Long biliopancreatic one-anastomosis gastric bypass vs Roux-en-Y gastric bypass in super obese: is there a difference?

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Context
There is a controversy on the optimum limb lengths in Roux-en-Y gastric bypass and one-anastomosis gastric bypass, especially in patients with body mass index (BMI) >50 kg/m^2.
Aims
To study the outcomes of 250-cm biliopancreatic one-anastomosis gastric bypass and 150-cm biliopancreatic Roux-en-Y gastric bypass in patients with;Deg;BM;Deg;I >50 kg/m^2.
Settings and design
This was a retrospective cohort study.
Methods and material
This study included patients with BMI >50 kg/m^2, of whom 49 underwent 250-cm biliopancreatic limb one-anastomosis gastric bypass and 53 patients underwent 150-cm biliopancreatic and 100-cm alimentary limb Roux-en-Y gastric bypass with common limb of 350–400 cm. Weight, BMI, hypertension, HbA1C, hemoglobin, iron, calcium, albumin, vitamin D, and parathormone levels were recorded preoperatively and also at 6, 12, 18, and 24 months postoperatively. Operative time, complications, postoperative percent of total weight loss, and incidence of alkaline reflux were recorded at 6, 12, 18, and 24 months.
Statistical analysis
Mean±SD and range were used for parametric numerical data, whereas frequency and percentage were used to describe nonnumerical data.
Results
One-anastomosis gastric bypass and Roux-en-Y gastric bypass achieved BMI of 29.15 ± 1.9 and 29.16 ± 1.5, respectively, and percent of total weight loss of 46.9 ± 3.096% and 47.5 ± 2.59%, respectively, at 24 months. One-anastomosis gastric bypass had an alkaline reflux of 4.1% at 24 months. One-anastomosis gastric bypass had significantly lower levels of hemoglobin, iron, calcium, and vitamin D with higher levels of parathormone. Differences in albumin levels were nonsignificant.
Conclusions
Long biliopancreatic Roux-en-Y gastric bypass is recommended for patients with BMI >50 kg/m^2, especially with a long total small intestinal length of 600–650 cm with less effect on the nutritional status of the patients and avoiding the incidence of alkaline reflux in comparison with one-anastomosis gastric bypass.

Keywords:
high BMI, long BP OAGB, long BP RYGB, patients with BMI >50, super obesity

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Introduction

The application of the same bariatric procedure yields different outcomes with different patients even if they are of the same body mass index (BMI) range. The causes are multifactorial [1–3]. One of the main factors is the individual differences of intestinal absorptive surface area, that is, the intestinal length [4]. Patients with longer bowel length usually suffer from failure to achieve the ideal BMI and are therefore candidates for redo-operations, especially if preoperative BMI is >50 kg/m^2 [5–9]. Moreover, if patients underwent bypass operations and have short intestinal length, this may cause nutritional deficiencies and increase morbidity. Several studies were conducted to try to formulate a design for the biliopancreatic limb (BPL), alimentary limb (AL), and common limb (CL) in bypass procedures such as Roux-en-Y gastric bypass (RYGB) and one-anastomosis gastric bypass (OAGB) [4,10], but no consensus has been reached to date [11]. The effect of long total intestinal length is more profound as the CL length increases.

The YOMEGA study compared OAGB and RYGB in BMI <40 kg/m^2 with BPL of 200 cm in OAGB and 150-cm AL and 50-cm BPL without mentioning the effect of the CL length in the outcomes [12].

In this retrospective study, we retrospectively compared patients with total small intestinal length of 600–650 cm length (from the duodenojejunal (DJ) junction till the ileocecal junction) who underwent long BPL (250 cm) OAGB vs long BPL (150 cm) with 100-cm AL RYGB and having preoperative BMI >50 kg/m^{2}regarding the postoperative outcomes and effects for up to 2 years.

Participants and methods

This was a retrospective study that included patients with BMI >50 kg/m^2 who underwent long BPL RYGB (150 cm with 100 cm AL) and long BPL OAGB (250 cm) with total small intestinal length of 600–650 cm from July 2017 till June 2019 and completed 6-month interval follow-up till June 2021 after approval by Ain Shams Medical Ethical Committee.

Inclusion criteria included patients between 18 and 60 years who underwent a primary RYGB/OAGB, not suffering from preoperative gastroesophageal reflux disease (GERD) symptoms, fit for surgery, with no past history of abdominal surgeries with BMI >50 kg/m^2.

Exclusion criteria included previous bariatric or abdominal surgeries with resection of small intestine, patients with hiatus hernia or GERD on routine preoperative upper gastrointestinal (GI) endoscopy or with cardiovascular or chest problems or BMI <50 kg/m^{2}or those with total intestinal length of less than 600 cm (to allow at least 350–400 cm CL after bypassing 250 cm).

