia. A hernia occurs when the muscle wall that normally covers the stomach and intestine becomes weakened at the point at which it was sewn together. A small sac-like pocket forms under the skin. The intestines can enter this pocket, where they can become trapped. Surgical repair is eventually necessary.

Ulcer. Gastric bypass surgery increases the chance that you will develop an ulcer during your lifetime. This is almost always treatable with medications. To help prevent this, antacid medication (Pepcid) must be taken daily for one month following surgery to help prevent this complication.

Gallstones. During the period of rapid weight loss, individuals who have not had their gallbladder removed have a higher risk of developing gallstones. Medication is prescribed (Actigall) that must be taken daily for six months following surgery.

Fistula. In rare patients, the two compartments of the stomach separated at the time of the gastric bypass can reconnect. This may occur suddenly even years out from surgery and is associated with sudden dramatic weight gain and increased ability to eat.

Nutrient deficiencies and anemia. These are the most common long-term side effects of surgery, but they are generally avoidable. Because of the bypass of the lower stomach and upper small intestine, you will not absorb folic acid, vitamin B12, calcium and iron normally after surgery. It is critical that you continue to take a daily multivitamin, vitamin B12 and calcium every day for the rest of your life. Menstruating females will need to take daily iron supplements as well. Failure to take these, supplements can result in anemia and osteoporosis (brittle bones).

Overview of the evaluation

You will be spending time with members of the Washington University Weight Management Program including a behavioral counselor, dietitian, obesity surgeon and a physical therapist. During your visit with the surgeon, a thorough history will be taken. You will spend time with a dietitian, who will evaluate your eating habits and medical history. All of the evaluations will be used to assess you as a surgical candidate. You may be asked to do further testing to evaluate any potential obesity related problems such as sleep apnea and GE reflux disease. If so, the tests will be ordered by the surgeon. If you are an appropriate candidate for surgery a letter will be written to your insurance company requesting approval for the procedure. Expect about a one to two month wait between your initial visit and precertification and another one to two months until your scheduled surgery date.

<u>Your role in Gastric Bypass Surgery</u>

Most of our patients have been very pleased with the results of their operation. On average, patients have lost 70% of their excess weight after one year. Gastric bypass surgery is designed to help you help yourself. Individuals considering gastric bypass surgery must be committed to certain lifestyle changes in order to help insure healthy and successful weight loss and management. The success of the surgery depends on you. The surgery can be beaten; therefore, you must follow a few simple principles:

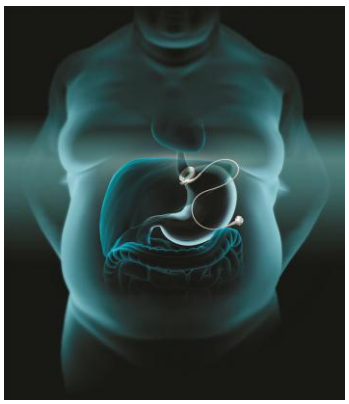
- Eating style. Due to the reduced size of the stomach, food must be eaten slowly, in small portions and chewed well, otherwise nausea and vomiting can result. Eating larger portions can also eventually stretch the stomach, defeating the purpose of surgery. YOU MUST TAKE VITAMINS FOR THE REST OF YOUR LIFE.

- Food choices. Eating foods that are high in dry fat calories, such as snack chips or fried foods will result in suboptimal weight loss as well as nutritional deficiencies. "NO JUNK FOOD" This is considered poison to a gastric bypass patient. This includes chips, crackers and buttered popcorn. "NO FRIED FOODS!" This includes french fries, fried fish and fried chicken. "NO SWEETS!" Foods such as regular soda, milk shakes, candy, cake and ice cream will likely result in lightheadedness, dizziness, sweating, nausea, abdominal cramping and diarrhea, i.e. dumping syndrome. If you test the system, you will likely be sorry you did.

Lap-band Procedure

Operation

The Lap-band systems adjustable band is a silicone elastomer hollow ring filled with saline and placed around the upper part of the stomach. This creates a new small stomach pouch, with the large part of the stomach below the band. This way, the food storage area in the stomach is reduced. The pouch above the band can hold only a small amount of food. The band also controls the stoma (the stomach outlet) between the two parts of the stomach. The size of the opening between the two sides of the stomach controls the flow rate of the food from the upper to the lower part of the stomach. This lets you feel full sooner the feeling also lasts longer. To change the size of the stoma, the inner surface of the band can be adjusted by adding or removing saline, this process if called inflating or deflating. Saline is a salty solution like other fluids in your body. The band is connected to a tube to an access port placed beneath the skin during surgery. Later, the surgeon can control the amount of saline in the band by piercing the access port through the skin with a fine needle. If the band is too loose and weight loss too small, adding more saline can reduce the size of the stoma. If the band is too tight, the surgeon will remove some saline. This too can be done without more surgery. Being able to adjust the band is a unique feature of the lap-band system and is a normal part of the follow-up. For successful outcome with the band, you will need to be committed to follow up every month for the first year and every two months for the second year and may require adjustments on 5 – 10 of those appointments.



