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ORIGINAL RESEARCH

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Fewer patients with insufficient weight loss after one anastomosis gastric bypass compared to Roux-en-Y gastric bypass after 5 years of follow-up

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Summary

This study aims to give a comprehensive overview of the one anastomosis gastric bypass (OAGB) and Roux-en-Y gastric bypass (RYGB) during 5 years of follow-up in terms of weight loss, the remission of obesity-associated diseases and complications. We performed a retrospective cohort study, with a 1:1 propensity-score matched (PSM) comparison between all adult patients who underwent a primary OAGB or RYGB in 2016. Patients with a body mass index (BMI) ≥50 kg/m^2 were excluded. In total, 372 patients underwent OAGB and 113 patients RYGB. After performing a 1:1 PSM, we obtained two nearly identical cohorts of 113 patients. After OAGB, the percentage of total weight loss (%TWL) was significantly higher during 5 years of follow-up. Also, more patients after OAGB had a successful weight loss (TWL > 20%) after 5 years (86% vs. 72%; $p = .019$). The remission of obesity-associated diseases and short-term complications did not differ between both procedures. Persistent reflux was the reason for conversion to RYGB in 11.3% of the patients after OAGB. More internal herniations were seen after RYGB (10.4% vs. 1.9%; $p = .010$). Overall, the proportion of patients with major mid-term complications did not differ between both procedures. In conclusion, OAGB resulted in more weight reduction and especially fewer patients with insufficient weight loss during 5 years of follow-up, while remission of obesity-associated diseases remained the same.

KEYWORDS
complications, OAGB, obesity-associated diseases, RYGB, weight loss

What is already known about this subject

- Roux-en-Y gastric bypass (RYGB) is considered the gold standard in metabolic bariatric surgery.

- One anastomosis gastric bypass (OAGB) is considered a technically easier procedure, resulting in shorter operation time and lower complication rates.
- Furthermore, OAGB shows equivalent (or even better) results in terms of short- to midterm weight loss and remission of obesity-associated diseases.

What this study adds

- A comprehensive overview of the 5-year outcomes after OAGB and RYGB in terms of weight loss, remission of obesity-associated diseases, and complications.
- A large cohort of patients, that enabled the use of propensity score matching for more robust comparison.
- OAGB resulted in more weight reduction, while remission of obesity-associated diseases remained the same.

1 | INTRODUCTION

Roux-en-Y gastric bypass (RYGB) is considered the gold standard in Metabolic Bariatric Surgery (MBS).[1] An alternative procedure is the one anastomosis gastric bypass (OAGB). Because of the single anastomosis, OAGB is considered a technically easier procedure, resulting in shorter operation time and lower complication rates.[2,3] Furthermore, OAGB is easier to revise or reverse and shows equivalent (or even better) results in terms of short- to midterm weight loss and remission of obesity-associated diseases.[2,3]

Despite the excellent results, OAGB remains a procedure that sparks discussion. This is due to the potential risk of bile reflux and anastomotic ulcers, leading to fear of the development of gastric or oesophageal cancer.[4] An anti-reflux stitch can be placed during the operation to reduce the incidence of biliary reflux after OAGB.[5,6] In case of severe symptomatic biliary reflux conversion to RYGB can be performed.[7]

Most studies comparing OAGB and RYGB are non-randomised studies.[2,3,8–12] Randomised control trials (RCTs) between OAGB and RYGB are often limited by a small number of patients or a limited follow-up duration.[2,13–19]

This study compares the outcomes between OAGB and RYGB during 5-year follow-up in terms of weight loss, remission of obesity-associated diseases, and complications (both short- and mid-term).

2 | METHODS

2.1 | Study population

We performed a retrospective cohort study in a non-academic teaching hospital in the North of the Netherlands. All adult patients undergoing a primary OAGB or RYGB in 2016 were included. Patients with a body mass index (BMI) ≥50 kg/m^2 were excluded because of the surgical preference for performing OAGB over RYGB in these patients at our centre. Compared with the RYGB, less lifting of the intestines is necessary as OAGB has a longer pouch, and with only one anastomosis less manoeuvring space is required.

Data were extracted from electronic patient records. The medical ethical committee approved the study (RTPO Leeuwarden, nWMO 2022 0007). Written informed consent was provided by all patients for using the data.

