

Systematic Review

Surgical techniques in bariatric surgery: minimally invasive approaches and long-term outcomes

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ABSTRACT

Obesity is a worldwide epidemic, and current weight loss strategies frequently do not effectively tackle the problem. Bariatric surgery effectively addresses this issue. A systematic research study was done to investigate minimally invasive bariatric operations, using 32 studies from a pool of 2,118 data. Bariatric surgery was found to greatly assist in weight reduction and enhance general health results. Procedures such as gastric balloon, gastric banding, and gastric bypass can decrease the weight of obese people and alleviate associated health conditions. Sleeve gastrectomy is highly successful and yields favorable long-term results. The procedure used relies on the patient's health and the surgeon's discretion. The primary risk factor is the recurrence of weight or the need for revision surgery. Ultimately, bariatric procedures provide weight loss and long-term health benefits, but it is important to acknowledge the associated surgical risks. Immediate dangers include of blood clotting, intestine blockage, bleeding, infections, abdominal pain, nausea, heartburn, vomiting, ulcers, and other issues associated with surgery. Long-term consequences include of dumping syndrome, starvation, and weight regain.

Keywords: Bariatric surgery, Surgical techniques, Weight loss

INTRODUCTION

Bariatric surgery is a medical procedure of obesity treatment where the digestive system is altered by surgical or non-surgical procedures (minimally invasive) to promote weight loss. Bariatric surgery involves techniques that restrict the amount of food the stomach can hold, limit nutrient absorption, or both.¹ Bariatric surgery involves different types, e.g. Gastric bypass, sleeve gastrectomy, gastric banding, and gastric balloon surgery. Patients are typically advised for bariatric procedures who are suffering from class II obesity (Body

mass index (BMI) over 35) and class III obesity (BMI over 40) along with obesity-related issues. Bariatric surgery can reduce weight and, at the same time, lead to better health by normalizing metabolic functions such as blood sugar levels, BP, and cholesterol levels.²

Obesity has been considered a global pandemic for the last two decades and has gained popularity in surgical approaches for the last 50 years, it is persistent among all age groups. So, laparoscopic surgery is an approach that needs very small incisions. In the US and Canada, the majority of people are classified as obese, 33.8%. The

centers for disease control and prevention conducted the 2010 national health and examination survey. Among all the weight loss modalities, bariatric surgery and procedures have been turning out to be the most effective long-term solution for those with a BMI of 35 or higher. Bariatric surgery has been a performance that has dramatically improved over the past decade.³

The American society for metabolic and bariatric surgery (ASMBS) estimated that about 228,000 individuals decided to go through weight loss operations in the United States, as per 2017 reports. ASMBS suggested that nearly 580,000 people worldwide undergo bariatric surgery annually. Besides reducing the rate of weight loss, bariatric operations are recognized as substantial improvement or remission of many obesity-related health conditions such as type 2 diabetes or chronic heart conditions, hypertension, or depression. In background, surgeon Roux performed the first metabolic surgery, jejunoileal bypass, in 1954. Further developments included the gastric bypass performed by Dr. Mason Jr. in 1966. In the 1990s, laparoscopic procedures, for example, the Roux-en-Y gastric bypass, became popular, with over 340,000 surgeries performed by 2011.³

Objectives

We aimed to conduct comprehensive research on minimally invasive bariatric surgical techniques, evaluating effectiveness and long-term outcomes. Readers can expect detailed analyses on the efficacy, safety, and impact of different bariatric surgeries on patients' quality of life. This paper will discuss gastric sleeves, gastric banding, gastric bypass, gastric bypass revision, and gastric balloon techniques.

METHODS

We conducted evidence-based systematic research articles dealing with minimally invasive bariatric techniques and their long-term outcomes. In inclusion, multiple journal proposals ensure that research papers with comprehensive methodology, solid clinical evidence, and large samples are included. Discovering trends such as introducing less invasive techniques, patient outcomes, and comparative studies of different procedures is likely to be top priority. Exclusion criteria include articles with unclear descriptions of methods used and statistical analyses. Exclude studies only interested in short-term outcomes, those needing more systematic review, and single case reports. Also, studies published before 2000 and not written in English are excluded.

