

Bariatric Surgery in Adolescence. Is this the Best Age to Operate?

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Background: Bariatric surgery in morbidly obese adolescents is controversial. Many argue that morbidly obese individuals should be of adult age before undergoing bariatric operations, despite the progressive and debilitating course of this increasingly common disease.

Materials and Methods: 19 consecutive adolescent patients, aged 13-17, underwent vertical banded gastroplasty-Roux-en-Y gastric bypass between May 1990 and August 2001. Average BMI was 49 kg/m², range 38-67. All had one or more co-morbidities. Follow-up was obtained up to 10 years.

Results: Postoperative BMI at the maximum time of follow-up, mean 5.5 years (range 1-10 years), was 28 (range 23 to 45). Only one patient did not lose enough weight and was considered a failure. There were two revisions and no mortality or morbidity. All co-morbidities disappeared. Family and patients were pleased with the surgery.

Conclusions: Early surgical intervention should be offered to a greater number of adolescents to minimize the emotional and physical consequences of morbid obesity.

Key words: Morbid obesity, bariatric surgery, adolescent obesity, vertical banded gastroplasty-gastric bypass, gastric bypass, adolescent bariatric surgery

Introduction

Bariatric surgery for morbidly obese adolescents is controversial. Many argue that morbidly obese individuals should be adult age before undergoing bariatric operations despite the progressive and debilitating course of this increasingly common dis-

ease.¹ Obese adolescents have a much greater chance of maintaining their obese state through adulthood.² While research specific to adolescents with a BMI ≥ 40 has not been conducted, it is theorized that obesity will persist into adulthood in nearly 100% of these extremely obese individuals. The physical consequences of obesity during adolescence are cumulative and progressive. Children and adolescents are known to suffer from hyperinsulinemia, glucose intolerance and diabetes, in addition to hepatic steatosis, gall bladder disease, systolic and diastolic hypertension, serious orthopedic problems, pseudo-tumor cerebri, sleep apnea and dyslipidemias. Severe obesity creates other problems in adolescents that are rarely mentioned, such as hormonal imbalances and dermatological problems. Hormonal imbalances are manifested by hyperandrogenemia.³ The dermatological problems include acanthosis nigricans, intertrigo, recurrent boils and rupture of elastic fibers. The rupture of the elastic fibers in the skin creates stretch marks or striae that persist through life and are intractable.

Perhaps just as devastating as the physical consequences of severe obesity are the social effects. Extremely obese children and adolescents are subjected to continuous teasing, discrimination and humiliation by their peers. They are considered to be the least desirable friends⁴ and are described by their peers as lazy, lying, cheating, sloppy, dirty, ugly and stupid.^{5,6} Often, they are not able to "belong" nor establish normal social contacts. Participation in sports or physical education is difficult or outright impossible. This sense of isolation and rejection in this formative period has lasting repercussions in later life, manifested by profound disturbances in body image.⁷

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Overwhelming evidence demonstrates that non-surgical methods of weight control fail in adolescents suffering from severe clinical obesity.^{8,9} Available studies with hypocaloric diets, very-low calorie regimens, exercise, behavior modification and pharmacological agents have been ineffective. Studies lasting longer than 1 year are few. In one study in which 1,187 subjects were enrolled to evaluate a hypo-caloric diet and Orlistat,¹⁰ 295 withdrew 4 weeks later when only the hypo-caloric diet was used. Of the remaining 892, 668 were chosen to receive Orlistat plus the hypo-caloric diet. Only 306 (46%) completed the study. In this already limited group, participants regained weight after the first year and completed the 2-year study losing an average of 5.56 kg (12.2 lb), insignificant weight loss for a morbidly obese adolescent.

The most successful reported medical regime was by Epstein and collaborators.¹¹ Their study was limited to predominately white and middle class children age 6-12. Despite a moderate degree of obesity, with a mean of 41% excess weight, at 5 and 10 years the most successful group lost 11.2% and 7.5% of their excess weight respectively. The study has importance because of its extended follow-up of 5 and 10 years. These results have not been replicated by others. It has previously been reported that the degree of persistence of obesity is related both to the severity and the age at which the obesity began. The later into adolescence the overweight persists and the more severe the obesity, the greater the likelihood of persistence into adulthood. The degree of persistence has not been analyzed in morbidly obese adolescents. The positive but limited success by surgical standards of Epstein's study could be the result of the group's young age, their moderate degree of obesity, and their limited racial and economic mix.

We will report 19 adolescents (from a total bariatric practice of 1,671 patients) suffering from severe obesity who underwent bariatric surgery. The long-term weight loss in these patients as well as the psychosocial impact on their lives are evaluated.