2.2 | Preoperative workup

All our patients started with counselling by a dietician to prepare for the postoperative lifestyle regimen before screening by our multidisciplinary team.[20] *Helicobacter pylori* testing in stool was done in all patients; an eradication treatment was given in case of a positive test result. All patients attended a group information session, which provided valuable insights into the surgical options available. During the preoperative consultation with the surgeon, the selection of the metabolic bariatric procedure was determined by a combination of the patient's preference and the surgeon's recommendations. The surgeon's preference is influenced by the patient's history of previous abdominal surgeries. At our centre, surgeons tend to favour the OAGB procedure due to its shorter operation time and lower complication rates. The procedures were performed in 2016 and at that time gastroesophageal reflux disease (GERD) was not considered an exclusion criterion for undergoing OAGB.

2.3 | Surgical technique

In short, with the OAGB, the creation of the pouch was started at the crow's foot (about 12 cm below the oesophageal-gastric junction) and an anti-reflux stitch was used.[5] The length of the limbs was not uniform between the different surgeons and was primarily based on BMI, traction on the bowel, adhesions, and space to manoeuvre. In the OAGB, the biliopancreatic limb (BPL) was 150–200 cm long (180 cm in 65.6% of the patients). With the RYGB, the length of the pouch was 6 cm, the BPL 80–180 cm (150 cm in 61.1% of the patients), and the alimentary limb (AL) 75–150 cm (100 cm in 44.2% of the patients). Mesenteric defects were not routinely closed in both procedures. All patients got intravenous antibiotics perioperatively and the integrity

of the gastrojejunal anastomosis was tested by methylene blue and air test.

2.4 | Postoperative care and follow-up

Patients were discharged the day after the operation if no complications occurred and if they had an adequate fluid intake. Proton pump inhibitors (PPIs) were prescribed for the first 4 months. Lifelong weight loss surgery-specific multivitamins and calcium-vitamin D supplements were recommended. Follow-up visits took place after 4–6 weeks, 6 months, 1 year, 1.5 years, 2 years, 3 years, 4 years, and 5 years.

Remission of obesity-associated diseases was evaluated by patient-reported changes in treatment: no change, less (partial remission), or no treatment anymore (total remission). Total remission of diabetes mellitus was considered as HbA1c <48 mmol/mol for more than 6 months without medication.

Weight loss was expressed in kilograms, BMI, the percentage excess weight loss (%EWL), and total weight loss (%TWL). TWL <20% was considered as a non-responder on MBS. The cut-off point of 20% is based on current literature about successful weight loss after MBS.[21]

Short-term complications were defined as complications within 30 days after surgery. Mid-term complications were defined as complications after these 30 days and within 5 years after surgery. All complications were classified according to the Clavien–Dindo Classification[22]; Grade I and II were considered as minor and Grade ≥III as major complications. While the Clavien–Dindo classification traditionally applies to postoperative complications, we have extended its application to grade midterm complications as well. Specifically, Grade I denotes complications managed with conservative treatment without medication, Grade II involves conservative treatment with medication, Grade III entails invasive treatment (endoscopic, radiological intervention or operation), Grade IV designates life-threatening complications requiring invasive intervention and Grade V signifies complications that, if left untreated, would lead to death within 24 h.

Reflux disease was defined as one or more episodes of reflux. Treatment of reflux was initiated with lifestyle recommendations to which medication (PPIs or sucralfate) was added in case of insufficient relief. Patients who experienced reflux of fluid in their mouth or lungs during the night for at least two nights a week and/or experienced reflux in their mouth/lungs multiple times during the day when stooping with no effect of conservative treatment after 4–8 weeks could opt for laparoscopic conversion to RYGB after being informed by their attending surgeon. Gastroscopy was conducted in cases where patients reported epigastric pain/discomfort or exhibited other signs indicative of an ulcer. Gastroduodenoscopy was not routinely performed to demonstrate the presence of biliary reflux.

2.5 | Statistical analysis

In total, 372 patients underwent OAGB and 113 patients RYGB. Baseline characteristics differed slightly between both populations and therefore a 1:1 propensity score matching (PSM) was performed which resulted in two nearly identical cohorts of 113 patients, matched by age, gender, BMI before surgery, hypertension, and diabetes mellitus.

All patients were included in the analysis of short-term complications. Patients with at least one annual follow-up visit were included in the analyses of mid-term complications. If these patients did not attend their follow-up visit after 5 years, patients were contacted by telephone to complete the data. For the analysis of remission of obesity-associated diseases, only patients with a follow-up visit after 5 years were included.

