

## Effects of Bariatric Surgery on Weight Loss and Quality of Life

Signe Nielsen<sup>\*</sup>, Maria S. Svane, Kirstine N. Bojsen-Møller and Sten Madsbad

Department of Endocrinology, Hvidovre University Hospital, University of Copenhagen, Kettegaard Allé 30, DK-2650 Hvidovre, Denmark

<sup>\*</sup>Corresponding author: Signe Nielsen, Bachelor of Medicine (MB), Department of Endocrinology, Hvidovre University Hospital, University of Copenhagen, Kettegaard Allé 30, DK-2650 Hvidovre, Denmark ; Phone: +45 3862 3032 ; Fax: +45 3862 6974 ; E-mail: [signe.nielsen.04@regionh.dk](mailto:signe.nielsen.04@regionh.dk)

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### Abstract

Bariatric surgery is the most effective treatment for severe obesity. The mean weight loss is approximately 30-40 kg/11-15 BMI units or approximately 60% of excess body weight. Many patients pursue bariatric surgery for improvement in their physical image and self-esteem rather than somatic health improvement. Health-related quality of life improves after bariatric surgery and the long-term improvements are positively associated with the long-term amount of weight reduction. After the major weight loss, excess skin presents problems for the patients and many patients want body contouring by plastic surgery. Plastic surgery adds further improvement in health-related quality of life.

**Conclusion:** Bariatric surgery leads to sustained weight loss and improved health-related quality of life. Plastic surgery has an additional positive effect on quality of life.

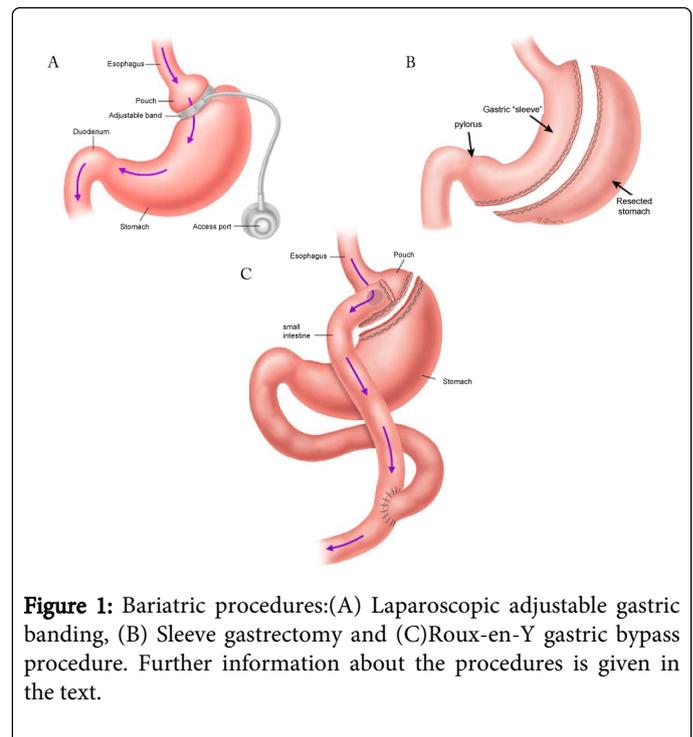
**Keywords:** Bariatric surgery; Weight loss; Health-related quality of life; Plastic surgery

### Introduction

Obesity is a worldwide epidemic and is currently one of the greatest health problems. Obesity is associated with increased risk of serious health consequences as type 2 diabetes, cardiovascular disease, certain cancers and increased mortality [1].

Bariatric surgery – and Roux-en-Y gastric bypass (RYGB) in particular – is superior to both medical therapy and intensive lifestyle interventions with regard to achieve substantial and durable weight loss. The mean weight loss is approximately 30-40 kg/11-15 BMI units or approximately 60% of excess body weight after RYGB [2]. Bariatric surgery is thus the most effective therapy to obtain substantial, long-lasting weight loss and furthermore improvement or remission of obesity related co-morbidities is seen. The beneficial effect of the operations on diabetes, hypertension and hyperlipidaemia is well described in the literature [2,3] and bariatric surgery also reduces the overall mortality compared to non-operated control groups [4,5]. Besides these obvious advantages on physical health, bariatric surgery also influences psychological and health-related quality of life (HRQL). The well-being of the patients and their perceived quality of life postoperatively are important issues when discussing pros and cons of bariatric surgery.

