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REVIEW

IFSO Update Position Statement on One Anastomosis Gastric Bypass (OAGB)

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Abstract

The International Federation for the Surgery of Obesity and Metabolic Disorders (IFSO) issued a position statement on the role of one anastomosis gastric bypass (OAGB) in the field of bariatric/metabolic surgery in 2018 De Luca et al. (Obes Surg. 28(5):1188-206, 2018). This position statement was issued by the IFSO OAGB task force and approved by the IFSO Scientific Committee and IFSO Executive Board. In 2018, the OAGB task force recognized the necessity to update the position statement in the following 2 years since additional high-quality data could emerge. The updated IFSO position statement on OAGB was issued also in response to inquiries to the IFSO by society members, universities, hospitals, physicians, insurances, patients, policy makers, and media. The IFSO position statement on OAGB has been reviewed within 2 years according to the availability of additional scientific evidence. The recommendation of the statement is derived from peer-reviewed scientific literature and available knowledge. The IFSO update position statement on OAGB will again be reviewed in 2 years provided additional high-quality studies emerge.

Keywords OAGB update · Bariatric surgery · IFSO position statement · Systematic review

Introduction

Bariatric surgical procedures are classically classified along a spectrum from purely restrictive to malabsorptive procedures, although recent reports suggest that more complex hormonal, inflammatory, central nervous system, and gut microbial factors may also have an important impact on the effects of the operations. One anastomosis gastric bypass (OAGB) is a "combined procedure" and it has both a "restrictive" and a "malabsorptive" component [1, 2].

While the early results in terms of weight management and T2DM control appear promising, the previous position

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statement noted that there is a lack of long-term evidence for durability of effect, as well as long-term nutritional complications. The role of the procedure in the revisional setting was also noted to not be well defined with available literature at the time demonstrating that weight loss tended to be more modest in that setting with more complications documented [3].

Bile reflux and stomal cancer have been potential complications of the OAGB based on experience with the Billroth II (BII) reconstruction following subtotal gastrectomy, as well as the Mason "loop" gastric bypass [4–7]. The 2018 OAGB position statement found that the rate of biliary reflux appeared to be lower than expected, not exceeding 2% of all operated patients, and rate of gastric cancer did not appear to be reported more often than other bariatric surgery procedures. The IFSO 2018 taskforce therefore recommended that "bile reflux is either under reported or does not seem to be a major issue but remains a theoretical risk" [3].

OAGB appears extremely effective in reducing obesity related comorbidities, offering a good quality of life with an acceptable complication rate [8, 9]. The increasing numbers of OAGB in Europe and in Asia-Pacific recently brought this technique in third position in order of frequency, behind sleeve gastrectomy (SG) and Roux-en-Y gastric bypass (RYGB) [10, 11].

The 2020 task force undertook a new systematic review to summarize the evidence of the literature on the efficacy and safety of the OAGB procedure with the aim of providing an up-to-date information to guide practice.

Methods

Search Strategy and Quality Assessment

A systematic review of literature was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) statement [12]. A literature search was carried out in electronic databases (Cochrane, Embase, MEDLINE, Pubmed) in order to retrieve all papers related to OAGB in combination or not with RYGB and SG. The following search string was used: One Anastomosis Gastric Bypass or Mini Gastric Bypass or Single Anastomosis Gastric Bypass and Sleeve Gastrectomy or Gastric Bypass or Roux en Y Gastric Bypass and Bariatric Surgery. Two independent researchers (GP and GM) analyzed each article, first by title and abstract, and subsequently by the full text and extracted the relevant data. In case of disagreement a third researcher (MDL) was consulted. A manual search was conducted to identify further relevant studies. Papers that were not written in the English language, or without available full text, or letters to the editor were excluded. No time restriction has been addressed for the research and studies already addressed in the 2018 IFSO position statement were included. Both randomized and nonrandomized studies were included in the review for quantitative analysis, while review and meta-analysis were included for qualitative analysis. The studies were divided into the following categories: (A) OAGB vs another procedure or as a stand-alone procedure, (B) evaluation of long- and short-term complications of OAGB compared or not with RYGB or SG and (C) technical details of OAGB.

In order to reduce the risk of bias, the JADAD score [13] was used to assess the quality of randomized controlled trials (RCTs) and papers with a score of ≥ 3 were included in the analysis. The methodological quality of nonrandomized surgical studies was assessed with a MINORS score. A score ≥ 10 for noncomparative studies and ≥ 14 for comparative studies was fixed as a threshold for inclusion in the analysis [13, 14].

Inclusion Criteria

All types of study design were accepted. Only full text articles were included. For quantitative analysis studies with greater than 15 participants and with greater than 12 months follow-up were included.

Data Extraction

Two authors independently extracted data from the included studies using standardized electronic forms. A third author checked the extracted data for any errors and resolved disagreements between authors. Studies' information included year, degree of evidence of the study, group comparative, primary or revisional, study size, follow-up rate, demographics, technique, weight loss, comorbidities resolution (T2DM, HTN, OSAS, DS), and complications.

Results

Literature Search

The outcome of the search strategy is summarized in the PRISMA flow chart describing literature data screening process (Fig. 1).