Continuous data are presented as mean ± standard deviation or median [interquartile range] in case of skewed distribution. Categorical data are presented as total numbers and percentages. The *t*-test was used for normally distributed data and the Mann–Whitney *U* test for skewedly distributed data. Categorical data were analysed with a Chi-square test. A two-sided *p*-value of ≤0.05 was considered statistically significant. All statistical analyses were performed using SPSS Statistics version 28. GraphPad (Boston, MA) was used to visually depict the data.

3 | RESULTS

3.1 | Patient characteristics

In total, 372 patients underwent an OAGB and 113 patients a RYGB. After 1:1 PSM, two nearly identical cohorts of 113 patients were obtained. The baseline characteristics of the matched and unmatched populations are shown in Table 1.

3.2 | Follow-up

Adherence to follow-up visits in patients after OAGB and RYGB were, respectively, 98% and 93% in year 1 ($p = .089$), 91% and 89% in year 2 ($p = .652$), 82% and 77% in year 3 ($p = .393$), and 72% and 63% in year 4 ($p = .187$). After 5 years, respectively, 63% and 65% of the patients attended the outpatient clinic. In total, 67 patients were invited by phone to complete the 5-year data, of which 24 patients responded. Finally, 5-year data were available from 76% of the patients with an OAGB and 83% of the patients with a RYGB ($p = .232$).

3.3 | Weight loss

%TWL was significantly higher during 5 years of follow-up in patients with an OAGB (Figure 1). After 5 years, the proportion of responders to MBS was higher in patients with an OAGB (86% vs. 72%; $p = .019$) (Table 2).

3.4 | Remission of obesity-associated diseases

For hypertension, the total remission rate was higher in patients who underwent OAGB (63% compared with 51%); however, this difference

TABLE 1 Patient characteristics.

	Not matched			Propensity match[a]		
	OAGB $N = 372$	RYGB $N = 113$	*p*-value	OAGB $N = 113$	RYGB $N = 113$	*p*-value
Demographics						
Age, years[b]	44 ± 11	46 ± 11	.091	46 ± 11	46 ± 11	.813
Female[c]	301 (81)	97 (86)	.232	92 (81)	97 (86)	.331
Body weight at preoperative screening, kg[b]	125 ± 17	121 ± 14	**.004**	124 ± 18	120 ± 14	.175
BMI at intake, kg/m^2	41 ± 4	41 ± 4	.112	42 ± 4	42 ± 4	.853
Comorbidities						
Hypertension[c]	130 (35)	53 (47)	**.022**	57 (50)	53 (47)	.491
Diabetes Mellitus type 2[c]	70 (19)	28 (25)	.462	24 (21)	28 (25)	.531
No medication	7 (2)	2 (2)	—	1 (1)	2 (2)	—
Metformin only	17 (5)	10 (9)	—	6 (5)	10 (9)	—
GLP1 analogues	1 (0)	3 (3)	—	-	3 (3)	—
Insulin	38 (10)	9 (8)	—	14 (12)	9 (8)	—
Sleep apnoea[c]	70 (19)	24 (21)	.568	21 (19)	24 (21)	.608
Asthma/COPD[c]	71 (19)	28 (25)	.189	19 (17)	26 (25)	.085
No comorbidities[d]	160 (43)	38 (34)	.076	47 (44)	43 (41)	.578

Note: A two-sided *p*-value of < 0.05 was considered statistically significant (as mentioned in the methods section).
Abbreviations: BMI, body mass index, kg/m^2; COPD, chronic obstructive pulmonary disease; GERD, gastroesophageal reflux disease; GLP1, glucagon-like peptide 1; *N*, number of patients; OAGB, one anastomosis gastric bypass; RYGB, Roux-en-Y gastric bypass.
[a]Nagelkerke R^2 .035.
[b]Mean ± standard deviation.
[c]Absolute number (percentage).
[d]No hypertension, diabetes mellitus type 2, sleep apnoea or asthma/COPD.