All patients underwent routine preoperative investigations including routine laboratory investigations, chest X-ray, pulmonary function test, echocardiogram (ECG), echocardiography, and upper GI endoscopy. All patients underwent the OAGB/RYGB laparoscopically with the same team.

OAGB

The gastric pouch was constructed by creating a window in the lesser omentum with ultrasound dissection at the crow's foot and firing a 45-mm cartridge horizontally and 4–5 cartridges vertically guided by a 36-F bougie for pouch calibration. The gastrojejunostomy was constructed at a distance of 250 cm from the DJ junction by a 45-mm cartridge. The enterotomies were then closed using V-lock sutures (V-lock 3/0, Medtronic, Minneapolis, MI, USA). The afferent and efferent loops were then fixed to the remnant stomach and the pylorus, respectively, using nonabsorbable sutures to minimize reflux and facilitate the passage of food.

RYGB

The gastric pouch was constructed by creating a window in the lesser omentum with ultrasound dissection at a distance of 6 cm from the cardia and firing a 45-mm cartridge horizontally and 2 cartridges vertically guided by a 36-F bougie for pouch calibration. The jejunum was then divided at a distance of 150 cm from the DJ junction (long BPL). Gastrojejunostomy was then carried out by firing a 45-mm cartridge. Jejunojejunostomy was done at a distance of 100-cm junction from the gastrojejunostomy using a 60-mm cartridge. The enterotomies were then closed using V-lock sutures (V-lock 3/0, Medtronic). Mesenteric defects were closed.

In both techniques, a minimum of 350–400 cm of small intestine was ensured to be present distally to prevent the incidence of short CL. An 18-F drain was left in the surgical bed.

All patients received postoperative multivitamin supplements with minerals such as calcium (Ca) and iron (Fe).

Data collection

Age, sex, height, weight, BMI, and comorbidities such as diabetes mellitus (DM) (level of HbA1C) and hypertension (HTN) were recorded preoperatively. Levels of hemoglobin (Hb), Fe, Ca, albumin (Alb), vitamin D (vit D), and parathormone (PTH) were recorded preoperatively. The operative time and the incidence of postoperative complications were monitored. For each patient in the two groups, the postoperative weight, BMI, percent of total weight loss (%TWL), incidence of remission in preoperative comorbidities such as HTN (defined by blood pressure <140/90 mm Hg without antihypertensive drugs) and DM (monitored through the change of level of HbA1C with levels below 5.7 gm/dl without insulin or hypoglycemic drugs to be considered as remission), incidence of alkaline reflux (by doing follow-up pH monitoring and levels of pH >7 to be considered as alkaline reflux), and levels of Hb, Fe, Ca, Alb, vit D, and PTH at 6, 12, 18, and 24 months were recorded.

The collected data were revised, coded, tabulated, and introduced to a PC using Statistical package for the Social Sciences (SPSS 26). Data were presented, and suitable analysis was done according to the type of data obtained for each parameter.

Descriptive statistics

(1) Mean, SD, and range were used for parametric numerical data, whereas median and interquartile range were used for nonparametric numerical data.
(2) Frequency and percentage were used for nonnumerical data.

Analytical statistics

(1) Independent *t*-test was used to assess a statistically significant difference between two group means.
(2) Pearson's χ^2 test was used to examine the relationship between two qualitative variables.
(3) Fisher's exact test was used to examine the relationship between two qualitative variables when the expected count is less than 5 in more than 20% of cells.
(4) Repeated measures analysis of variance (ANOVA) was used to assess the statistical significance of the difference between means measured more than twice for the same study group.
(5) Post hoc test was used to detect the statistical significance between each mean pair in the same group.

Results

Of 893 patients who underwent RYGB and OAGB from July 2017 till June 2019, only 49 patients who met the inclusion criteria with BMI >50 kg/m^2 and underwent OAGB and 53 patients who met the inclusion criteria with BMI >50 kg/m^2 and underwent RYGB, with a total small intestinal length of 600–650 cm, in the specified period (from July 2017 till June 2019) and completed 24-month follow-up with 6-month intervals were included in the study.

There were no significant differences between OAGB and RYGB patients preoperatively concerning age, sex, height, weight, BMI, and comorbidities such as HTN and DM (Table 1). The operative time was significantly longer in RYGB than that in OAGB (P<0.001). There was no significant difference between OAGB and RYGB regarding the incidence of leak, although the incidence of leak in RYGB is higher than that in OAGB (3.77% vs 2.04%) (Table 1). In OAGB, one patient had postoperative leak at day 4 and was managed conservatively, whereas in RYGB, two patients experienced leak in gastrojejunostomy with one of them requiring reoperation with redo of the anastomosis and the other was managed conservatively. No major complications were encountered in the follow-up period of 24 months.