Keywords used

In this systematic research article titled "surgical techniques in bariatric surgery: "bariatric surgery: minimally invasive approaches and long-term outcomes," are considered as main words in bariatric surgery, while specifically focused on minimally invasive methods and

their long-term outcomes, covering gastric sleeves, gastric banding, gastric bypass, gastric bypass revision, and gastric balloon procedures. These keywords catch the pulse of different surgical operations as the treatment for obesity and their efficacy over years. With these primary keywords, carefully selected some secondary keywords, which consist of metabolic surgery, laparoscopic procedures, and criteria of BMI to be more specific.

Search strategy

We started with a broad search using primary keywords: "bariatric surgery", "minimally invasive methods" and "long-term effects" on PubMed and Scopus. We specified the search by including specific surgical procedures that we decided to add as additional keywords: ["sleeve gastric" or "gastric banding" or "gastric bypass" or "gastric bypass revision" or "gastric balloon"] and ("weight loss surgery" or "obesity treatment"). we refined the search further by adding secondary keywords: (metabolic surgery or laparoscopic procedures or BMI criteria) and [(quality of life or surgical complications or patient satisfaction)].

Selection and screening process: a flow diagram for PRISMA

Our PRISMA signifies systematic selection and screening of relevant studies in our review. First, 2,118 records were detected from two databases, NCBI and Scopus. The 854 duplicated records were discarded from record, and 1252 unique records were screened. This elimination has led to reduction of the number of records to 1,032. Forty-nine reports were then chased and found, with only three needing more responses. After screening abstract, 72 reports were screened for eligibility. After reading the full text, 24 studies were retrieved, and eight additional studies were selected manually to make it more specific.

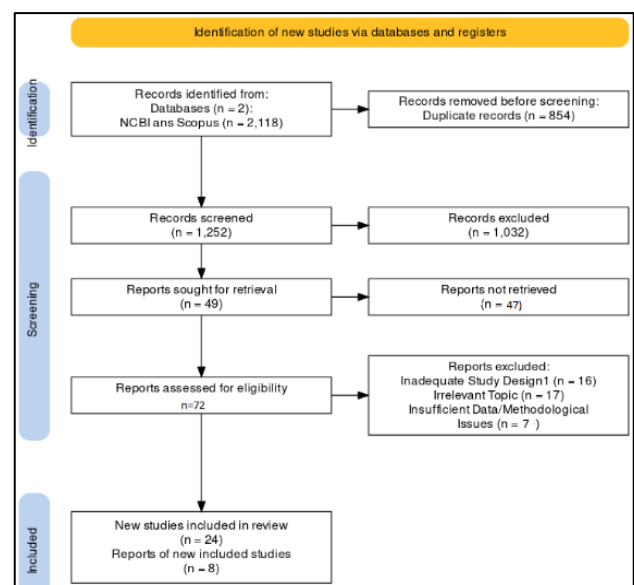


Figure 1: Flow diagram for PRISMA.

Ethical approval statement

Our review is based on publicly available data from previously published research articles, and we did not discuss direct human subjects or animal research. Our research aligns with ethical standards outlined in the declaration of Helsinki and other relevant guidelines for research integrity and publication ethics.