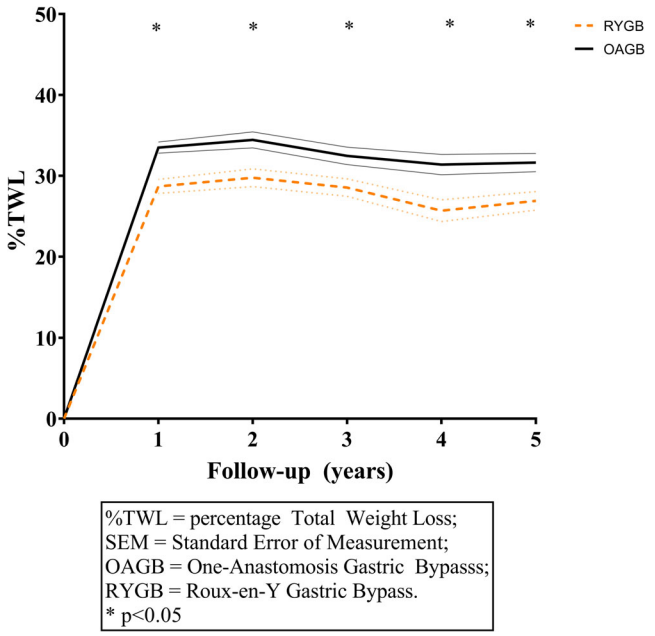

FIGURE 1 %TWL with SEM after OAGB versus RYGB.

TABLE 2 Weight loss after 1 and 5 years.

	OAGB	RYGB	*p*-value
After 1 year			
N	104	99	
BMI[a], kg/m^2	28 ± 4	30 ± 4	**<.001**
%TWL[b]	33 ± 7	29 ± 9	**<.001**
%EWL[b]	86 ± 20	73 ± 23	**<.001**
After 5 years			
N	81	88	
BMI[a], kg/m^2	29 ± 4	30 ± 5	**.013**
%TWL[b]	30 ± 10	27 ± 11	**0.015**
%EWL[b]	78 ± 25	68 ± 27	**0.010**
%TWL < 20[c]	11 (14)	25 (28)	**.019**
%TWL > 20[c]	70 (86)	63 (72)	

[a]Median [interquartile range].
[b]Mean ± standard deviation.
[c]Absolute number (percentage).
Abbreviations: %EWL, percentage excess weight loss; %TWL, percentage total weight loss; BMI, body mass index; *N*, number of patients; OAGB, one anastomosis gastric; RYGB, Roux-en-Y gastric bypass.

was not statistically significant ($p = .300$). Partial remission was greater following RYGB (47% vs. 23%; $p = .030$). The proportion of patients with no remission of hypertension was higher after OAGB (14% vs. 2%; $p = .049$).

No differences were found in the percentage of patients with remission of diabetes mellitus type 2, sleep apnoea, and asthma/COPD between both procedures (Table 3).

TABLE 3 Remission of obesity-associated diseases after 5 years.

	OAGB ($N = 81$)	RYGB ($N = 88$)	*p*-value	
Hypertension				
Patients with hypertension[a]	35 (43)	43 (49)	.461	
Total remission[a]	22 (63)	22 (51)	.300	.056
Partial remission[a]	8 (23)	20 (47)	**.030**	
No remission[a]	5 (14)	1 (2)	**.049**	
Diabetes mellitus type 2 with medication preoperative				
Patients with diabetes mellitus[a]	28 (22)	21 (24)	.705	
HbA1c[b]	44 [36–61]	44 [38–55]	.621	
Use of insulin[a]	1 (4)	1 (5)	.911	
Use of GLP1 analogues[a]	—	2 (10)	.179	
Total remission[a]	11 (39)	12 (57)	.802	.815
Partial remission[a]	7 (25)	8 (38)	.959	
No remission[a]	—	1 (5)	.348	
Sleep apnoea				
Patients with sleep apnoea[a]	16 (20)	20 (23)	.637	
Total remission[a]	13 (81)	13 (65)	.279	.403
Partial remission[a]	—	3 (15)	.106	
No remission[a]	3 (9)	4 (20)	.669	
Asthma/COPD				
Patients with asthma/COPD[a]	13 (16)	24 (27)	.078	
Total remission[a]	5 (38)	8 (33)	.755	.352
Partial remission[a]	5 (38)	9 (38)	.954	
No remission[a]	3 (23)	7 (29)	.690	

Note: Data expressed as absolute frequencies and rates (%).
Abbreviations: COPD, chronic obstructive pulmonary disease; GLP1, glucagon-like peptide 1; OAGB, one anastomosis gastric bypass; RYGB, Roux-en-Y gastric bypass.
[a]Absolute number (percentage).
[b]Median [interquartile range].

3.5 | Complications

Short-term complications did not differ between both procedures. However, minor mid-term complications were more present after OAGB (65.1% vs. 20.8%; $p < .001$), mainly due to the high incidence of reflux (69.8% vs. 15.1%; $p < .001$). This resulted in conversion to RYGB in 11.3% of the patients with OAGB. On the other hand, more patients with RYGB required surgery for internal herniations (10.4% vs. 1.9%; $p < .001$). Overall, the number of major mid-term complications and the total of reoperations did not differ between both procedures (Table 4).