Materials and Methods

We report on 19 consecutive adolescent patients, ages 13-17, between May 1990 and August 2001,

who underwent a form of gastric bypass, which combines the vertical banded gastroplasty with a Roux-en-Y gastric bypass (VBG-RYGBP). Their average BMI was 49, range 38-67. They had an average weight of 133 kg (293 lb) with a range of 91 to 201 kg (201 to 442 lb). The average weight of 133 kg was only slightly less than the average weight of our adult morbidly obese population (136 kg).

The average height for males and females together was of 163 cm, with a range of 128 to 178 cm. The average height for the male and female patients respectively was of 168 and 160 cm. Since most of the patients were fully-grown at the time of initial visit, no further recording of height was made.

The family history and past history of each patient was explored with a preoperative questionnaire (Table 1). All patients had attempted several weight-reducing regimes that included medically supervised diets, exercise, behavior modification, commercial diets, psychological interventions and pharmacological agents (Table 2). One or several co-

Table 1. Adolescent past history

Morbid obesity in family members	83%
Childhood obesity	88%
Great need for sweets	70%
Moderate need for sweets	29%
Ate much more than average	12%
Ate more than average	76%
Ate less than average	12%
Smoke	15%
Drink alcohol	0%
Never exercised	41%
Exercised sometimes	29%
Exercised frequently	29%

Table 2. Preoperative attempts at weight reduction

Physician, nutritionist supervised diet	22
Psychiatrist, psychologists, Overeaters Anonymous	8
Own diets	7
Gymnasiums, spas, exercise camps	6
Commercial diets	33
Pharmacological agents	5
Total attempts at weight loss	81
Average number of attempts per patient	4.2
Minimum weight loss	4.5 kg (10 lb)
Maximum weight loss	27 kg (60 lb)
Weight regained in average no. of months	2 (range 1-6)

morbidities were present in all patients. There were a total of 36 co-morbidities that ranged from exertional dyspnea to rapidly deteriorating conditions such as pulmonary hypertension and severe obstructive sleep apnea. In two patients suffering from pulmonary hypertension and severe obstructive sleep apnea, their pediatrician on urgent bases requested surgery (Table 3).

The technique of the VBG-RYGBP consists of the creation of a very narrow pouch in the proximal stomach along the lesser curvature. The outlet of the pouch is restricted with a polypropylene mesh band. The pouch is anastomosed to the upper jejunum, bypassing most of the stomach, the duodenum and about 30 cm of upper jejunum. The Roux limb is 100 cm long.

In five cases performed in years 1990-1991, the pouch was stapled in continuity with the excluded stomach with four lines of staples (Figure 1A). In the following two cases operated in 1992-1993, the gastric segments were stapled and completely transected (Figure 1B). In the next 14 cases, in addition to transecting the stomach, a limb of jejunum was interposed between the pouch and excluded stomach (Figure 1C). Until 1994, the gastrojejunostomy was constructed with staples. Since that time, the anastomosis has been hand-sewn with absorbable sutures.

Weight was recorded at yearly intervals, and the percent of excess weight loss (%EWL)* was calculated.¹² A patient was considered lost to follow-up when further weight recordings were no longer pos-

sible. Contact with patients was made through office visits, their personal physicians and by phone or mail. For a successful surgical intervention, the patient was expected to have %EWL $\geq 50\%$.

Extensive interviews were carried out with the patients and at least one of their parents. In these interviews, the operation was explained in detail. The need for ingesting a balanced diet, rich in proteins, was stressed. A hospital dietician also discussed diet requirements with parents and child. The need for supplemental vitamins for life, the proper chewing of food and the ingestion of sufficient low-calorie fluids was reviewed. Except for eating a balanced diet, no restrictions were placed on the amount of food ingested. The dumping phenomena were discussed in detail, and patients were advised to avoid high-calorie foods and fats that may precipitate this unsatisfactory feeling. The benefits of enrolling in a program of regular exercise to preserve lean tissue and improve weight loss were discussed with the patient and family. Likewise, the importance of lifelong follow-up was stressed. If not requested by their health insurance, these youngsters were not sent for psychological counseling. We only recommend psychological consultation when we feel that they could benefit from this type of intervention. Since every member of the study group had been on several diets, no attempts were made to refer them for another diet or behavioral modification.

A written or oral questionnaire was given to patients after at least 3-year follow-up. They were encouraged to candidly express themselves in their own words about the impact of the surgery on their lives. Photographs of all patients were obtained at the time of the preoperative visit and postoperatively at ≥ 1 year after surgery, if there was no objection by the child and family.