RESULTS

Laparoscopic gastric balloon surgery

The intragastric balloon procedure facilitates significant weight loss, where patients typically lose between 20 percentages and 30 percentages of their body weight.⁴ The less invasive method is also associated with lower risk than more radical bariatric surgery, helping the patient get a safe weight-loss solution. It is a preventive surgery that boosts the patient's healthy lifestyle, which may aid in long-term weight loss.⁵ The procedure results are evident and have demonstrated a reduction in the risk of obesity-related conditions like heart diseases, diabetes, hypertension, and some types of cancers, with reported 12% to 40% weight loss during the six months of balloon placement.⁶

Complications associated with intragastric balloon insertion

However, the procedure also has severe risks. Common problems include nausea and stomachache, which often appear in many patients. More serious complications, though rare, can include: Deflation of balloons and its blocking of about 1.5 percentages of cases. Spontaneous balloon overinflation calls for giving early ditches in approximately 2 percentages of the patients. Acute pancreatitis is the reason for removing the balloon, despite this being so seldom done and gastric ulcers and perforation (which take place in 0.1 percentages of the cases) could result in severe conditions requiring emergency reach.⁷

The outcomes of the intragastric balloons with respect to initial weight loss are good, but in the long term, they vary. Findings suggest post balloon extraction that weight can be maintained to a certain extent, with EWL at the 12-month mark being between 14 percentages and 50.9 percentages and maintaining the levels of 14.2 to 27.2 percentages at 12 months post-removal. Nevertheless, a considerable percentage of the patients (78.7%) at the time of the balloon removal either got back their weight or sought further bariatric measures 3.3 years later, on average. In addition, the method is shown to have benefits for diseases of metabolic origin connected to obesity, such as metabolic syndrome, type 2 diabetes, as well as the hypertension. The NAFLD activity index has been improved, with the differences between the NAFLD activity scores noticed in the treated group compared to the control group.⁸

Gastric banding

Gastric band surgery, as a limiting procedure for weight loss, is a surgery carried out to place a band around the upper part of the stomach to create a small pouch. The use of gastric band implants with a limited food-holding capacity induces a feeling of satiety after consuming a small quantity of food.⁹ The band's tightness can be adapted following the surgery and used to control the speed of the food passage. When other methods like diet and physical exercises have failed, this surgery is an option for those with moderate to high-risk obesity. Candidates must have a BMI of at least 35, or between 30-34.9, with serious health problems that could diminish with weight loss.¹⁰

The operation implies introducing four minor cuts in the abdomen, passing a laparoscope and surgical tools, and using the band without the inside entering. It is typically a 30 to 60-minute session. Following the procedure, they can return to their regular routine within 2-3 days and work gradually from liquids to solid foods after a week.¹¹ The risks involve allergic reactions, blood clots, infection and complications concerning the gastric band, such as erosion, slippage, or port problems that might need further surgeries. Preparation for the surgery takes place by completing various tests, nutritional counselling, and possibly stopping some medications. Smoking cessation is another area where emphasis is being placed on better recovery.¹²

The result of laparoscopy is not as much as that of other bariatric surgeries, which may leave about one-third to a half of the excess weight, depending on the patient.¹³ Compliance with dietary and physical activity instructions is the key to a successful outcome. Even though it is beneficial or treats overweight-related health issues, surgery cannot be the only solution to weight loss and needs lifestyle changes.¹²

The possibilities of poor nourishment and vitamin deficiency due to digestive rerouting are minimal within gastric banding surgery. The process is also reversible, which gives the option of return in case of glitches. Well-managed dieting will result in losing 15% of the total body weight within three years.¹⁴

While gastric banding is safer and less risky for early postoperative complications than other bariatric surgical indications, it is far from being free of potential side effects.¹⁵ The most common complications are nausea and vomiting, port-site infection, band slippage, and stomach perforation, which happens on rare occasions. Band erosion is seen less and less as a complication along with many others since the progress in the surgery, but yet it can still occur if a patient overeats or does not stick to their dietary guidelines. Other technical problems may be due to the saline leaking from the band, the port or the tubing problem, and very rarely, the stomal blockage or gastroesophageal reflux disease (GERD).¹⁴

Table 1: Results.