The aim of this review is to provide an update on bariatric surgery and changes in quality of life, focusing especially on the three most common bariatric procedures, RYGB, sleeve gastrectomy (SG) and laparoscopic adjustable gastric banding (LAGB) (Figure 1).



**Figure 1:** Bariatric procedures: (A) Laparoscopic adjustable gastric banding, (B) Sleeve gastrectomy and (C) Roux-en-Y gastric bypass procedure. Further information about the procedures is given in the text.

### Bariatric Surgical Procedures

Bariatric procedures have traditionally been divided into restrictive procedures, including *Laparoscopic adjustable gastric banding (LAGB)*, *Vertical banded gastroplasty (VBG)* and *Sleeve gastrectomy (SG)*, and the so-called “combined restrictive and malabsorptive” procedures involving bypass of segments of the gastrointestinal tract as *Roux-en-Y gastric bypass (RYGB)* and *Biliopancreatic diversion (BPD)* [6]. However, this classification may be outdated as the

mechanisms of actions are more complex and seem to involve neural (LAGB) as well as gut hormone mediated signals (RYGB, SG) to appetite regulating centers of the brain [7]. RYGB is the most commonly performed bariatric procedure worldwide, followed by SG and LAGB, whereas BPD is used less often [8].

*LAGB* is a procedure where a small silicone band is placed around the upper portion of the stomach creating an adjustable and reversible small stomach pouch (30 mL) above the band with a small opening through which food can enter the stomach. The band is lined by an inflatable cuff, which is linked to a subcutaneous abdominal reservoir, allowing adjustment of the pouch outflow by removing or adding saline (Figure 1) [6]. VBG creates a permanently small stomach pouch by using a band and staples. Recent research has indicated that it is distension of the small pouch activating gastric sensory receptors that induce satiety via vagal nerve signaling [7]. Another possible mechanism of action is induction of satiety by direct pressure or contact of the band with the gastric wall [7]. However, altered secretion of anorexigenic hormones do not seem to be involved in appetite regulation after LAGB or VBG [7,9].

*SG* creates a narrow tubular pouch, like the shape of a banana, by removing a large portion (70-80%) of the stomach following the major curve (Figure 1) [6]. Postoperatively, nutrient delivery to the small intestine is accelerated, which is likely to elicit an altered gut hormone response affecting appetite control and insulin release [7]. Exaggerated release of glucagon-like-peptide 1 (GLP-1) as well as other anorexigenic hormones are likely to explain the beneficial effects on weight as well as an early effect of type 2 diabetes [7].

*RYGB* involves creation of a stomach pouch of 30 mL around the oesophagus and division of the small intestine 50-75 cm distal to the ligament of Treitz (Figure 1). The pouch is connected to the distal part of the severed small intestine (the "alimentary limb"). The proximal part of the severed small intestine is reattached about 100 cm below the division (the "secretory limb"). Postoperatively, nutrients bypass the major part of the stomach, the duodenum and the upper part of the jejunum and are mixed with biliary and pancreatic secretions at the site of the entero-entero anastomosis. The weight loss is primarily explained by the postprandial changes in the levels of gut hormones, including GLP-1, gastric inhibitory polypeptide (GIP), Peptide YY (PYY), cholecystokinin (CCK) and ghrelin [6]. Weight loss and remission of type 2 diabetes are slightly superior after RYGB compared to SG in a randomized controlled trial (RCT) at three years follow-up [10]. The marked changes in postprandial hormone responses reported after SG and RYGB lead to a classification of the two procedures as "metabolic surgery".

