



## Review Article

# Positive correlation of different bariatric surgery techniques with low back pain

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## Abstract

Low back pain is considered a universal and frequent health problem that is closely and causally associated with obesity, a modern era epidemic. The increased mechanical load placed on the spine, the systemic chronic inflammation or the metabolic syndrome are some of the causes of low back pain detected in obese patients that are directly linked to obesity. The aim of this article is to present a mini review of the existing literature regarding the relation between low back pain and different bariatric surgeries which have been shown to be valid methods of weight loss. Several studies in last decade have advocated that weight loss resulting from bariatric surgeries is associated with a lessening in impairment and intensity of low back pain. The need for further systematic reviews and prospective trials is evident in order to support the claims that bariatric surgeries may prove beneficial to low back pain.

**Keywords:** Low back pain, Bariatric surgery, Obesity, Weight loss

## Introduction

Obesity is defined as an atypical or disproportionate amassing of fat in the body to level that may have adverse health effects leading to a reduction in life expectancy and an increase in health problems<sup>1</sup>.

Obesity is considered one of the most important public health issues. According to the World Health Organization (WHO), global prevalence of obesity has tripled since 1975<sup>1</sup>. In 1997, obesity was officially recognized by WHO as a global epidemic. It is estimated that 3.4 million adult deaths per year are due to obesity<sup>2</sup>.

In 2016, the number of overweight adults exceeded 1.9 billion people (in total, 39% of all adults over 18, 38% of men and 40% of women) with over 650 million of them obese (11% of men and 15% of women), while 41 million children under 5 were in the overweight or even obese range<sup>1</sup>.

The widespread presence of obesity in the United States increased in late 20th and early 21<sup>st</sup> century. Recent research shows that nearly 17% of children and adolescents were obese in the 2009-2010 period while 35.7% of adults were obese also<sup>3</sup>. Within 11 years, from 1999-2010, the percentages of obese men reached the percentages of women. In general, adults over the age of 60 were more likely to be obese than younger adults, and the prevalence of obesity in the over 18 age group showed no significant

variances. In women, however, the prevalence of obesity in the over 60 age group was significantly higher (42.3%) in comparison to younger age groups (31.9% in the 20-39 year olds)<sup>4</sup>.

## Method

A review of the existing literature on the issue of bariatric surgery and patients suffering from low back pain was carried out in various electronic databases (Medline/ PubMed, Google Scholar) with the use of the key words: low back pain, bariatric surgery, obesity, weight loss. Data reflecting encouraging a relation between low back pain, obesity and bariatric surgery were gathered from online publications, articles, studies, meta-analyses, prospective assessments and reviews internationally. The articles reviewed were from

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1989 to 2018 and were all in the English language. Of the 118 references identified in total in our search, 52 met our main inclusion criteria which were the positive correlation of bariatric surgeries with obesity comorbidities and, more narrowly, low back pain. Exclusion criteria were the undetermined and negative results in regard to the relation between bariatric surgery and low back pain.

## Results

### *Links between obesity and low back pain*

Obesity is defined as the excess percentage of fat tissue in the body, and in particular an excess weight of 20% of the ideal or a Body Mass Index (BMI) that equals or exceeds 35<sup>1</sup>. Body Mass Index (BMI) is defined as the quotient of weight division in kilograms by height in square meters and is expressed in kilograms per meter in the square<sup>1</sup>. It is worth noting that life expectancy of the obese patients is 20 years less than the non-obese individuals of the same age. Patients with BMI>50 are characterized as morbidly obese<sup>3,4</sup> and require a more aggressive treatment approach.

Obese and morbidly obese patients, apart from facing stigma and discrimination, run a high risk of adverse health conditions, such as cardiovascular disease, diabetes, certain forms of cancers and musculoskeletal disorders, with low back pain featuring prevalent in the latter category<sup>2</sup>. Excess weight, a sedentary lifestyle and lack of fitness feature among the most common risk factors for low back pain, along with age, occupational risk factors, genetics, pregnancy and mental health factors<sup>5</sup>.