The LAP-BAND ® System (shown at right) is placed around the upper part of the stomach.
(Photo courtesy of Apollo)

The Lap-band system Indications

The Lap-band system is not right for everyone. You and your surgeons should work together to decide if this is the right treatment for you. Here are some of the things your surgeon will consider.

The Lap-band system may be right for you if:

- You are an adult at least 18 years of age
- Your BMI is 30 to 39.9 with one or more obesity related comorbid conditions
- Your BMI is 40 or higher or you weigh at least twice your ideal weight for you weigh at least 100 pounds (45 kilos more than your ideal weight)
- You have been overweight for more than five years
- Your serious attempts to lose weight have had only had short-term success
- You do not have any other disease that may have caused you to be overweight
- You are prepared to make a major change in your eating habits and lifestyle
- You are willing to continue working with a specialist who is treating you
- You do not drink alcohol in excess

What are the specific risks and possible complications?

Talk to your doctor about all of the following risks and complications:

- Ulceration
- Gastritis (irritated stomach tissue)
- Gastroesophageal reflux (regurgitation)
- Heart burn
- Gas/Bloat
- Dysphagia (difficulty swallowing)
- Dehydration
- Constipation
- Weight gain
- Death

Laparoscopic surgery has its own set of possible problems, they include:

- Spleen or liver damager (sometimes requiring spleen removal)
- Damage to major blood vessels
- Lung problems
- Thrombosis (blood clots)
- Rupture of the wound
- Perforation of the stomach or esophagus during surgery

Laparoscopic surgery is not always possible. The surgeon may need to switch to an "open" method due to some of the reasons mentioned here. This happened in about 5% of the cases in the US clinical study. There are also problems that can occur that are directly related to the Lap-band system. They include:

- The band can spontaneously deflate because of leakage. That leakage can come from the band, the access port, or the tubing that connects them.
- The band can slip.
- There can be stomach slippage.
- The stomach pouch can enlarge.
- The stoma (stomach outlet) can be blocked.
- The band can erode into the stomach.

Obstruction of the stoma can be caused by:

- Food
- Swelling
- Improper placement of the band
- The band being over-inflated
- Band or stomach slippage
- Stomach pouch twisting
- Stomach pouch enlargement

There have been some reports that the esophagus has stretched or dilated in some patients. This could be cause by:

- Improper placement of the band
- The band being tightened too much
- Stoma obstruction
- Binge Eating
- Excessive vomiting

Patients who have a weaker esophagus may be more likely to have this problem. A weaker esophagus is one that is not good at pushing food through. Tell your surgeon if you have difficulty swallowing. Then your surgeon can evaluate this.

Weight loss with the Lap-band system is typically slower and more gradual than with some other weight loss surgeries, including gastric bypass. Tightening the band too fast or too much to try to speed up weight loss should be avoided. The stomach pouch and or esophagus can become enlarged as a result. You need to learn how to use your band as a tool that can help you reduce the amount you eat.

Infection is possible. Also, the band can erode into the stomach. This can happen right after surgery or years later, although this rarely happens.

Complications can cause and reduce weight loss. They can also cause weight gain. Other complications can result that require more surgery to remove, reposition, or replace the band.

Some patients have more nausea and vomiting than others. You should see your physician at once if vomiting persists. Rapid weight loss may lead to symptoms of:

- Malnutrition
- Anemia
- Related complications

It is possible you may not lose much weight or any weight at all. You can also have complications related to obesity.

Lap-band Adjustments

With the Lap-band system, the band can be adjusted to meet your specific needs. This is one of its more attractive aspects. The feature allows you and your surgeon to find the right level of restriction just for you.

When first placing it, your surgeon usually leaves the band empty or only partially inflated this lets you get acquainted with your band during the first few weeks after surgery. It also let's healing occur around the new band site.