*BPD with duodenal switch* reduces the stomach to a tubular pouch, similar to SG. The distal part of the small intestine is connected to the pouch bypassing a larger portion of the small intestine than the gastric bypass operation [6]. In contrary to RYGB [11], malabsorption is a significant contributor to the beneficial effect on weight and type 2 diabetes after BPD probably explaining why weight loss is larger and more durable than with the other procedures [12]. However, nutritional deficiencies are also more common after BPD compared to other bariatric procedures [13].

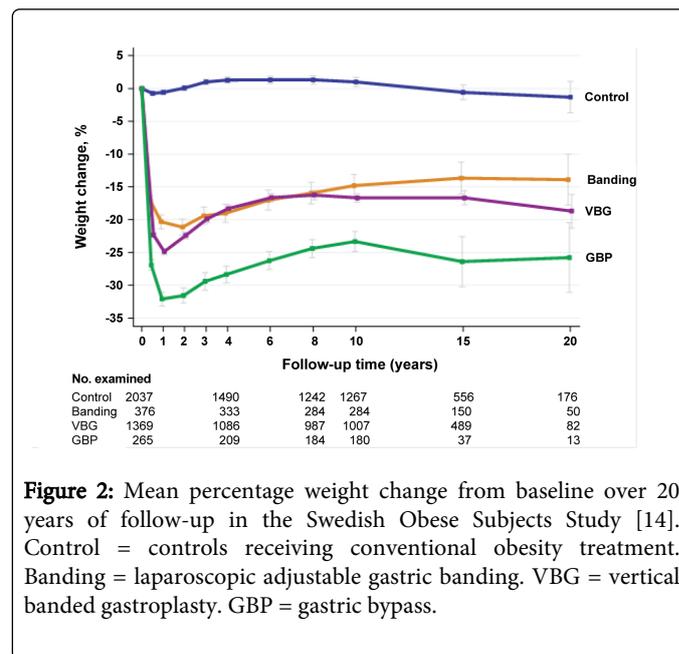
### Weight loss after bariatric surgery

Weight loss in severely obese patients after bariatric procedures is best described by the percentage of excess body weight loss (%EBWL) or BMI loss (%EBMIL) calculated by the formula (preoperative weight

or BMI – postoperative weight or BMI) / (preoperative weight or BMI – ideal body weight or 25) × 100%.

In a meta-analysis by Buchwald et al. %EBWL was greatest in the BPD subgroup (64%), followed by RYGB (60%), VBG (56%) and LAGB (46%) [2]. The weight loss after SG seems to be greater than weight loss after LAGB and VBG but slightly lower than after RYGB [10].

The *Swedish Obese Subject (SOS) Study* is a major prospective, non-randomized intervention study comparing three types of bariatric surgery (n=2010, fixed or adjustable banding (n=376), VBG (n=1369) and RYGB (n=265)) with nonsurgical treated patients undergoing conventional treatment for obesity (n=2037). The weight changes in the surgical subgroups over 20 years were consistent with the results of Buchwald et al. and the nonsurgical treated patients showed the smallest weight changes during the follow-up (Figure 2). The phases of weight changes in the surgical subgroups indicated maximal weight loss after 1-2 years, weight regains in the following years followed by stable weights after 8-10 years (Figure 2) [14]. Approximately 5-10% of patients regain the weight loss after RYGB and even a higher number of patients after LAGB. On average it is expected that 20-25% of the weight lost will be regained over a period of 10 years after bariatric surgery [15].



**Figure 2:** Mean percentage weight change from baseline over 20 years of follow-up in the Swedish Obese Subjects Study [14]. Control = controls receiving conventional obesity treatment. Banding = laparoscopic adjustable gastric banding. VBG = vertical banded gastroplasty. GBP = gastric bypass.

### Risks of Bariatric Surgery

Concerns about the safety of bariatric surgery have grown with its increasing popularity. Perioperative mortality (30 days) is approximately 0.1% for LAGB and VBG and 0.3% after RYGB [16,17]. In general, higher rates of acute and long term complications have been reported among patients undergoing the more invasive procedures (BPD, RYGB and SG) compared to banding procedures [17].