Key Term	Designed criteria	Results/data/notes
Evidence-based systematic research	Research based on systematic review and analysis of existing studies to draw conclusions about a specific area of interest.	Focus on minimally invasive bariatric techniques and their long-term outcomes.
Comprehensive methodology	A methodological approach that is thorough and detailed, covering all necessary aspects of research design.	Criteria for inclusion to ensure robust and reliable findings.
Clinical evidence	Data and outcomes derived from clinical studies that test the effectiveness and safety of medical interventions.	Key for inclusion to provide solid backing for the review's conclusions.
Minimally invasive methods	Surgical techniques requiring smaller incisions, associated with quicker recovery and fewer complications than traditional surgery.	The core focus, highlighting less invasive techniques for bariatric surgery.
Long-term Effects	The outcomes or consequences that persist long after the initial treatment, often years later.	Essential for inclusion; studies with only short-term focus were excluded.
Exclusion criteria	Specific reasons or conditions for which studies would not be included in the review.	Includes unclear method descriptions, lack of systematic review, and focus on short-term outcomes.
Primary keywords	The main words or phrases used to guide the search for relevant literature.	Included "bariatric surgery", "minimally invasive methods", and "long-term effects".
Secondary keywords	Additional terms used to refine the search and focus on specific aspects of the primary keywords.	Included "metabolic surgery", "laparoscopic procedures", and "BMI criteria".
Search strategy	The planned approach to finding relevant literature based on predefined criteria and keywords.	Broad search on PubMed and Scopus, refined by surgical procedures and secondary keywords.
PRISMA flow diagram	A standardized flow diagram that maps out the number of studies identified, included, and excluded, and the reasons for exclusions.	Systematically select and screen relevant studies, from 2,118 records to a final selection of 32 studies.
Quality of life	A measure of an individual's overall well-being and satisfaction, particularly after medical treatment.	An important outcome measure for the review and one of the secondary keywords.
Surgical complications	Any undesirable results of surgery that affect a patient's health or recovery process.	Considered in the review to assess the safety and risk associated with different bariatric techniques.
Patient satisfaction	The degree of contentment patients feel regarding the outcome of their surgery and the care they received.	An important factor in evaluating the success and effectiveness of bariatric procedures.

As explained by the review of gastric banding surgery in the passage, the short and long-term results both ensure its benefits and raise some concerns. The patients underwent a 14-year period during which they significantly lost weight; the initial weight loss percentages varied from 40.2% to 46.3% in the early years after the surgery, which gradually declined to 15.6% after 14 years. This course of events signals a decrease in weight loss effectiveness with time. Nevertheless, while weight loss was observed in these patients, diabetes and hypertension overlapping comorbidities were observed to be reduced, with an apparent reduction in insulin dose and a better amelioration of hypertension. Although some favorable results are achieved, it has its complications. For instance, pyrosis, reflux, and bleeding are the major complications reported to be the case in some of the

patients who have had the procedure done. Band removal due to slippage, pouch dilatation, and band migration may also occur in the end, thus leading to a 12.0% overall band removal rate. A substantial portion of patients required reoperation; the cumulative reoperation rate is about 30.5% over the follow-up periods. In conclusion, while gastric banding can yield significant benefits in weight loss and comorbidity improvement, its long-term effectiveness and associated complications necessitate careful consideration in patient selection and ongoing management to optimize outcomes and minimize risks.¹⁴

Laparoscopic gastric bypass

Laparoscopic gastric bypass (GBP) is a kind of surgery that is of great importance and helps to achieve significant weight loss; therefore, it is used on people

with morbid obesity. This involves the creation of a small gastric pouch, which is used to limit food intake and, hence, facilitate weight loss. The other options are the single loop (mini) GBP and robot-assisted methods, while the standard laparoscopic Roux-en-Y gastric bypass remains on the radar. The utility happens when the obesity epidemic is extant in the United States in over 100 million people. They account for about 65% of the adult population, and the cause of preventable death is smoking. Obesity, which leads to less longevity, is connected to many diseases, i.e. diabetes mellitus, hypertension, dyslipidemia, arthritis, sleep apnea, cholelithiasis, cardiovascular disease and cancer.¹⁶