There were no significant differences between OAGB and RYGB patients preoperatively and at 6, 12, 18, and 24 months regarding patients' weight (Table 2). Regarding the OAGB and RYGB groups, a repeated measures ANOVA with a Greenhouse-Geisser correction determined that mean weight differed statistically significantly between time points at 6, 12, 18, and 24 months in both groups (F(1.692, 81.215)=2373.133, P<0.001, and F(1.854, 96.400)=3286.320, P<0.001, respectively) (Table 2). Post hoc analysis with a Bonferroni adjustment revealed that weight was statistically significantly decreased from each time point to the other in both groups, with P<0.001.

Table 1 Demographic data of the patients in the two groups preoperatively and operative time

	OAGB		RYGB		Test of significance	
	Mean	SD	Mean	SD	Value*	*P* value**
Age	34.57	5.958	36.91	7.312	−1.773	0.079
Height	1.6594	0.04399	1.6609	0.02559	−0.216	0.830
Weight	151.39	7.480	153.57	6.329	−1.581	0.117
BMI	55.0129	2.5966	55.6934	2.6346	−1.313	0.192
DM (HbA1C)	7.471	0.8193	7.266	0.6740	1.376	0.172
Operative time	121.47	11.838	167.15	15.123	−17.054	0.000
	N (%)		*N* (%)			
Sex						
Female	34 (69.4)		35 (66)		χ^2=0.131a	0.718
Male	15 (30.6)		18 (34)			
HTN						
No	18 (36.7)		14 (26.4)		χ^2=1.259b	0.262
Yes	31 (63.3)		39 (73.6)			

BMI, body mass index; DM, diabetes mellitus; HTN, hypertension; OAGB, one-anastomosis gastric bypass; RYGB, Roux-en-Y gastric bypass. *Independent *t*-test was done in continuous values. Pearson χ^2 was done in nominal values with Fisher's exact test done when expected count was less than 5 in more than 20% of cells. **P value is considered highly significant if <0.001. [a]0 cells (0.0%) have expected count less than 5. The minimum expected count is 15.85. [b]0 cells (0.0%) have expected count less than 5. The minimum expected count is 15.37.

Table 2 Patients' weight in the two groups preoperatively and at 6, 12, 18, and 24 months

Weight	OAGB (49 patients)		RYGB (53 patients)		Test of significance	
	Mean	SD	Mean	SD	Value*	*P* value**
Preoperative	151.39	7.480	153.57	6.329	*t*=−1.581	0.117
6 months	116.94	7.540	115.26	5.654	*t*=1.261	0.211
12 months	90.47	6.151	91.28	5.597	*t*=−0.697	0.488
18 months	84.24	5.494	84.98	5.168	*t*=−0.696	0.488
24 months	80.14	3.731	80.40	3.433	*t*=−0.356	0.723
Repeated measures ANOVA with Greenhouse-Geisser correction	*F*=2373.133	*P*<0.001	*F*=3286.320	*P*<0.001		

ANOVA, analysis of variance; OAGB, one-anastomosis gastric bypass; RYGB, Roux-en-Y gastric bypass. *Independent *t*-test. ***P* value is considered highly significant if <0.001.

Table 3 Patients' BMI in the two groups preoperatively and at 6, 12, 18, and 24 months

BMI	OAGB (49 patients)		RYGB (53 patients)		Test of significance	
	Mean	SD	Mean	SD	Value*	*P* value**
Preoperative	55.0129	2.5966	55.6934	2.6346	*t*=−1.313	0.192
6 months	42.5005	2.7971	41.8057	2.3113	*t*=1.362	0.177
12 months	32.9110	2.7171	33.1099	2.2382	*t*=−0.402	0.689
18 months	30.6476	2.4590	30.8255	2.0975	*t*=−0.391	0.696
24 months	29.1564	1.9380	29.1638	1.5515	*t*=−0.021	0.983
Repeated measures ANOVA with Greenhouse-Geisser correction	*F*=2792.819	*P*<0.001	*F*=3272.086	*P*<0.001		

ANOVA, analysis of variance; BMI, body mass index; OAGB, one-anastomosis gastric bypass; RYGB, Roux-en-Y gastric bypass. *Independent *t*-test. ***P* value is considered highly significant if <0.001.