Results

There has been no mortality or serious morbidity following these operations. This includes the two revisions done for gastro-gastric fistulas. The revisions were performed at 2 and 6 years after their primary VBG-RYGBP. In both patients, the original surgery was performed during the years 1990 and

Table 3. Preoperative co-morbidities in 19 adolescent patients

Dyslipidemia	3
Sleep apnea	3
Pulmonary hypertension	1
Low back pain and severe arthralgias	9
Hypertension	3
Liver steatosis	4
Peptic esophagitis	3
Cholelithiasis	2
Bronchial asthma	1
Diabetes mellitus, type II	2
Urinary urgency and stress incontinence	3
Dependent edema	2

*[(operative weight - follow-up weight)/operative excess weight] X 100

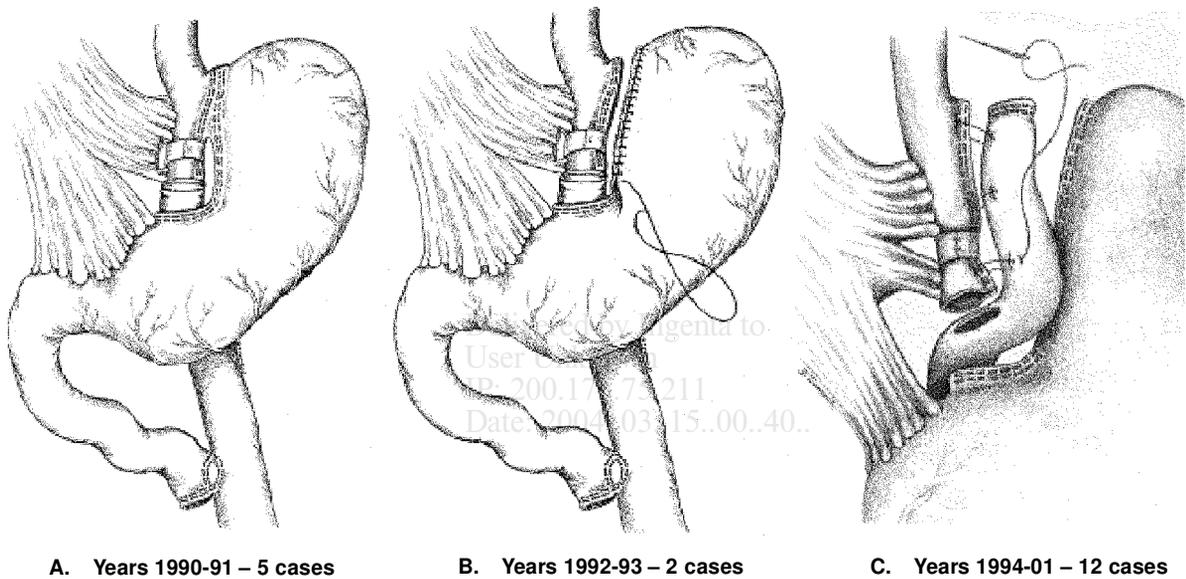


Figure 1. Evolution of vertical-banded gastroplasty-gastric bypass

1991, when both gastric segments were stapled in continuity (Figure 1A).

Two patients underwent cholecystectomy for cholelithiasis at the time of the bariatric operation. A liver biopsy was also performed in one patient. A subsequent cholecystectomy was performed in one patient, and three patients have undergone plastic surgery for excess skin. One patient has had a recurrent marginal ulcer requiring almost continuous treatment with antacids. This patient underwent surgery in 1993 when we were performing stapled gastrojejunostomies. She has tested negative for *H. pylori*. One patient with heavy menstrual periods was diagnosed to have severe hypochromic anemia that was corrected with reduced iron. At least two other patients have reported anemia. All serious comorbidities disappeared early in the weight loss process, including the ones suffered by the patient considered a surgical failure.

Postoperative follow-up was 100% at 3 and 4 years. One patient was lost to follow-up at 5 years and two at 6 years. We lost information on two patients in the 7th year of follow-up. Of the five patients eligible for 10-year follow-up, data was obtained on two (Table 4). Average %EWL at 3, 4, 5, and 6 years was 80%. %EWL for patients who had completed at least 3 years follow-up is depicted in Figure 2. The initial average BMI of our patients was 49 kg/m² (range 38 to 67). The postoperative

BMI at the maximum time of follow-up averaging 5.5 years (range 1-10 years) was 28 (range 23 to 45). One patient was a failure from the surgical point of view. At 4 years, she lost 33 kg (73 lb), but her weight was still 45 kg (100 lb) above ideal. She had %EWL of only 35%. Figure 3 illustrates the preoperative and postoperative BMI of all patients that completed at least 1-year follow-up.