The condition obesity results from a variety of genetic, environmental, and behavioural factors, in which excessive high-calorie food consumption, overeating, and a sedentary lifestyle are seen as prominent contributors.¹⁷ The body mass index is a relatively popular measure that describes weight in relation to height in adults and has a significant correlation with total body fat. Bariatric surgery is the only option that still offers morbidly obese patients significant and lasting weight loss in the comparison to the medical treatments that usually cause little weight loss and much gain after the medical treatment.¹⁸

There are also other benefits due to the strict diet regimen, such as rapid weight loss and less caloric absorption. It has faster initial weight loss. Body suffering from computer pain helps you prefer to eat healthier foods due to the intense discomfort caused by eating sugars, carbohydrates, and fats.¹⁹

Gastric bypass revision

In people who do not experience the desired improvement, have a higher chance of weight regain, or face medical problems after undergoing gastric bypass surgery, gastric bypass revision surgery may be an option. Roux-en-Y gastric bypass is considered to be the best procedure in bariatric surgery.²⁰ Patients who undergo the procedure usually lose as much as 60 to 80% of the excess weight. On the other hand, a considerable number of patients may regain weight back or with unsuccessful weight loss, defined as less than 50% of excess weight loss or a BMI more than 35, mainly for super obese patients (BMI more than 50). For those who did not achieve expected weight loss or those prone to weight regain, the laparoscopic distal Roux-en-Y gastric bypass, a minimally invasive procedure, decreased the body's ability to absorb food and calories, thereby facilitating further weight loss. Surgery stands out because of its effectiveness and large amounts of weight loss outcomes, unlike other revision alternatives, and most patients can leave the hospital one or two days after restoring weight loss.²¹ Nevertheless, due to the malabsorption the procedure may cause, patients have a lifelong requirement of taking larger doses of vitamins. They may

end up with increased bowel movements or diarrhoea that can be controlled by using a low FODMAP diet.²²

Roux-en-Y gastric bypass operation is the standard operation that separates the liver and pancreas digestive juices from the food in the first 200 cm of the intestine. Thus, it introduces malabsorption to the procedure. In a distal gastric bypass revision, the surgeons restore the connection of the limb to a distal segment of the small intestine, about 200 cm from the end, thereby significantly decreasing food absorption and resulting in patients regaining about 60% of their original weight losses.²²

What separates the bariatric program of the University of Los Angeles from the others is this emphasis on personalized care, in which each patient is treated as an individual, and the treatment consists of both surgery and ongoing support and counselling to maintain healthy weight loss.²¹

Although the gastric bypass revision is mainly done in a safe setting, it is almost like any other medical process and has some risks. Complications that may arise from this procedure could include bleeding, infection, or some adverse reaction to sedation, but they are rare. Moreover, the closing is accompanied by a complexity risk in the case of suturing.²³ The perforation or the leakage may lead to further intervention. Post-gastric bypass redo, the success is greatly influenced by the patient's receptiveness towards positive lifestyle changes. The fact that the procedure can offer short-term weight loss only guarantees sustained results if it braces healthy eating, exercises, and regular follow-ups with the doctor.²⁴ Patients must be open to these mutations to realize the numerous benefits of the revision expeditiously. However, different from insurance policies that support some weight loss procedures, the revision and services of gastric bypass may not be covered.¹¹ Patients should understand the expenses that may occur during the surgery, including the consultation fees, facility charges, and post-surgery care package. Financing would be available to handle these costs, yet individuals must consider the financial implications beforehand.

The long-term effects of revisional sleeve gastrectomy, as reported in the study "revision surgery after sleeve gastrectomy: the study with a period of 10 years and nationwide scale presented in "Do surgical and non-surgical rhinoplasties impact the people immaterially? A nationwide observer study with 10 years of follow-up" showcases significant outcomes for this procedure. The study was based on a claims database spanning ten years and centered on assessing the revision rate post-sleeve gastrectomy and analyzing the most typical causes of surgery conversion and early complications. Research stated that the rate of revision surgery after sleeve gastrectomy increases over time, and in this review, the revision rates were reported as 4.7%, 7.5%, and 12.2% at 5-, 7-, and 10-years post-procedure, respectively.²⁵

Table 2: Studies and findings.