There were no significant differences between OAGB and RYGB patients preoperatively and at 6, 12, 18, and 24 months regarding patients' BMI (Table 3). Regarding the OAGB and RYGB groups, a repeated measures ANOVA with a Greenhouse-Geisser correction determined that mean BMI differed statistically significantly between time points in both groups ($F(1.779, 85.386)=2792.819$, $P<0.001$, and $F(1.830, 95.180)=3272.086$, $P<0.001$, respectively) (Table 3). Post hoc analysis with a Bonferroni adjustment revealed that BMI was statistically significantly decreased from one time point to another in both groups, with $P<0.001$.

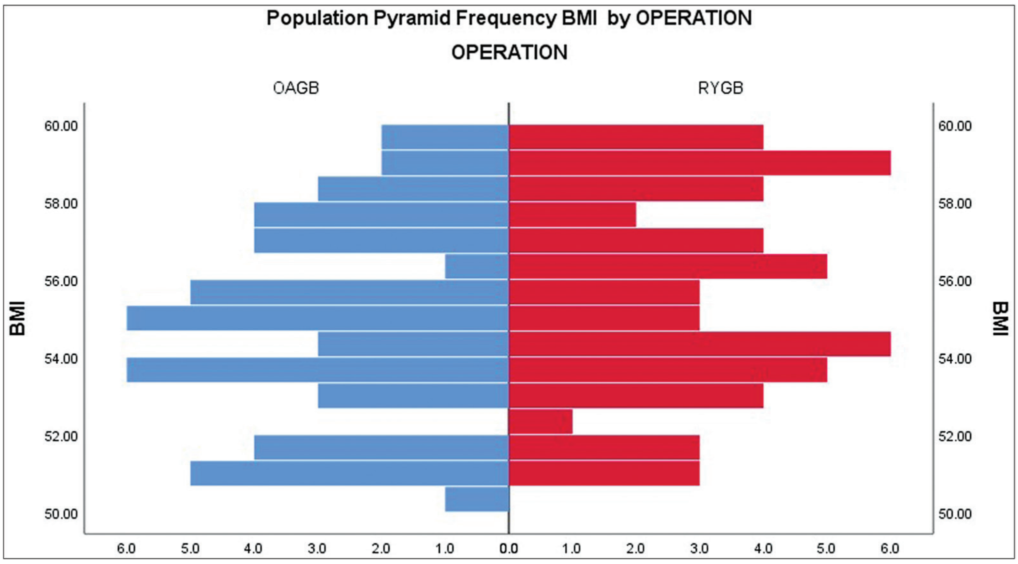
Population pyramid frequency showed comparable distribution of BMI frequencies in OAGB and RYGB preoperatively and at 12 months postoperatively. However, it showed tendency for lower BMI in OAGB in comparison with RYGB in spite of a nonsignificant difference between them by independent *t*-test (Figs. 1–3).

The *P* value of patients'%TWL between the two groups is significant ($P=0.005$) at 6 months in favor of OAGB, whereas it is not significant at 12, 18, and 24 months (Table 4). Regarding the OAGB and RYGB groups, a repeated measures ANOVA with a Greenhouse-Geisser correction determined that mean %TWL differed statistically significantly between time points in both groups ($F(1.994, 95.721)=1953.669$, $P<0.001$, and $F(1.769, 91.968)=1669.570$, $P<0.001$, respectively) (Table 4). Post hoc analysis with a Bonferroni adjustment revealed that %TWL was statistically significantly decreased from one time point to another in both groups, with $P<0.001$.

There was a progressive increase in the percent of HTN-free patients (blood pressure <140/90 mm Hg without antihypertensive drugs) in both groups from 36.7% preoperatively in OAGB to 55.1%, 89.8%, 93.9%, and 98% at 6, 12, 18, and 24 months, respectively, and from 26.4% preoperatively in RYGB to 43.4%, 81.1%, 86.8%, and 90.6% at 6, 12, 18, and 24 months, respectively, which was higher in OAGB than RYGB though statistically nonsignificant (Table 5).

