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Bariatric Surgery Significantly Improves Body Proportion

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ABSTRACT

Background: It is well known that bariatric surgery provides excellent weight loss and resolution of comorbid conditions. We propose an additional benefit: Because body proportion is an independent predictor of diabetes and cardiovascular risk, we hypothesize that bariatric surgery results in improved body proportion and may thus improve health risk independent of overall weight loss and resolution of comorbid conditions.

Methods: A total of 168 patients underwent laparoscopic bariatric surgery at our institution from December 2006 to September 2009. Prospective data gathered preoperatively and at 3, 6, and 12 months postoperatively included body mass index (BMI); excess weight loss (EWL); waist-hip ratio (WHR); and discontinuation of hypertensive, hyperlipidemic, and diabetic medications.

Results: Of the 168 patients, 122 underwent Roux-en-Y gastric bypass, 40 gastric band, and 6 gastric sleeve procedures. Mean preoperative BMI was 48.6 kg/m^2 (SD = 7.8 kg/m^2). Mean EWL was 33.7 lbs (SD = 11.9 lbs) at 3 months, 46.35 lbs (SD = 15.58 lbs) at 6 months, and 52.48 lbs (SD = 24.19 lbs) at 1 year. Mean WHR was 0.91 (SD = 0.1) preoperatively, 0.87 (SD = 0.1) at 3 months ($P < .0001$), 0.87 (SD = 0.09) at 6 months ($P < .0001$), and 0.86 (SD = 0.1) at 1 year ($P = .0006$). At 1-year follow-up, 52% of patients had discontinued hypertensive medications, 64% had discontinued diabetic medications, and 56% had discontinued hyperlipidemic medications.

Conclusions: Along with well-known improvements in overall weight and comorbid conditions, bariatric surgery significantly improves body proportion, which may decrease health risk. Continued follow-up will determine if this change is long term or if patients will revert to preoperative WHRs. Future studies with sufficient power to study individual bariatric procedures will determine which procedures, if any, provide patients with the greatest improvement in WHR and if inferior WHR results are associated with cardiovascular events.

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INTRODUCTION

Bariatric surgery provides excellent weight loss and resolution of comorbid conditions. We propose an additional benefit of bariatric surgery. Body proportion—described in terms of android (apple) and gynoid (pear) shapes—is measured in terms of waist circumference or waist-hip ratio (WHR). WHR greater than 0.9 in males and greater than 0.85 in females defines the less-favorable apple body shape. WHR less than 0.9 in males and less than 0.85 in females defines the more favorable pear body shape. It is thought that increased WHR indicates a preponderance of visceral, ie metabolically harmful, fat.

Body proportion is increasingly recognized as an independent predictor of diabetes and cardiovascular risk. Numerous studies have shown that increased WHR is associated with an increased risk of coronary heart disease, diabetes, and myocardial infarction.[1–3] In fact, because WHR greater than 0.9 for men and 0.85 for women has been associated with adverse cardiovascular risk profiles, the World Health Organization and European Group for the Study of Insulin Resistance adopted these cut-off points to define central obesity in the diagnosis of metabolic syndrome.[4] We suggest that bariatric surgery results in improved body proportion and may thus improve health risk independent of well-established improvements in overall weight loss and resolution of comorbid conditions.

METHODS

We studied 168 patients who underwent laparoscopic bariatric surgery at our institution from December 2006 to September 2009. Institutional Review Board approval was obtained. Prospective data gathered preoperatively and at 3, 6, and 12 months postoperatively included body mass index (BMI); excess weight loss (EWL); WHR; and discontinuation of hypertensive, hyperlipidemic, and diabetic medications. The same nutritionist measured WHR for all patients.

RESULTS

Surgeons at our institution performed 122 Roux-en-Y gastric bypass, 40 gastric band, and 6 gastric sleeve surgeries on 116 females and 52 males. Mean preoperative BMI was 48.6 kg/m^2 (SD = 7.8). Mean EWL was 33.7 lbs (SD = 11.9) at 3 months, 46.35 lbs (SD = 15.58) at 6 months, and 52.48 lbs (SD = 24.19) at 1 year.

Mean WHR was 0.91 (SD = 0.1) preoperatively, 0.87 (SD = 0.1) at 3 months ($P < .0001$), 0.87 (SD = 0.09) at 6 months ($P < .0001$), and 0.86 (SD = 0.1) at 1 year ($P = .0006$) (Table). For females, mean WHR was 0.86 preoperatively, 0.83 at 3 months, 0.82 at 6 months, and 0.80 at 1 year. For males, mean WHR was 1.00 preoperatively, 0.98 at 3 months, 0.94 at 6 months, and 0.96 at 1 year. Thus, the female patients successfully attained a pear, or gynoid, body shape.

Improvement in WHR was more durable in patients undergoing the gastric bypass and gastric sleeve compared to patients undergoing the gastric band. See the table for mean WHR for all 3 procedures preoperatively and at 3, 6, and 12 months follow-up. Gastric bands appeared to produce initial dramatic improvements in WHR, but this improvement was of a more temporary nature.