No.	Author(s)	Year	Techniques for weight loss
1	American Society for Metabolic and Bariatric Surgery ¹	2012	Sleeve Gastrectomy, Roux-en-Y Gastric Bypass, Adjustable Gastric Banding, Biliopancreatic Diversion, Duodenal Switch, Single Anastomosis Duodeno-Ileal Bypass with Sleeve Gastrectomy.
2	Crossan ²	2023	Gastric Banding, Sleeve Gastrectomy, Gastric Bypass.
3	Dana Team, UpToDate ³	2012	General endorsement of bariatric surgery as an effective long-term weight loss solution.
4	Safer et al ⁴	2018	Critical evaluation of Intra-gastric Balloon (IGB) effects, suggesting need for standardized evaluation techniques.
5	Mui et al ⁵	2008	Intra-gastric Balloon (IGB) treatment.
6	Mayo Clinic ⁶	2023	Intra-gastric Balloon procedure.
7	Dayyeh et al ⁷	2015	Orbera Intra-gastric Balloon (IGB), EndoBarrier Duodenal-jejunal Bypass Sleeve (DJBS).
8	Kim et al ⁸	2016	Intra-gastric Balloon therapy.
9	Busetto et al ⁹	2004	Preoperative Intra-gastric Balloon before Laparoscopic Adjustable Gastric Banding (LAGB).
10	Jensen et al ¹⁰	2014	Preoperative Intra-gastric Balloon before Laparoscopic Adjustable Gastric Banding (LAGB).
11	Maselli et al ¹¹	2023	Comparison of Endoscopic Sleeve Gastroplasty (ESG) after Intra-gastric Balloon (IGB) vs. ESG-alone.
12	MedlinePlus Medical Encyclopedia ¹²	2015	Laparoscopic Gastric Banding.
13	Sjöström et al ¹³	2004	Gastric Surgery (unspecified).
14	Stroh et al ¹⁴	2011	Gastric Banding.
15	Bradley et al ¹⁵	2011	Bariatric Surgery (specific techniques for diverting nutrients from the upper GI tract).
16	SAGES ¹⁶	2019	Gastric Bypass, Gastric Banding, Sleeve Gastrectomy, Malabsorption Procedures.
17	De Castro et al ¹⁷	2010	Comparison of Heliosphere® bag (air-filled) and Bioenterics-BIB® (saline-filled) gastric balloons.
18	Obesity Expert Panel ¹⁸	2013	General endorsement of surgical techniques for managing obesity, underlined by the accreditation of bariatric surgery centers.
19	Ayloo ¹⁹	2019	Laparoscopic Gastric Bypass.
20	Genco et al ²⁰	2013	Comparison of Adjustable Balloon System (ABS) and BioEnterics Intra-gastric Balloon (BIB).
21	Alami et al ²¹	2007	Laparoscopic Gastric Bypass, with and without preoperative weight loss requirements.
22	UCLA Health ²²	-	Laparoscopic Distal Roux-en-Y Gastric Bypass for gastric bypass revision.
23	Tarnoff et al ²³	2008	Preoperative weight loss to reduce surgical risks and enhance recovery in bariatric surgery.
24	Alexandrou et al ²⁴	2021	Revision options for inadequate weight loss or regain post-Roux-en-Y gastric bypass, including endoscopic and surgical revisions, conversion to distal RYGBP or biliopancreatic diversion, and duodenal switch.
25	Lazzati et al ²⁵	2018	Study on postoperative care fragmentation in bariatric surgery, suggesting improved management strategies.
26	Kim et al ²⁶	2022	Study on predictors of readmission post-bariatric surgery, targeting modifiable predictors to alleviate healthcare system burdens.
27	Jefferson Health ²⁷	-	Laparoscopic Sleeve Gastrectomy.
28	Marincola et al ²⁸	2021	Comparison of Laparoscopic Sleeve Gastrectomy (LSG) and Endoscopic Sleeve Gastroplasty (ESG).
29	Assalia et al ²⁹	2020	Importance of pre- and postoperative endoscopy in laparoscopic sleeve gastrectomy (LSG), with specific considerations for GERD patients.
30	Kraljević et al ³⁰	2021	Long-term analysis of laparoscopic sleeve gastrectomy (LSG) outcomes, including sustained weight loss and comorbidity improvements, but noting high reoperation rates for insufficient weight loss or reflux.
31	Sullivan et al ³¹	2013	Endoscopic aspiration therapy for obesity treatment, showing significant weight loss efficacy.
32	Forssell et al ³²	2014	AspireAssist gastrostomy aspiration therapy system for significant weight loss efficacy in obese individuals.