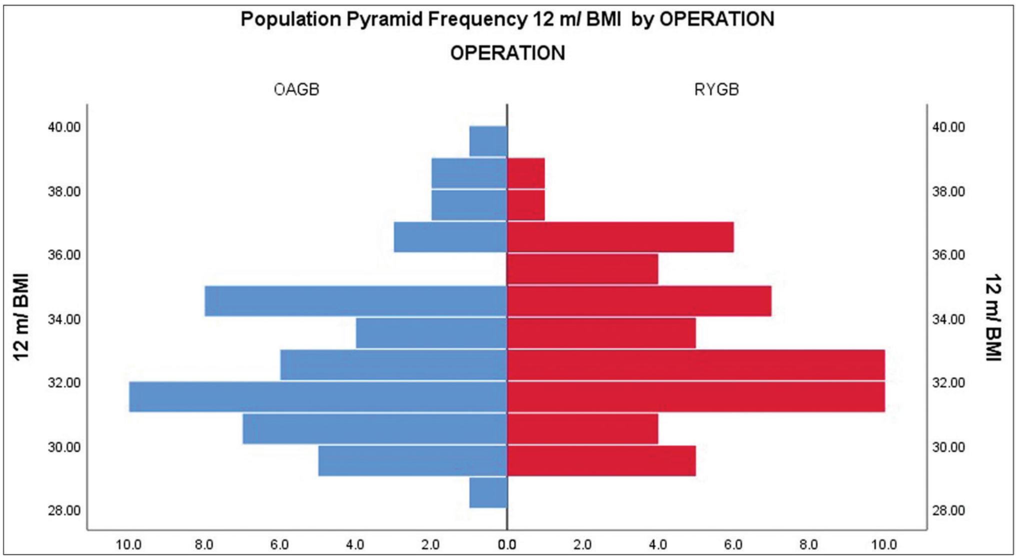
There were no significant differences between OAGB and RYGB patients preoperatively and at 6, 12, and 18 months and slightly significant at 24 months in favor of RYGB regarding patients' HbA1C level (Table 6). Regarding the OAGB and RYGB groups, a repeated measures ANOVA with a Greenhouse-Geisser correction determined that mean HbA1C level differed statistically significantly between time points in both groups ($F(1.235, 59.286)=258.049$, $P<0.001$, and $F(1.365, 70.976)=323.116$, $P<0.001$, respectively) (Table 6). Post hoc analysis with a Bonferroni adjustment revealed that HbA1C level was statistically significantly decreased from one time point to another ($P<0.001$ in both groups except in OAGB

Figure 1



Population pyramid frequency of body mass index in one-anastomosis gastric bypass and Roux-en-Y gastric bypass preoperatively.

Figure 2



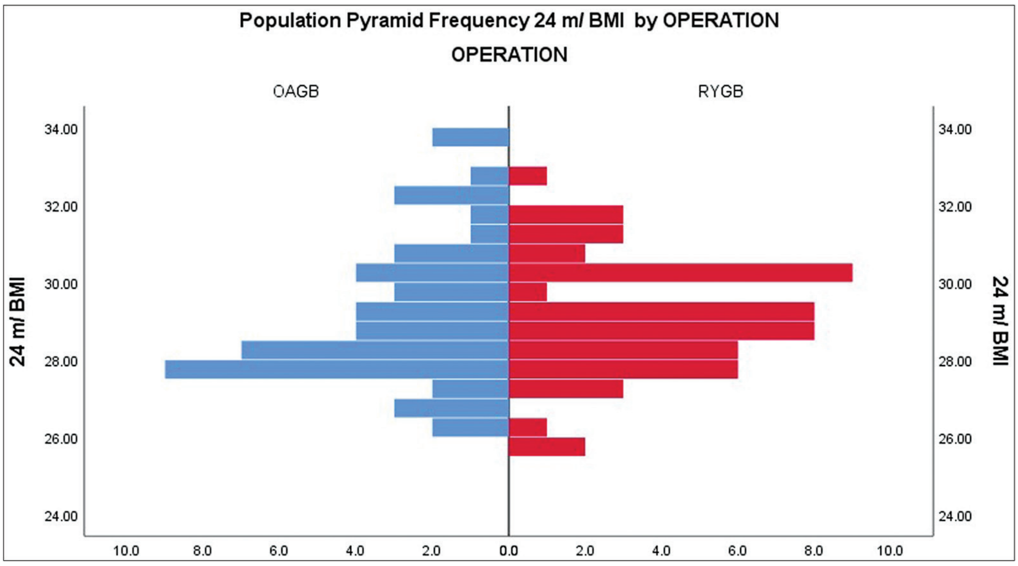
Population pyramid frequency of body mass index in one-anastomosis gastric bypass and Roux-en-Y gastric bypass at 12 months postoperatively.

group between 18 and 24 months with *P*=0.017 and in RYGB group between 12 and 18 months with *P*=0.001 and between 18 and 24 months with *P*=0.004.

No patients experienced alkaline reflux in RYGB group, whereas in OAGB, 8.2% had alkaline reflux (by pH monitoring with pH >7) at 6 months who received medical treatment to decrease incidence of reflux symptoms. The ratio decreased to 6.1% at 12 months and 4.1% at 24 months, although the difference between the two groups was statistically nonsignificant in all time points.