The results of the questionnaire from all patients contacted were overwhelmingly positive.

Discussion

We are pleased with the surgical results of these 19 adolescent patients. Only two patients required reoperations that could be directly related to the bariatric procedure. In both cases, the original procedures were performed early in the evolution of our surgical technique. We were initially unaware that stapling gastric segments together was accompanied by a high incidence of staple-line disruption and the formation of gastro-gastric fistulas. Both patients underwent uneventful revisions. In one patient that regained weight following staple-line failure, significant weight reduction was reinitiated after revision. At least one patient required a subsequent cholecystectomy for cholecystitis and cholelithiasis, a known

Table 4. Weight loss data in 13 adolescents with at least 3 years follow-up

Operation Year	Patient Age	Initial Weight	Weight at follow-up in years								
			3	4	5	6	7	8	9	10	
90	15	109	78(66)	72(78)	78(66)	77(69)					
91	17	125	66(92)	66(92)							
91	15	159		83(79)	102(59)	83(79)	80(82)				
91	16	91	61(77)	59(83)		59(83)					70(53)
91	17	131	76(79)		76(79)						73(83)
92	17	145	68(94)		61(103)		61(103)		91(66)		
93	15	135	78(77)	75(81)	73(81)	70(88)		66(93)			
94	16	108	61(91)	61(91)	61(91)						
94	14	125				72(83)					
98	17	156		123(35)							
98	16	108	64(92)	65(89)							
98	13	122	61(98)	74(78)							
99	15	150	98(69)								
Percentage follow-up			100%	100%	89%	78%	72%	58%	50%	40%	

The last recorded weight represents weight at maximum follow-up. Numbers in parentheses are percentages of excess weight loss.

complication following massive weight loss through any modality.

In the patient suffering from a recurrent marginal ulcer, we feel that this complication could have been avoided with our present level of knowledge. The incidence of marginal ulcers dropped from 6% to 0.6% in our adult population when we started using absorbable sutures instead of staples.¹³ There have been reports of anemia¹⁴ and lack of perseverance in the routine use of supplemental medication by these patients.¹⁵ Our data on the subject is incomplete despite our efforts to contact the patients and their pediatricians. There was evidence of anemia in at

least three of our patients, even though the majority indicated that they were taking supplements. It is possible that this complication could be avoided in the future if the primary physician or pediatrician works more closely with the bariatric surgeon in their follow-up.

Our form of gastric bypass appears particularly well-suited for these patients. The operation combines a strong element of restriction with a mild component of malabsorption. In this operation, a relatively long and very narrow pouch empties directly into the jejunum to create a sensation of

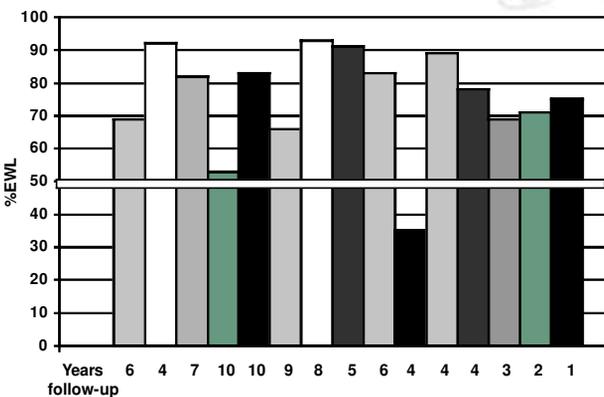


Figure 2. Percent of excess weight loss (%EWL) at maximum follow-up. Surgical failure (<50% excess weight loss) is indicated by horizontal white line.

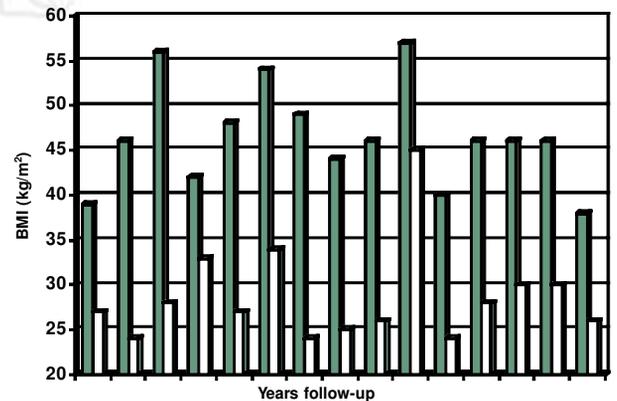


Figure 3. BMI before and after surgery at maximum follow-up time. There are 15 adolescent patients with a follow-up of at least 1 year.