At 1-year follow-up, 52% of patients had discontinued hypertensive medications, 64% had discontinued diabetic medications, and 56% had discontinued hyperlipidemic medications.

DISCUSSION

More important than overall obesity is the distribution of adipose tissue on the body. Individuals with fat stored preferentially at the waist have a higher risk of diabetes and cardiovascular disease than individuals with fat stored preferentially at the hips. This difference in body proportion can be measured as WHR, which numerous studies have found superior to measurements of overall obesity, namely BMI, in assessing disease risk. The European Prospective Investigation into Cancer and Nutrition in Norfolk trial reported that increased WHR was associated with increased risk of coronary heart disease.[1] In 2005, Wang et al[2] concluded that abdominal adiposity—measured as WHR—is a strong risk factor for type 2 diabetes independent of overall obesity, as assessed by BMI. The landmark INTERHEART study showed that WHR was closely associated with the risk of myocardial infarction and was a substantially better predictor than BMI.[3] Thus, increased abdominal adiposity, evidenced by higher WHR, leads to increased cardiovascular risk. The mechanism is not fully understood, but the prevailing theory is that higher abdominal adiposity indicates a preponderance of visceral fat. This visceral fat produces metabolic disturbances that ultimately lead to insulin resistance and hypertriglyceridemia.

Studies using magnetic resonance imaging and computed tomography have in general shown that excess visceral fat, rather than subcutaneous fat, correlates with metabolic abnormalities seen in obese patients.[5] Individuals matched for subcutaneous abdominal adiposity but with differing levels of visceral adipose tissue have markedly different levels of insulin resistance and glucose tolerance. On the other hand, individuals matched for visceral adiposity but with differing levels of subcutaneous fat did not demonstrate differences in insulin sensitivity.

Research about metabolic syndrome has helped explain the relationship between visceral adiposity and diabetes and cardiovascular disease. It is likely that a combination of three mechanisms is involved.[5] First, the hyperlipolytic omental adipose tissue exposes the liver, via portal circulation, to high levels of free fatty acids. This activity impairs hepatic metabolic processes and leads to hyperinsulinemia, glucose intolerance, and hypertriglyceridemia. Second, the adipose tissue acts as an endocrine organ and secretes adipokines and inflammatory cytokines such as interleukin-6 and tumor necrosis factor-alpha. This process contributes to an insulin-resistant, proinflammatory, prothrombotic, prohypertensive state. Third, visceral adiposity may simply be a marker of hypertrophied or dysfunctional subcutaneous adipose tissue that has lost its ability to store energy surplus, eg dietary triglycerides. As a result, fat is deposited in

Table. Waist-Hip Ratio Following Bariatric Surgery

	Preoperative	3 months	6 months	1 year
All patients (n = 168)	0.91	0.87	0.87	0.86
Female (n = 116)	0.86	0.83	0.82	0.80
Male (n = 52)	1.00	0.98	0.94	0.96
Gastric bypass (n = 122)	0.91	0.87	0.86	0.83
Gastric sleeve (n = 6)	0.96	0.93	0.92	0.90
Gastric band (n = 40)	0.91	0.85	0.88	0.89

undesirable sites such as the liver, heart, skeletal muscle, and pancreas.

Measurements of abdominal obesity, namely WHR, are important for monitoring risk factor modification in patients. Therefore, it is important to determine not only whether patients lose weight after bariatric surgery but also if their body proportion changes as well. We believe that by decreasing the relative amount of visceral fat in patients, bariatric surgery attenuates the metabolic derangements that visceral fat produces. This decrease in visceral fat is demonstrated by decreased WHR and translates into a decreased risk of diabetes and cardiovascular disease. Our study group demonstrated improvements in all aspects of metabolic syndrome: obesity, insulin resistance dyslipidemia, and hypertension[4] as shown by significantly decreased WHRs and a majority of patients able to discontinue diabetic, hyperlipidemic, and hypertensive medications. The greatest improvement was seen in female patients, who within 1 year of bariatric surgery had reached pear, or gynoid, body shape.

In 2007, de Koning et al[6] showed that for a 0.01 U increase in WHR, the relative risk of a cardiovascular disease event (stroke or coronary heart disease) increased by 5%. Our results show that bariatric surgery results in significantly improved WHR, thus improving the patient's body proportion. This improvement may translate to decreased cardiovascular risk independent of other established factors. Our cohort had a 0.05 U decrease in WHR at 1 year. If the findings of de Koning et al are applied, our cohort can expect a 25% decrease in stroke and coronary heart disease risk. Future case-control studies may confirm this theory.

CONCLUSIONS

Along with well-known improvements in overall weight and comorbid conditions, bariatric surgery results in significantly improved body proportion, which may decrease health risk. Continued follow-up will determine if this change is long term or if patients will revert to their preoperative WHRs. Future studies with sufficient power to study individual bariatric procedures will determine which procedures, if any, provide patients the greatest improvement in WHR and if inferior WHR results are associated with cardiovascular events.

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