4 | DISCUSSION

This study compared mid-term outcomes after OAGB and RYGB. We found more weight reduction and especially fewer patients with insufficient weight loss after OAGB during 5 years of follow-up. The incidence of internal herniation was higher in patients after RYGB, whereas a substantial proportion of the patients with OAGB required conversion to RYGB because of reflux. Overall, the proportion of patients with major mid-term complications did not differ between both procedures.

4.1 | Weight loss

Patients after OAGB experienced more %TWL during 5 years of follow-up; 30% versus 27%. In the literature, %TWL 5 years after OAGB varied from 34.7% to 40.8%[2,23–25] and from 24.0% to 37.2% after RYGB.[2,23–26] Our relatively lower %TWL after OAGB can potentially be explained by less BP limb lengths. The majority of studies reported BPL lengths ranging from 150 to 350 cm.[2,23–25] Notably, the study that specified a range of 150–250, predominantly implemented a BPL of 200 cm.[25] Among our patients, the BPL length varied from 150 to 200 cm, with a prevailing majority having a BPL of 180 cm. A

TABLE 4 Short- and mid-term complications.

	OAGB	RYGB	*p*-value
Short-term complications	*N* = 113	*N* = 113	
Length of hospital stay in days[a]	2 [1–2]	2 [1–2]	.071
Number of patients with minor complications[b]	3 (2.7)	3 (2.7)	1.000
Number of patients with major complications[b,c]	1 (0.9)	–	.316
Hospital readmission[b]	−1 (0.9)	1 (0.9)	1.000
Mortality[b]	–	–	–
Mid-term complications	*N* = 106	*N* = 106	
Number of patients with minor complications[b]	69 (65.1)	22 (20.8)	**<.001**
• Deficiency in macronutrients requiring TPN/enteral feeding	2 (1.9)	4 (3.8)	.407
• Hypoglycaemia requiring medication	1 (0.9)	2 (1.9)	.561
• Complaints of reflux	74 (69.8)	16 (15.1)	**<.001**
• Gastric ulcer	5 (4.7)	7 (6.6)	.552
Number of patients with major complications[b]	13 (12.3)	12 (11.3)	.659
• Conversion OAGB to RYGB because of reflux	12 (11.3)	–	<.001
• Perforation of gastric ulcer requiring surgery	1 (0.9)	–	.316
• Internal herniation requiring surgery	2 (1.9)	11 (10.4)	**.010**
• Stenosis at the anastomosis	–	–	–
• Miscellaneous operations	3 (2.8)	5 (4.7)	.701
○ Diagnostic laparoscopic surgery without any findings	2 (1.9)	2 (1.9)	
○ Undo operation	–	1 (0.9)	
○ Minimiser/revision or adjustment of the bypass	1 (0.9)	1 (0.9)	
○ Other operation	–	1 (0.9)	
Total number of reoperations[b]	18 (17.0)	16 (15.1)	.701
Mortality within 5 years after surgery[b]	2 (1.9)	1 (0.9)	.561
• Carcinoma, unknown location	–	1 (0.9)	
• Perforation	1 (0.9)	–	
• Unknown	1 (0.9)	–	

[a]Median [interquartile range].
[b]Absolute number (percentage). Minor complications = Clavien–Dindo Classification I and II. Major complications = Clavien–Dindo Classification IIIa, IIIb, IV and V.
[c]One bleeding from the laparoscopic wound, for which a stitch was placed under local anaesthesia, 1 re-admission because of postoperative pain without signs of complications.
Abbreviations: *N*, number of patients; OAGB, one anastomosis gastric bypass; RYGB, Roux-en-Y gastric bypass; TPN, total parenteral nutrition.

recent systematic review found more weight loss after OAGB with a BPL of 200 cm, compared with 150 cm; however, this was accompanied by more nutritional deficiencies.[27]

Also, the limb lengths in RYGB varied in the literature; with BPL lengths between 50 and 350 cm and AL lengths between 100 and 150 cm.[2,23–26] The majority of our patients received a BPL of 150 cm and an AL of 100 cm. Differences in BPL and AL lengths, and thus in lengths of the common channel influence weight loss. Yet, up till now no consensus on the ideal limb lengths of the RYGB has been reached.[28]

In addition to differences in limb lengths, the studies exhibited variations in follow-up rates, ranging from 22% to 67%, whereas our study maintained a significantly higher follow-up rate of almost 80%.[2,23–26] Another explanation for discrepancies in %TWL could be the exclusion of patients with BMI ≥50 kg/m^2 in our study.