fullness. It protects the adolescent from drinking high-calorie liquids, sweets or fats, a ubiquitous diet in this era of fast foods and carbonated drinks. Their ingestion will bring the unpleasant symptoms of the dumping syndrome. A non-stretchable band controls the outlet of the pouch. The relatively long, narrow pouch and the stable size of the pouch outlet may be the factors that have played a role in the superior weight loss reported here. It is interesting that our only failure lost more weight than the maximum preoperative weight loss obtained in all our patients in their 81 preoperative attempts. Our weight loss in adults was also very successful,¹⁴ but the weight loss in our adolescent population was even more striking. Despite the weight gain seen in some patients at 9 and 10 years follow-up, at that late interval all these patients were successful in losing >50% of their excess weight.

Purely gastric restrictive procedures are probably not indicated in this group of patients because of the poor weight loss results observed in adults.^{16,17} Surgical procedures in which success depends completely on the avoidance of certain foods, like high-calorie liquids or semi-liquids, have even less chance of success in adolescents than in adults. In our preoperative questionnaire, 70% of our patients manifested a strong need for ingesting sweets. Operations such as the biliopancreatic diversion and other malabsorption procedures that are accompanied by an incidence of malnutrition and potential serious deficiencies have not been found to produce superior weight loss.

Most of the co-morbidities disappeared early in the weight loss process; however, in the adolescent population this is only one part of the problem. Despite the seriousness of their co-morbidities, these adolescents are more concerned about their grotesque appearance, their isolation and continuous humiliation. On that basis, we were also pleased with the results of our survey. All patients contacted were extremely satisfied with their operations and indicated that they would do it again. Despite their overall improvement, some manifested dissatisfaction with their excess skin after weight loss and expressed reluctance to expose their bodies. At this particular age when sexuality is important, these deformities are especially a concern. Irreversible changes have already occurred in the bodies of these youngsters that make our early surgical interven-

tion, ironically, somewhat late. Despite the good efforts of multiple plastic surgery procedures to remove excess skin, these young people will be plagued by multiple, long scars and non-treatable stretch marks (Figure 4).

Surgery is indicated in this population because of the dismal failure of the conservative methods of weight control, the permanence of adult obesity following adolescent obesity and the many obesity-disabling and deadly obesity-related co-morbidities of adulthood. The subject becomes even more relevant considering the epidemic proportions of obesity affecting our children and adolescents. Based on our data and the very poor results of non-surgical therapy, bariatric surgery should be considered seriously after conservative methods have failed.

Operating on this young population is a great responsibility, and only very experienced surgeons who have demonstrated a low complication rate in their adult series should perform the surgery. If laparoscopic techniques are to be performed, they should replicate exactly the open operation. There is an urgent need to obtain surgical data in the younger pediatric population, and present available studies are small.^{16,18,19} Obesity should be controlled before serious emotional and physical consequences develop.

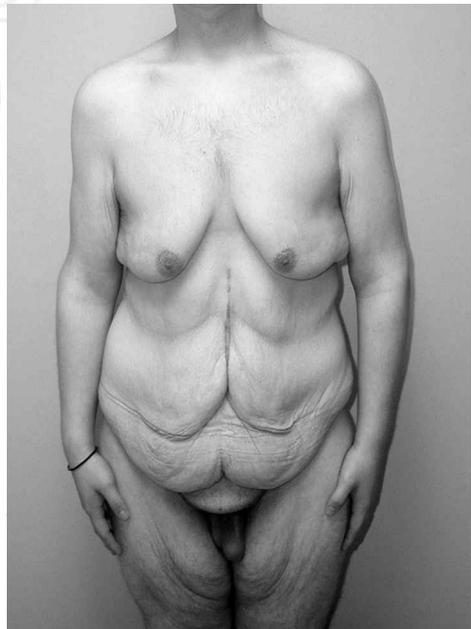


Figure 4. Severe redundancy of skin in a 15-year-old after losing 80 kg.

Conclusion

Morbid obesity in adolescence is a devastating disease that is becoming increasingly common. Surgery appears to be the only effective treatment. Our form of gastric bypass, performed in 19 adolescent patients, had excellent long-term weight loss with no mortality and minimal morbidity. This operation appears to be particularly well-suited to this young population. Submitting these patients to a multitude of ineffective non-surgical weight loss modalities is not indicated, and early surgical treatment should be considered to minimize the serious consequences of extreme obesity.

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