The most common revision procedure observed in the study was a gastric bypass, which is followed by a sleeve. The need for revision surgery is the persistence of obesity (87.0%) and GERD (5.2%). However, it is essential to note that after revision surgery, several complications were observed, including gastric leak (5.1%), bleeding (18%), and a reoperation rate of 6.4%.²⁶

Laparoscopic gastric sleeves

Laparoscopic sleeve gastrectomy (LSG) is the minimally invasive weight loss surgery offered by the award-winning bariatric surgery team of Jefferson Health. This surgical process-called vertical sleeve gastrectomy or gastric sleeve-achieves weight loss by shrinking the stomach, thus reducing the amount of food it can contain. This is to be accomplished by permanently eliminating the central portion of the stomach (between 70% and 85%), the portion responsible for ghrelin production, a hormone responsible for giving the brain the signal that one is hungry.²⁷

LSG recipe is specifically indicated for individuals who don't want their intestines rerouted, like in a gastric bypass procedure, or for people with BMIs greater than 50 or who weigh more than 500 pounds. This may also rank higher in the patients' choice who have undergone numerous abdominal operations in the past, causing an increase in the probability of post-surgical complications.²⁷

Jefferson Health is a leader in minimally invasive, laparoscopic bariatric surgery and provides patients with benefits like needless pain, shorter hospital stays, quick recovery and few complications, unlike open surgery. It stresses holistic care, reaching beyond the surgical procedure, covering pre-operative evaluations, postoperative monitoring, counselling and support. For those undergoing LSG, there will be several small incisions in the abdomen made so that the camera and the surgical equipment can be inserted. This surgery entails surgically removing a considerable part of the stomach, which creates a 'sleeve' or tube of limited width, thus restricting the amount of food your intake and allowing you to eat (almost) all foods in smaller quantities. Many benefits and advantages come from this surgery as it has been proven safe and effective in the long term. In contrast, other complications like reflux, which can be managed with antacids, have antibiotic protection. LSG is considered a better alternative to gastric bypass as it does not have the risk of malabsorption issues and the requirement of a foreign body implant, which is decidedly where gastric bypass is concerned.²⁷

Sleeve gastrectomy using laparoscopy (LSG) can be considered one of the bariatric surgical options for those patients suffering from obesity because of some reasons. It can be used as a first-line mechanism to treat people who have a body mass index over 60 and helps in weight reduction that is necessary before broader surgery starts.