Acute complications after bariatric surgery include bleeding, infections, anastomotic leaks, arrhythmias and pulmonary emboli. Postoperative long-term complications are nutritional deficiencies, internal hernias and anastomotic stenosis. To avoid postoperative

nutritional deficiencies, especially after BPD, RYGB and SG, patients must supplement lifelong with tablets of calcium, D-vitamin, A-vitamin, iron, folate, thiamine and injections of B12-vitamin [18]. Anemia due to iron deficiency is one of the major concerns after BPD and RYGB but may also be seen after SG, especially in premenopausal women [13]. Postoperative monitoring is of major importance as all patients may not respond adequately to tablet supplementation and may require intravenous iron supplementation. Adequate protein intake is emphasized postoperatively, especially after BPD. Ideally 60-120 gram/day or 1 gram/kg is essential for preservation of lean body mass and wound healing. Protein deficiency is most commonly seen one to two years after surgery and is confirmed by a low albumin level [13,18].

After RYGB and to a lesser degree after SG some patients will experience dumping symptoms including abdominal pain/cramping, sweating, tachycardia and diarrhea beginning 30 to 60 minutes after eating. A few patients develop postprandial hypoglycemia due to postprandial hyperinsulinemia accompanying an exaggerated GLP-1 response [18]. Postprandial hypoglycemia is thus not observed after LAGB and VBG.

Although, safety is of major importance when choosing among the different bariatric procedures, it is not the only relevant metric. Effectiveness and durability on weight loss and improvements of comorbidities are critical [16]. Moreover, many obese individuals suffer from impaired HRQL and other forms of psychosocial distress including low self-esteem and may pursue bariatric surgery in order to improve quality of life, physical image and self-esteem [19,20]. Changes in HRQL after bariatric surgery are therefore important to consider.

### HRQL after bariatric surgery

Many studies assessing the effects of bariatric surgery on HRQL suffer from methodological limitations such as small sample sizes, lack of control groups, short-term follow-up and retrospective designs [21–28]. Five RCTs have compared bariatric surgery to other interventions [10,12,29–31] and only two reported HRQL outcomes [10,30]. Recently Schauer et al. reported 3-year outcomes after randomization of 150 obese patients with uncontrolled type 2 diabetes to intensive medical therapy alone or medical therapy plus RYGB or SG. HRQL was significantly improved in the two surgical groups compared to the medical-therapy group [10], supplementary material. RYGB was slightly although not significantly superior to SG in improving HRQL. Furthermore, the greatest weight loss from baseline was reported in the RYGB group [10]. Another study found similar weight loss and improvements in HRQL among patients randomized to either SG or RYGB but did not include a non-surgical control group [32]. O'Brien et al. investigated changes in HRQL in patients randomized to LAGB or intensive lifestyle modifications [30]. After 2-years of follow-up LAGB was superior in reducing weight and improving HRQL. These results are consistent with longitudinal LAGB studies, which however did not include control groups [33–35].

The *SOS-study* evaluated HRQL after 10 years of follow-up in 655 surgically (LAGB (n=161), VBG (n=457) and RYGB (n=37)) versus 621 conventionally treated obese patients [36]. Although not randomized, surgically treated patients were closely matched on 18 parameters (gender, age, weight, height, waist and hip circumferences, systolic blood pressure, serum cholesterol and triglyceride levels, smoking status, diabetes, menopausal status and six psychological parameters) to the obese conventionally treated group and therefore

this study provides the best long-term evidence at present for comparing bariatric surgery with conventional treatment for obesity. The overall changes in HRQL were closely linked to the amount of weight loss. HRQL in the surgical group improved during the first year of weight loss and peaked at 0.5 and 1 year, between years 1 and 6 the weight regain was attended by a decline in HRQL, whereupon the HRQL as well as the weight stabilized from years 6 to 10. Finally, at 10-years follow-up significant weight losses were seen in the surgical groups with no significant weight loss in the control group and the HRQL in the surgical subgroup remained improved compared to baseline [36]. However, because RYGB is the most common bariatric procedure at present, the *SOS* study is limited by the small number of RYGB operated patients [14].