Several possible mechanisms may be the culprit for the close connection between obesity and low back pain, such as the increase in the mechanical load placed on the spine<sup>6</sup>, the systemic chronic inflammation due to the increased secretion of cytokines and concentration of acute phase reactants with the activation of inflammation signaling pathways<sup>7</sup>, abdominal obesity<sup>8</sup>, the metabolic syndrome<sup>9,10</sup>, disc degeneration<sup>11</sup> and vertebral endplate changes<sup>12</sup>.

### *Obesity treatment interventions*

The treatment of obesity is distinguished in conservative and surgical. For pathogenic obesity, surgical treatment is considered very effective, while for obese patients with BMI <30, conservative treatment is generally recommended. The main reason for surgical treatment is the inability to maintain the weight loss with conservative methods. Because weight loss at 10-30% of the original weight maintained in the long term leads to improvement or cure of the obese patients, surgical treatment appears to be an effective solution to the problem. In order to drive an obese patient into the surgery, there must be specific, reliable, and bibliographically acceptable criteria.

#### Surgical interventions

The surgical interventions are divided into 4 categories<sup>13-16</sup>.

1. Restrictive procedures
  - Gastric balloon
  - Vertical partitioning
  - Gastric ring
  - Sleeve gastrectomy
2. Incorporation of malabsorption
  - Enterectomy
  - Intestinal bypass
3. Mixed-type interventions
  - Gastric bypass
  - Holopagaric bypass
4. Interventions modifying gastric motility
  - Gastric pacemaker

#### Efficacy of obesity treatment interventions

The gastric balloon effectiveness did not meet expectations. Over 60% of patients who remove the balloon will recover the lost weight in a short time. It deflates 3% by itself. Today the only indication of balloon placement is considered to be short-term weight loss in preparation for a more effective bariatric surgery<sup>17</sup>.

Patients undergoing vertical partitioning intervention report an 80% failure to lose weight after 10 years of follow-up. A percentage of 18-20% of patients recur in surgery due to stenosis of the gastrointestinal tract or severe gastroesophageal reflux. Mortality is low and ranges from 0.5-1%<sup>18</sup>. Early morbidity (30 first postoperative days) is less than 10%.

The philosophy of the gastric ring is based on the same principles as compartmentalization. Today it considered the routine laparoscopic bariatric surgery in Europe. Major clinical studies in the United States and Australia agree that average weight loss amounts to 30-40% of overweight.

The gastric sleeve is a method that lately gains ground because it is performed relatively simply laparoscopically. The mortality of the method is 0.3%, while the morbidity is 25.7%. Because the method is relatively recent, there are no conclusive conclusions justifying the enthusiasm of those using it.

We will examine the unsatisfactory and mixed-type interventions unified. These include gastric bypass against Roux en Y, cholecogranial deflection with suboptimal gastrectomy and ileogastric anastomosis<sup>19</sup>, cholecogranial aberrant gastrectomy and duodenal switch<sup>20,21</sup>, and various variants of the gastric bypass Roux en Y<sup>22</sup>.

Roux en Y gastric bypass is nowadays the prevalent bariatric surgery due to its very good results in weight loss<sup>23</sup>. In the 10-year follow-up, most patients maintain a loss of at least 50% of the surplus weight. It is the most commonly performed bariatric surgery (it accounts for 65% of bariatric surgery worldwide). More than 50% of the surgeries are performed laparoscopically. It is clear that the great advantage of the method is that it can be applied both to obese and over-obese patients since overweight loss is greater than after limiting operations<sup>24</sup>.

With cholecranial aberrations the results are very good

and there is a reported loss of 70% of the excess weight after 20 years of follow-up. Mortality is at 1% while morbidity is at 15% and patients should take lifelong dietary supplements.