Regarding the nutritional status, both groups had no significant differences between them concerning the Hb, Fe, Ca, Alb, vit D, and PTH levels preoperatively. Both groups had reduction of Hb, Fe, and Ca levels with OAGB having statistically highly significant lower levels (*P*<0.001) than RYGB at 6, 12, 18, and 24 months (13.7, 13.1, 12.5, and 12.1 gm/dl; 121, 112, 105, and 102 mcg/dl; and 9.3, 9, 8.8, and 8.7 mg/dl in OAGB vs 14.7, 14, 13.6, and 13.1 gm/dl; 141, 124, 117, and 112 mcg/dl; and 9.6, 9.3, 9.1, and 8.9 mg/dl in RYGB, respectively) but remaining within normal range (Table 7). Both groups had a reduction of Alb level with no significant differences between them at 6, 12, 18, and 24 months (4.059, 3.885, 3.755, and 3.628 gm/dl in OAGB and 4.050, 3.888, 3.750, and 3.626 gm/dl in RYGB, respectively). Both groups had vit D deficiencies at 6, 12, 18, and 24 months, with OAGB

Figure 3



Population pyramid frequency of body mass index in one-anastomosis gastric bypass and Roux-en-Y gastric bypass at 24 months postoperatively.

Table 4 Patients' %TWL in the two groups at 6, 12, 18, and 24 months

%TWL	OAGB (49 patients)		RYGB (53 patients)		Test of significance	
	Mean	SD	Mean	SD	Value*	*P* value**
6 months	22.7160	4.1088	24.8912	3.3969	*t*=–2.901	0.005
12 months	40.1245	4.7352	40.4752	4.1523	*t*=–0.396	0.693
18 months	44.2374	4.3633	44.5866	3.8263	*t*=–0.428	0.669
24 months	46.9691	3.0964	47.5889	2.5985	*t*=–1.090	0.278
Repeated measures ANOVA with Greenhouse-Geisser correction	*F*=1953.669	*P*<0.001	*F*=1669.570	*P*<0.001		

ANOVA, analysis of variance; OAGB, one-anastomosis gastric bypass; RYGB, Roux-en-Y gastric bypass; TWL, total weight loss. *Independent *t*-test. ***P* value is considered highly significant if <0.001.

Table 5 HTN in the two groups preoperatively and at 6, 12, 18, and 24 months

HTN	OAGB (49 patients) *N* (%)	RYGB (53 patients) *N* (%)	Test of significance	
			Value*	*P* value**
Preoperative				
No	18 (36.7)	14 (26.4)	χ^2=1.259a	0.262
Yes	31 (63.3)	39 (73.6)		
6 months				
No	27 (55.1)	23 (43.4)	χ^2=1.396b	0.237
Yes	22 (44.9)	30 (56.6)		
12 months				
No	44 (89.8)	43 (81.1)	χ^2=1.524c	0.217
Yes	5 (10.2)	10 (18.9)		
18 months				
No	46 (93.9)	46 (86.8)	Fisher's exact testd	0.323
Yes	3 (6.1)	7 (13.2)		
24 months				
No	48 (98)	48 (90.6)	Fisher's exact teste	0.207
Yes	1 (2)	5 (9.4)		

HTN, hypertension; OAGB, one-anastomosis gastric bypass; RYGB, Roux-en-Y gastric bypass. *Pearson χ^2 was done in nominal values with Fisher's exact test done when expected count was less than 5 in more than 20% of cells. ***P* value is considered highly significant if <0.001. [a]0 cells (0.0%) have expected count less than 5. The minimum expected count is 15.37. [b]0 cells (0.0%) have expected count less than 5. The minimum expected count is 24.02. [c]0 cells (0.0%) have expected count less than 5. The minimum expected count is 7.21. [d]1 cells (25.0%) have expected count less than 5. The minimum expected count is 4.80. [e]2 cells (50.0%) have expected count less than 5. The minimum expected count is 2.88.

Table 6 Patients' HbA1C level in the two groups preoperatively and at 6, 12, 18, and 24 months

HbA1C level	OAGB (49 patients)		RYGB (53 patients)		Test of significance	
	Mean	SD	Mean	SD	Value*	*P* value**
Preoperative	7.471	0.8193	7.266	0.6740	*t*=1.376	0.172
6 months	6.476	0.5960	6.240	0.5231	*t*=2.117	0.037
12 months	5.749	0.2931	5.658	0.2735	*t*=1.609	0.111
18 months	5.631	0.2023	5.570	0.1917	*t*=1.555	0.123
24 months	5.561	0.1998	5.483	0.1878	*t*=2.033	0.045
Repeated measures ANOVA with Greenhouse-Geisser correction	*F*=258.049	*P*<0.001	*F*=323.116	*P*<0.001		