The *Utah Obesity Study* is a prospective cohort study of RYGB patients (n=323) that included two control cohorts: individuals, who sought but did not have RYGB (n=257) and severely obese subjects (n=272) identified from a database [37]. HRQL was estimated at 2 and 6 years of follow-up [38,39]. RYGB operated patients had significantly greater weight loss and improvements in HRQL compared to the two control groups at 2-years follow-up [38]. At 6-years follow up, HRQL deteriorated slightly from the 2-year assessment which potentially could be explained by weight regain. However, HRQL improvements remained significantly larger in RYGB operated patients compared to both control groups [37,39].

Overall, bariatric surgery, RYGB in particular, causes a significant weight loss compared to non-surgical weight loss techniques which result in significant improvements in HRQL postoperatively.

### Plastic surgery and HRQL

Excessive weight loss after bariatric surgery often leads to the perception of excess skin as a negative consequence of surgery motivating patients to seek plastic surgeons for skin removal and body contouring [40,41]. Excess skin is most pronounced in patients with preoperatively morbid obesity and greatest weight loss and with increasing age at the time of surgery. Common problems are abdominal skin folds (hanging abdominal pannus) and skin fold at the buttocks which can lead to discomfort of sitting. Excess skin at upper arms, thighs and the breast area can also cause trouble and skin infections can develop leading to erythema and unpleasant odours. Studies have indicated that 74-85% of RYGB patients want body contouring but that the majority (80%) do not have surgery, often for economically reasons [42,43].

A case-control study measured the impact of plastic surgery on HRQL by firstly comparing HRQL before and after plastic surgery and secondly by comparing HRQL between a subgroup of patients undergoing RYGB followed by plastic surgery and a matched subgroup undergoing RYGB alone [44]. The study confirmed previous findings of improved HRQL after RYGB which was directly related to weight loss. Moreover, the study showed that plastic surgery further improved HRQL in comparison to RYGB alone. Another report, from the same researchers, showed that patients who received plastic surgery after RYGB displayed a better long-term weight control than patients who had RYGB alone despite matching of preoperative BMI, sex and age and BMI and %EBWL at the 2-year follow-up [45]. Another study showed sustained improvements in HRQL up to 7 years after RYGB followed by plastic surgery but did not include control groups [46].

In summary, bariatric surgery followed by plastic surgery seems to improve HRQL to a larger extent than bariatric surgery alone and may also contribute to better weight loss maintenance.

## Comment

Obesity is an increasing cause of morbidity and mortality and at present bariatric surgery is the only intervention demonstrating substantial and sustained weight loss. Safety of the different procedures is an important consideration along with effects on comorbidities to obesity. However, quality of life after bariatric surgery is also an important clinical outcome. Therefore, the aim of this review was to provide an overview of changes in quality of life after different bariatric surgical procedures.

In general, long-term improvements in HRQL are positive associated with the degree of long-term weight reduction. RYGB is superior to the restrictive operations with respect to the amount and durability of weight loss and therefore long-term improvements in HRQL seem to be more favorable after gastric bypass. This is supported by an observational cohort study including 2949 SG patients and equal numbers of RYGB and LAGB patients. By comparing HRQL after SG, RYGB and LAGB, they found better HRQL after RYGB and SG than after LAGB [47]. However, a prospective randomized trial comparing RYGB with LAGB demonstrated that postoperative improvements in HRQL were larger in the RYGB group than in the LAGB group at 1-month follow-up but 1 year after surgery the HRQL did not differ between the two procedures [48]. Other non-randomized studies comparing LAGB and RYGB reached similar conclusions [22,49,50].

In conclusion, bariatric surgery is superior to other interventions in achieving long-term sustained weight loss in morbidly obese patients leading to improvements of obesity-related comorbidities as well as marked improvements in HRQL. Changes in HRQL are closely related to weight loss and weight regain. Furthermore, plastic surgery has additional beneficial effects on HRQL and should be considered as a postoperative support to stabilize the long-term success of bariatric surgery.

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