Based on experimental data, it was decided that a pacemaker similar to the one used in the heart could be used to cause anti-wrist waves in the stomach and result in delayed stomach emptying. The pacemaker electrode is laparoscopically placed in the submucosa while the pacemaker is placed subcutaneously. The clinical results of the gastric pacemaker were disappointing. There was a weight loss as low as 25% of the excess weight, so it was not widely accepted.

All the interventions described above are now performed laparoscopically. The contribution of laparoscopic surgery is considered positive since it provides comparable results with open surgery, and because it dramatically reduces postoperative recovery time and minimizes postoperative complications<sup>25</sup>.

The main success criteria for surgical treatment are considered the following:

1. Satisfactory weight loss.
2. Maintaining this loss for a long time.
3. Improving the comorbidities of obesity.

The most important studies set the success limit of interventions as the loss of 25% of the initial or 50% of the excess weight and its maintenance in the long run.

It is believed that the main goal is the treatment of concomitant obesity diseases. There is data to support the claim that bariatric procedures improve or even cure type 2 diabetes mellitus, arterial hypertension, sleep apnea, and contribute decisively to the correction of menstrual disorders, infertility, and musculoskeletal disorders. According to the international literature, morbidity varies between 5-10% (in the first 30 postoperative days), mortality rate is 0.1-1.1% while the metabolic complications are 5-30%. Weight loss after bariatric surgery ranges from 40-85% for the first 5 years and from 20-70% for the next 5 years<sup>26,27</sup>.

### **Low back pain and obesity**

Risk factors, causes, prevention and recovery

Low back pain (LBP) is considered a routine health issue. It is consistent with spinal and paraspinal symptoms in the lumbosacral region. The diagnosis is often hindered by the different forms the problem presents itself, the different etiologies, the absence of a dependable diagnostic test, as well as the manifold nature of neuropathic pain<sup>28,29</sup> resulting in the exacerbation of the symptoms and the requirement of various treatments. Even though LBP is not considered a deadly disease as such, it is one of the most common reasons for sick absence and work disability<sup>30-32</sup>.

Amongst the prevalent risk factors for LBP feature psychosocial distress and smoking<sup>33,34</sup>. Obesity, more narrowly, has been shown to relate LBP and general musculoskeletal pain<sup>33,35,36</sup>. Most of the studies however try

to establish a link between obesity and low back pain instead of investigating the physiological causality<sup>37</sup>. According to hypotheses made in studies, the surplus adipose tissue in obese patients applies further mechanical pressure or increased shear on load bearing joints, like the lumbar spine structures<sup>38</sup>. Additionally, obesity is closely associated with LBP through systemic chronic inflammation, since it is associated with the increased production of cytokines and acute-phase reactants as well as the activation of pro-inflammatory pathways<sup>7</sup>. Abdominal obesity has also been connected with LBP in several studies<sup>8</sup>. Other studies claim that the metabolic syndrome may also be a cause of LBP, due to the fact that its components, hypertension and dyslipidemia, have been linked to LBP<sup>9</sup>. Dyslipidemia is also considered a factor in the development of atherosclerosis in obese people, leading to the malnutrition of the disc cells and predisposing disc degeneration, which in turn increases the possibility of LBP occurrence<sup>39</sup>.

In the field of prevention of LBP with weight reduction due to lifestyle modification, data is scarce and general conclusions cannot be deduced<sup>33</sup>. However, there are findings to support the claim that a reduction of the level of systemic inflammation by means of physical exercise, dieting and ultimately weight loss can help obese patients manage their LBP<sup>37</sup>. Specifically, the reduction of the levels of systemic inflammation leads to a decrease of the inflammatory insult on neurons and improves pain thresholds and pain regulation, thus enabling better responses to mechanical strain or stimuli<sup>37</sup>.