ANOVA, analysis of variance; OAGB, one-anastomosis gastric bypass; RYGB, Roux-en-Y gastric bypass. *Independent *t*-test. ***P* value is considered highly significant if <0.001.

having statistically significant lower level at 6 months (*P*<0.05) and statistically highly significant lower level (*P*<0.001) at 12, 18, and 24 months than RYGB (34.44, 30.81, 27.87, and 24.40 ng/ml in OAGB and 36.60, 33.30, 30.79, and 27.30 ng/ml in RYGB, respectively) (Table 7). PTH levels show level elevation in both groups with a nonsignificant difference (*P*>0.05) at 6 and 12 months (47.67 and 54.85 pg/ml in OAGB, and 46.30 and 54.24 pg/ml in RYGB, respectively) and significant difference at 18 months (*P*<0.001) and at 24 months (*P*=0.023) (60.71 and 66.81 pg/ml in OAGB, and 56.07 and 63.66 pg/dl in RYGB, respectively) (Table 7).

Discussion

The manipulation of limb lengths in bypass procedures such as OAGB and RYGB is considered as a method to achieve target BMI in patients with obesity. This may be a successful way in patients with BMI <50 kg/m^2 as reported by several studies such as YOMEGA and Taiwan studies [12], where a BPL of 200 cm in OAGB and 150 cm AL in RYGB were used. However, the potentiality of limb-length manipulation decreases as BMI increases. It is well known that the length of CL plays an important role in the postoperative nutritional status; however, it was not considered when studying the outcomes of these studies whether it had an effect or not on postoperative BMI.

In this study, we retrospectively compared patients with a total small intestinal length of 600–650 cm who underwent long BPL (250 cm) OAGB vs long BPL (150 cm) with 100-cm AL RYGB and having preoperative BMI >50 kg/m^{2}regarding the postoperative outcomes and effects for up to 2 years.

There were no significant differences between OAGB and RYGB in weight, BMI, and %TWL at all time points other than significantly higher %TWL in OAGB at 6 months postoperatively. Patients undergoing OAGB had a BMI of 29.1564 ± 1.9380 kg/m^2 and those undergoing RYGB had a BMI of 29.1638 ± 1.5515 kg/m^{2}at 24 months. Both procedures had the same effect on HTN, yet RYGB had more control of DM with lower levels of HbA1C, especially at 6 and 24 months, with significant differences. OAGB patients experienced alkaline reflux [13,14], although the difference was statistically nonsignificant. OAGB had undesirable effects on postoperative nutritional states [15] with significantly lower levels of Hb, Fe, Ca, vit D, and significantly higher levels of PTH in comparison with RYGB [16]. The Alb levels showed no significant differences owing to the presence of enough CL length for protein absorption while affecting the nutrients that had main absorption in proximal jejunum.

A study by Bhandari *etal.* [17] stated that %TWL at 2 years was 38.52% and 43% in RYGB and OAGB, respectively. Meytes *etal.* [18] studied retrospectively patients who underwent RYGB having the BPL of 150 cm with 150 cm AL in patients with BMI >60 kg/m^2 and found it effective and safe. Singla *etal.* [19] compared OAGB with sleeve gastrectomy in patients with BMI >50 kg/m^2 and found that OAGB had %TWL of 39.9% at 1 year with folate deficiency despite regular supplementation. A study by Plamper *etal.* [20] performed OAGB at a length of 250 cm for patients of BMI 50–60 kg/m^2 with good results.

Ahuja *etal.* [10] studied OAGB with 150-, 180-, and 250-cm BPL in patients with BMI >35 kg/m^2 and concluded that 180-cm BPL can be used in BMI >40 kg/m^2, whereas 250-cm BPL should be used with care as it leads to significant nutritional deficiencies, but they did not study it exclusively on BMI >50 kg/m^2.

Moreover, in a study by Darabi *etal.* [21], patients with BPL of 150-cm RYGB had higher %TWL. In this study, both procedures had at least 350–400 cm present distally to prevent incidence of short CL. Similar lengths were suggested by Felsenreich *etal.*, Khalaj *etal.*, and Soong *etal.* [4,22,23].