These first few weeks are a critical time. You need to avoid vomiting. You also need to avoid putting pressure on your new small stomach above the band. The first time the band is adjusted is usually four to six weeks after your surgery. The exact time will vary. You and your surgeon will decide when the right time is for your band adjustment. Adjustments are made by your surgeon in the office. To determine how ready you are for a band adjustment, your surgeon will consider:

- Weight loss
- Amount of food you can comfortably eat
- Exercise routine
- How much fluid is already in your band

To get the best results, you will need to follow-up monthly for the first year and every two months during the second year. During each adjustment, only 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. An ideal "fill" should be just right enough to let you gradually lose weight. That means, you should still be able to eat enough to get the nutrients that you need while still reducing the overall amount you can eat.

The Lap-band system is meant to offer you a way to obtain steady and safe weight loss. Do not be in a hurry to have an adjustment before you are ready. To work, the band needs your participation. You success will depend on you and on the partnership between you and your surgeon.

Your motivation is key

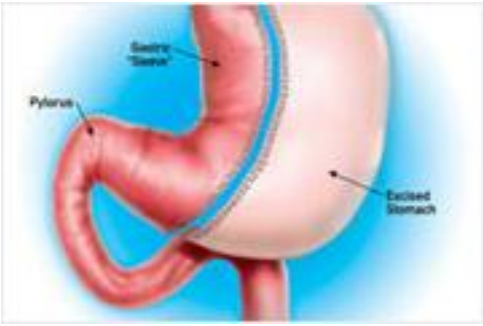
Your surgeon will not do the operation unless he or she knows you understand the problems your excess weight is causing. Also, your surgeon will make sure you know you have responsibilities. These include new eating patterns and a new lifestyle. If you are ready to take an active part in reducing your weight, your surgeon will consider the treatment. First, though, your surgeon will want to make sure you know about the advantages, disadvantages and risks involved.

- EXERCISE, EXERCISE, EXERCISE! Your success will greatly depend on your commitment to an exercise routine. We strongly recommend that patients participate in the preoperative and postoperative physical rehabilitation program. We encourage patients to take advantage of the dramatic weight loss to increase their exercise capacity and to include exercise in their daily routine.

- Medical follow-up. In order to monitor for potential long-term complications, such as anemia, it is important to keep scheduled appointments and see your primary care physician regularly.

Vertical Sleeve Gastrectomy

A sleeve gastrectomy is a restrictive surgical weight loss procedure that limits the amount of food you can eat and helps you feel full sooner. In this procedure, a thin, vertical sleeve of stomach is created and the rest of the stomach is removed. The sleeve is about the size of a banana. The surgery is usually done using a tiny camera that is placed in your belly. This type of surgery is called laparoscopy. The camera is called a laparoscope. It allows your surgeon to see inside your belly.



(Photo courtesy of Ethicon)

In this surgery:

- Your surgeon will make 2 to 5 small cuts in your abdomen.
- The surgeon will pass the laparoscope and the instruments needed to perform the surgery through these openings.
- The camera is connected to a video monitor in the operating room. Your surgeon will look at the monitor to see inside your belly.
- Your surgeon will insert thin surgical instruments through the other openings.

Your surgeon will remove most (about 80 - 85%) your stomach.

- The remaining portions of your stomach are joined together using staples. This creates a long vertical tube or banana-shaped stomach.
- The surgery does not involve cutting or changing the sphincter muscles that allow food to enter or leave the stomach
- Your surgery may take only 60 - 90 minutes if your surgeon has done many of these procedures.

When you eat after having this surgery, the small pouch will fill up quickly. You will feel full after eating just a very small amount of food.

Risks for vertical sleeve gastrectomy are:

- Gastritis (inflamed stomach lining), heartburn, or stomach ulcers
- Injury to your stomach, intestines, or other organs during surgery
- Leaking from the line where parts of the stomach have been stapled together
- Poor nutrition, although much less than with gastric bypass surgery
- Scarring inside your belly that could lead to a blockage in your bowel in the future
- Vomiting from eating more than your stomach pouch can hold

- GERD (reflux disease) seems to be common occurrence after surgery, but in most cases resolved spontaneously

Sleeve gastrectomy patients have been shown to experience significant weight loss and improvements in their health. Patients have been shown to lose an average of 55%[13] of their excess weight.

The majority of sleeve gastrectomy procedures are performed using a laparoscopic technique. Laparoscopic (minimally invasive) surgery results in a shorter hospital stay, faster recovery, smaller scars, and less pain than open surgical procedures.

A clinical study showed that 50% of patients who had a sleeve gastrectomy procedure lost their craving for sweets after 1 year, and after 3 years 23% still experienced a loss of cravings for sweets.[25] In addition, the level of a hormone called ghrelin, which has been described as a hunger-regulating hormone, was found to be significantly reduced after sleeve gastrectomy surgery.[26], [27]