Last but not least, in the field of recovery from LBP in obese patients, bariatric surgery seems to show promising preliminary evidence of alleviation of LBP symptoms<sup>37,40,42</sup>. Furthermore, weight loss surgeries have been shown to help in the alleviation of the symptoms of or in the recovery from various comorbidities of obesity such as diabetes, hyperlipidemia, hypertension, gastroesophageal reflux disease (GERD), and nonalcoholic hepatic steatosis<sup>41</sup>.

Positive changes in low back pain after bariatric surgery interventions

*Vertical gastropasty (VGB).* There have been various studies exploring the connection between weight loss following VGB and LBP, even though in the past decade VGB has been replaced by other surgeries with better weight loss results. Since 1990, McGoey et al., examined several cases where 105 obese Canadian patients with a mean preoperative weight of 125 kg had VGB and in 88% of the cases the patients reported chronic musculoskeletal pain, severe enough to interfere with everyday activities<sup>40</sup>. Orthopedic surgeons used detailed standardized questionnaires and radiographic examinations prior to the surgery to study the problematic areas where the patients reported feeling pain. According to the results, the areas reported were in the low back (62%), in the hips (11%), in the knees (57%), in the ankles (34%) and in the feet (21%). After the surgery and an average weight loss of 44 kg, the vast majority of the

patients (89%) reported complete relief of pain in one or more symptomatic joints.

Later studies confirmed the results of this study. In the 2003 study of Melissas et al., 50 morbidly obese Greek patients, candidates for VGB and 50 non-obese controls, with minor benign conditions were examined with the use of questionnaires for symptoms of LBP. LBP was reported in 29 of the morbidly obese patients (58%) and in 12 of the control patients (24%). In 24 month follow-ups, and after significant weight loss, 10 patients reported continuing symptoms of LBP but they were occasional and manageable with reduced medication. Their conclusion was that weight loss is a significant factor in the alleviation or even disappearance of the symptoms of LBP<sup>42</sup>.

In another study by Melissas et al. in 2005, 29 obese patients with symptoms of LBP were examined. In an effort to estimate the exact levels of disability induced by obesity and the extent of improvement of LBP after VGB, they concluded that following VGB, weight loss helps improve LBP and functional disability scores in general<sup>43</sup>.

*Adjustable gastric band (AGB).* AGB has also been the focus of many studies in the effort to establish a relationship between weight loss and improvement of LBP. In the 2005 study by Ahroni et al., prospective data was collected from 195 obese patients undergoing laparoscopic AGB (LAGB). According to the results collected in a one year follow-up to measure the overall quality of life improvement, a statistically important relationship between back/joint pain and weight loss emerged, with 80.8% of the patients who had reported pain in these areas preoperatively, reporting pain relief postoperatively, and 65.2 of the patients who had stated taking medication for joint/back pain preoperatively stating the reduction or stopping the medication in the one year follow up<sup>44</sup>.

Furthermore, in the 2001 study by Dixon et al., they examined the LAGB results in 459 severely obese patients in Australia during annual reviews over a period of 4 years. According to the results, the average reduction in BMI was from 45.0 to 35.1. In the study, 47.5% of the patients reported symptoms of low back pain (54%) or pain in the low extremities (45%) preoperatively. In the one year follow-up, these patients reported pain alleviation or relief and better overall results in relation to the quality of life, even though the extend of weight loss was not considered a factor corresponding to better results in the overall quality of life improvement<sup>45</sup>.

*Roux-en-Y gastric bypass (RYGB).* Various studies have looked into the relationship between RYGB and LBP. In the 2007 retrospective study by Peluso and Vanek, the results of RYGB were investigated in relation to obesity comorbidities, including LBP, in 400 patients. According to the study, 260 patients had reported LBP preoperatively and 195 of them reported symptom relief or alleviation of the symptoms in the period from 3months to 2.5 years after surgery<sup>46</sup>.