Furthermore, LSG could be more suitable for seniors or people highly vulnerable to health issues because LSG entails low risk compared to most complex procedures. LSG is a procedure for people to reduce BMI between 40 and 50. It will reduce the risk of adverse effects commonly associated with this type of surgery. Although LSG surgery is an efficient tool, it is still risky as it can be associated with some of the common risks, including bleeding, leakage, and nutritional deficiency. Thus, the importance of thorough evaluation and being well-informed must be considered. Moderate-term consequences of reducing the stomach's size with laparoscopic sleeving.²⁸

The long-term benefits of LSG are impressive and long-term, so patients achieve sustainable weight loss, have a chance to improve the health status associated with obesity and may even get back to everyday life. However, the other important side of the issue is that long-term drawbacks are caused by the risk of weight regain, the frequencies of new-onset reflux, and the need for reoperation due to complications or inadequate weight loss.²⁹

LSG has quick results for reducing weight and is concerned about regaining after the long term. Factors like daily diet structure, lifestyle adjustments and metabolic changes may account for the pattern of rebound weight after surgery in some patients. Acid reflux provoked by gastric teaming or the aggravation of pre-existing reflux symptoms as an LSG complication. The change in the anatomy of the stomach may cause increased acid reflux. The repetition of this can be problematic for the patients and, in the long run, may require medical management and, in some cases, surgical intervention. By investigating the proportion of patients with subsequent LSG reoperation due to insufficient weight loss, lasting reflux symptoms, or other postoperative complications, the researchers deduced that the procedure of LSG carries a high occurrence of per-op complications. Possible complications of a subsequent operation are always present, and its impact can be a disappointment, both physically and the psychologically.³⁰

Aspiration procedure

Aspiration therapy (AT) is a novel obesity treatment that entails extracting a portion of a meal using a silicone percutaneous gastrostomy tube known as the A-tube. The device is connected to a skin port with a valve, allowing a water tank to flow tap water into the stomach for suctioning. After two weeks of insertion, the exterior part of the tube is cut shorter and a skin port with a valve is connected level with the skin. The process usually lasts 5 to 10 minutes and utilizes a siphon effect, often occurring 20 minutes after eating.³¹

Out of 18 patients with AT who underwent a preliminary trial with lifestyle intervention, 7 out of 11 patients opted

to continue the therapy for two years. Following one year of therapy, patients in the AT group lost an average of $18.3 \pm 7.6\%$ of their body weight, whereas patients in the LIA group lost an average of $5.9 \pm 10.0\%$. After two years of aerobic training, seven individuals sustained a $20.1 \pm 9.3\%$ reduction in body weight. An open-label, randomized, controlled, multicenter 52-week experiment is ongoing in the United States to aid in obtaining FDA permission for the device. This device could be suitable for treating persons with super-obesity because of its putative mechanism of action and the probability of long-term weight loss.³²

DISCUSSION

From above data, it is justified that minimal invasive surgeries and treatments for obesity, such as bariatric surgery, intragastric balloon (IGB) therapy, and endoscopic procedures, offer significant benefits in weight loss and improvement in obesity-related conditions. Surgical options like sleeve gastrectomy, gastric bypass, and adjustable gastric banding are highlighted for their effectiveness in reducing food intake or altering nutrient absorption, thereby facilitating significant weight loss and improving metabolic conditions such as diabetes and hypertension. Non-surgical options like the intragastric balloon show promise for temporary weight loss, emphasizing the importance of lifestyle changes for long-term success. Complications and methodological concerns are acknowledged, including risks associated with specific surgeries and the need for standardized evaluation methods in treatments like IGB therapy. Despite the challenges, these interventions are recognized for their role in reducing obesity's socioeconomic burden, enhancing patients' quality of life, and offering an effective treatment pathway for severe obesity. The importance of comprehensive support, including preoperative preparation and postoperative care, is underscored to ensure successful outcomes and minimize risks.

CONCLUSION

Bariatric surgery is a major advancement in addressing obesity, including laparoscopic techniques such as banding, bypass, and sleeve gastrectomy to promote weight loss and decrease obesity-related health problems. Nevertheless, there are worries over potential consequences and the necessity for comprehensive patient evaluation and assistance programs. Obesity is a persistent health issue that necessitates lifestyle modifications as well as the medical oversight. It underscores the significance of a comprehensive strategy involving surgery, nutrition, psychology, and the physical exercise.

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