Table 7 Levels of Hb, Fe, Ca, Alb, vit D, and PTH preoperatively and at 6, 12, 18, and 24 months in both groups

Time of measurement	OAGB (49 patients)		RYGB (53 patients)		Test of significance	
	Mean	SD	Mean	SD	Value*	*P* value**
Hemoglobin 12–16 gm%						
Preoperative	15.6796	0.7144	15.6585	0.7419	0.146	0.884
6 months	13.7714	0.7588	14.7113	0.6815	–6.562	0.000
12 months	13.1388	0.7713	14.0830	0.7276	–6.347	0.000
18 months	12.5653	0.8030	13.6189	0.7387	–6.879	0.000
24 months	12.1347	0.8652	13.1887	0.8047	–6.356	0.000
Iron (60–180 mcg/dl)						
Preoperative	164.1020	9.2966	161.9434	9.1869	1.178	0.242
6 months	121.2857	6.3541	141.0943	8.2164	–13.677	0.000
12 months	112.8367	6.7154	124.8868	6.6900	–9.071	0.000
18 months	105.9388	6.6470	117.3774	7.3307	–8.264	0.000
24 months	102.0816	7.0351	112.4906	8.6104	–6.706	0.000
Calcium (8.6–10.6 mg/dl)						
Preoperative	10.0673	0.2357	10.0755	0.2129	–0.182	0.856
6 months	9.3143	0.2226	9.6000	0.1593	–7.400	0.000
12 months	9.0184	0.1703	9.3113	0.1137	–10.128	0.000
18 months	8.8551	0.1514	9.1377	0.1023	–10.954	0.000
24 months	8.7286	0.1291	8.9830	0.0994	–11.085	0.000
Albumin (3.5–4.5 gm%)						
Preoperative	4.2449	0.1860	4.2660	0.1543	–0.626	0.536
6 months	4.0592	0.1743	4.0509	0.1381	0.263	0.793
12 months	3.8857	0.1594	3.8880	0.0953	–0.113	0.910
18 months	3.7551	0.1646	3.7509	0.1011	0.152	0.879
24 months	3.6286	0.1720	3.6264	0.1374	0.070	0.945
Vitamin D (20–50 ng/ml)						
Preoperative	39.8776	4.6976	40.5283	4.4661	–0.716	0.476
6 months	34.4490	4.8436	36.6038	3.7944	–2.487	0.015
12 months	30.8163	3.8061	33.3019	2.8527	–3.709	0.000
18 months	27.8776	3.2636	30.7925	3.1644	–4.573	0.000
24 months	24.4082	3.2782	27.3019	5.2057	–3.385	0.001
PTH (10–55 pg/ml)						
Preoperative	37.2653	5.2510	37.7358	5.2920	–0.450	0.653
6 months	47.6735	3.6135	46.3019	4.1071	1.794	0.076
12 months	54.8571	4.3301	54.2453	3.4413	0.786	0.434
18 months	60.7143	5.6273	56.0755	4.3933	4.615	0.000
24 months	66.8163	7.8652	63.6604	5.5985	2.318	0.023

Alb, albumin; Ca, calcium; Fe, iron; Hb, hemoglobin; OAGB, one-anastomosis gastric bypass; PTH; parathormone; RYGB, Roux-en-Y gastric bypass; vit D, vitamin D. *Independent *t*-test. ***P* value is considered highly significant if <0.001.

In the study by Lee *etal*. [12], a comparison of YOMEGA and Taiwan studies was carried out. They concluded that the OAGB is superior to RYGB in BMI <50 kg/m^2, yet this was not the case in patients with BMI >50 kg/m^2.

Carbajo *etal*. [24] stated that in OAGB, nutritional deficiencies and malnutrition are increasingly reported when the bypassed jejunum is >250 cm. IFSO Consensus Conference recommends OAGB to be performed if BMI >50 with the presence of suitable length common channel in OAGB if BP is to be more than 200 cm [25]. There is a controversy on the length of bypassed jejunum ranging from 150 up to 350 cm in OAGB [22,26]. Felsenrich *etal*. [4] conducted a review study about the effect of limb lengths in different procedures and concluded that there should be a balance between weight loss and susceptibility to nutritional deficiencies, but at all times, a minimum of 300 cm should be present as a CL.

A study by Komaei *etal*. suggested a tailored BPL for OAGB based on the total bowel length [27]. Ruez-Tovar *etal*. conducted two studies in trial to reach a conclusion on limb-length effect and concluded that the total bowel length affected bariatric procedure outcomes [28,29].

Conclusion

Long BPL RYGB is recommended for patients with BMI >50 kg/m^2 especially with long total small intestinal length of 600–650 cm (>6 m) in comparison with OAGB. It had the same effect on BMI with less effect on the nutritional status of the patients and avoiding the incidence of alkaline reflux. Further studies on RYGB with different ratio between BPL and AL lengths are needed to be carried out to determine the optimum lengths for achieving the target BMI in patients with BMI >50 kg/m^2.

The limitations of this study were the retrospective design and absence of long-term follow-up (>5 years). A larger scale study involving a higher number of patients and follow-up for longer periods of time postoperatively are required to confirm the aforementioned results.

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Conflicts of interest
There are no conflicts of interest.

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