The 2009 prospective longitudinal study by Khoueir et al.

assessed the changes in axial low back pain symptoms after weight loss following RYGB. The patient sample included 58 consecutive patients with a BMI>40. Of the 38 patients who completed the study (65%), and with a mean reduction in BMI of 26.9% within 12 months postoperatively, 44% of the patients reported a decrease in axial back pain on the VAS scale in the postoperative 12 month follow up, leading the researchers to the conclusion that significant weight reduction can possibly be linked with amelioration of chronic back pain when followed up early<sup>47</sup>.

These findings were further supported in the 2010 study of Josbeno et al., where 20 obese patients undergoing RYGB were examined three months postoperatively for improvement in the physical activity and physical function as well as pain relief results after a substantial reduction in the mean BMI. Overall, the RYGB helped improve the self-reported LBP in 17 of the 20 patients in the 3 month follow up<sup>48</sup>.

Furthermore, in the 2001 study by Schoepel et al., 168 morbidly obese patients with average preoperative weight of 141 kg were examined after a period of 2 years following RYGB and a mean weight loss of 55%. Approximately 111 patients with reported LBP problems amongst other comorbidities stated there was significant improvement in the follow-up<sup>49</sup>.

Finally, according to the findings of the 2007 study by Hooper et al., of the 48 morbidly obese patients (mean BMI  $51 \pm 8$  Kg/m<sup>2</sup>) examined in 6 and 12 month follow-ups after RYGB and after an average weight loss of  $41 \pm 15$  kg/m<sup>2</sup>, 45 patients reported improvement in the LBP<sup>50</sup>.

*Laparoscopic sleeve gastrectomy (LSG).* Finally, a number of studies have looked into the relationship between LSG and improvement in LBP after weight loss. In the 2006 study by Cottam et al., 126 obese patients underwent LSG as a first step in the weight loss procedure before undergoing laparoscopic RYGB. Their average BMI was  $65.3 \pm 0.8$  preoperatively and  $49.1 \pm 1.3$  postoperatively, and their mean weight loss was 43.5 kg. In the one year follow-up, approximately 10% of the patients reported improvement in their preoperative co-morbidities, including LBP<sup>51</sup>.

According to the 2015 study by Çakir et al., pain in the areas of the head, neck, shoulder, lumbar spine and knees is significantly relieved after weight reduction achieved via LSG. In the study, 39 morbidly obese patients with a mean body weight of 127.3 kg preoperatively and 91.21 kg postoperatively were examined six months after surgery and the results showed a significant relief of pain after the surgery in all areas, including LBP. Furthermore, the patients reported improvement in mobility, sport and work related activities, as well as reduced use of pain relief medication<sup>52</sup>.

To summarise, the gastric bypass surgery seems to present high risk factors but proves most beneficial in terms of LBP, the gastric banding seems to present the lowest risk but proves the least effective, whereas vertical gastroplasty and sleeve gastrectomy seem to occupy the in-between positions in terms of effectiveness.

## Conclusions

The majority of research studies discussed in this paper have reached the conclusion that weight loss as a result of bariatric surgery shares strong links with the improvement or, in some cases, total relief from the severe symptoms and disabilities relating to LBP. A very interesting area of research in the future could focus on the examination of the risk factors associated with bariatric surgeries and especially the relief of LBP. Other research questions for investigation could be the amount of weight loss that can be associated with LBP reduction and its extent, whether a BMI target for obese patients could be set before trying to improve LBP, and finally whether LBP relief can safely be linked with other areas of investigation, apart from weight loss, for example the alleviation of other symptomatic joint pains. Orthopaedic surgeons, and surgeons in general can both benefit from the multidisciplinary use of the documentation of surgical interventions and their link in the treatment of LBP and other common pains as this will lead to the incorporation of the understanding of the physical function and quality of life results. The minimization of pain assessment fluctuations by the use of standardized surveys and tests relating to pain, joint pain-inducing activities and clinical trials can lead to higher quality data collection and study comparison. Developing this exciting research area will perform an important role in the development of detailed data that can be used for setting expectations for obese patients suffering from low back pain.

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