4.2 | Evolution of obesity-associated diseases

The improvement of obesity-associated diseases was evaluated through patient-reported changes in treatment. Previous studies also showed no differences in the evolution of diabetes mellitus, sleep apnoea, and hypertension between OAGB and RYGB.[9,11,15,17,23] Asthma/COPD was not investigated in these previous studies.

4.3 | Complications

No significant differences were seen in the percentage of short-term complications between OAGB and RYGB. Mocanu et al. focused specifically on the first 30 days after surgery in a large cohort

(OAGB = 1344; RYGB = 46 040) and found that patients with RYGB had more serious complications (8.4% vs. 4.7%; $p < .001$).[12] Our study showed fewer serious complications. This can potentially be explained by the fact that Mocanu et al. used a large database including more than 800 centres.[12] It is plausible that surgical outcomes differ significantly between centres. In our centre, the procedures were performed by a small team, including four well-trained metabolic bariatric surgeons.

Regarding the mid-term complications, more internal herniations were seen after RYGB (10.4% vs. 1.9%). Liagre et al. found comparable percentages of 8.8% internal herniations in patients with RYGB and 3.9% in patients with OAGB.[10] However, the prospective study of Lee et al. found lower percentages, 0.4% after RYGB and 0% after OAGB.[29] This higher incidence in our population could be explained by the fact that these operations were performed in 2016; at that time mesenteric defects and/or Petersen space were not closed during the procedure. Nowadays, these defects are closed. A recent meta-analysis found 8.7% internal herniations in the RYGB group without closing the defects, compared with 2.0% when closing the defects.[30]

Our definition of reflux may have contributed to the high incidence of reflux (69.8%) in patients with OAGB. With only one episode of reflux, a patient already met our definition of reflux disease. Patients who experienced reflux of fluid in their mouth or lungs during the night for at least two nights a week and/or experienced reflux in their mouth/lungs multiple times during the day when stooping with no effect of conservative treatment could opt for conversion to RYGB. Our conversion rate of 11.3% is high compared with the literature. This observation follows our earlier paper about the anti-reflux suture in OAGB to prevent biliary reflux.[5] Given this finding, we now refrain from offering OAGB to patients who report reflux symptoms or are on PPIs, as the revision rate in this group tends to be significantly higher. Consequently, these percentages may be lower in contemporary practice. Carbajo et al. did not report any conversion to RYGB in their large cohort of 1200 patients with OAGB.[31] In a systematic review with more than 12 000 patients, the conversion rate was 0.4%–1.6%.[32]

4.4 | Strengths and limitations

The strength of this study is the 5-year follow-up duration including data on weight loss, remission of obesity-associated diseases, and short- and mid-term complications. Our study has some limitations that need to be mentioned: first, the study's retrospective design leads to a level of evidence that is not as strong as one obtained from an RCT. Second, the procedures included in this study were performed in 2016. Compared with our current clinical practices, there have been some notable changes. Nowadays, OAGB is not performed in patients with GERD, and mesodefects are perioperatively closed in both procedures. Third, gastroduodenoscopy was not routinely performed to demonstrate the presence of biliary reflux, nor could be differentiated between biliary or acid reflux. As a result, our data may be challenging to align with existing literature and clinical practices where gastroduodenoscopy is a standard procedure in case of reflux. Nevertheless, our conversion rate does reflect the prevalence of therapy-resistant reflux complaints. Suggestions for further research would be an RCT between OAGB and RYGB with a follow-up duration of at least 5 years.

In conclusion, we found more weight reduction and especially fewer patients with insufficient weight loss after OAGB during 5 years of follow-up.

AUTHOR CONTRIBUTIONS

Lindsy van der Laan participated in data acquisition, analysed data, and drafted the manuscript. Dionne Sizoo participated in the data analysis. Loek J. M. de Heide, André P. van Beek, and Marloes Emous assisted with data interpretation, revised the manuscript, and gave final approval of the version to be published. We would like to thank Alicia I. Barten, MSc and Ger-Anne van Keeken, MD for their help with the collection of data.

CONFLICT OF INTEREST STATEMENT

The authors declare they have no conflict of interest.

ETHICS STATEMENT

Formal consent is not required for this type of study (RTPO Leeuwarden, nWMO 2022 007).

INFORMED CONSENT

Informed consent was obtained from all individual participants included in the study.

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