Identification

4296 articles were identified from search strategy (from 1946 to June 2020), 4259 from databases (Cochrane, Embase, Medline, PubMed) and 37 from other sources (manual search, gray literature).

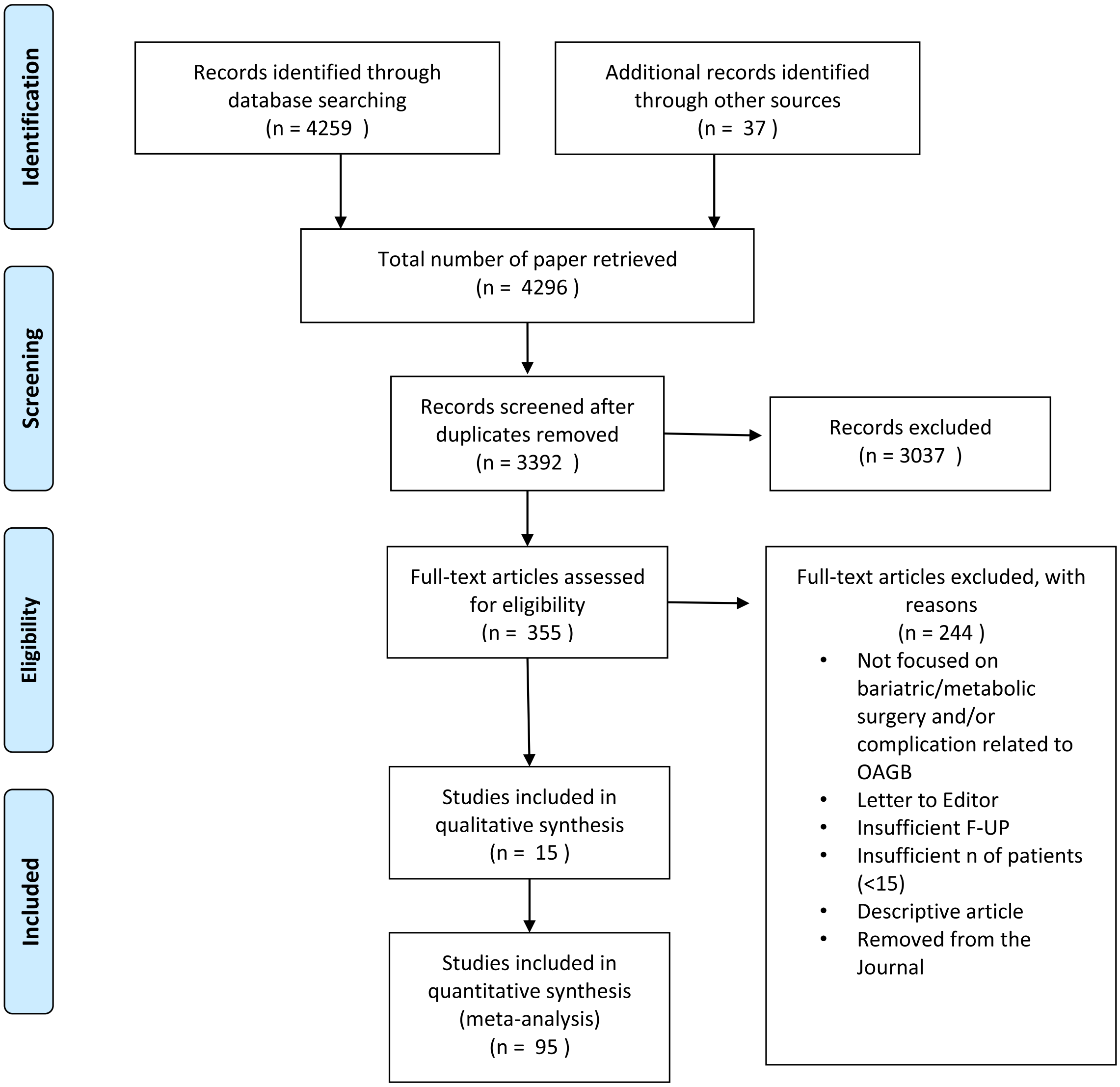

Fig. 1 PRISMA flow chart

Screening

3392 titles and abstract were screened after duplicates removal, and 355 full text were analyzed.

Eligibility

110 full texts articles were assessed for eligibility (244 excluded because not full text, letter to the editor, not in English language, not focused on bariatric/metabolic surgery and/or OAGB complications, insufficient follow-up, insufficient number of patients, and fraudulent article).

Included

110 total number of articles full text reading and included in the final analysis, 95 included in quantitative synthesis (randomized and nonrandomized studies) and 15 included in qualitative synthesis (review and meta-analysis).

The included studies were grouped according to the following categories: (1) OAGB vs another procedure or a standalone procedure (Table 1); (2) evaluation of long- and short-term complications of OAGB compared or not with other surgical techniques (Table 2); and (3) technical detail of OAGB (Table 3).

Overall Summary

A number of 110 good quality studies, 9 randomized and 86 nonrandomized quantitative studies and 15 reviews and meta-analysis of qualitative studies were analyzed. All of them reported number of patients > 15 and follow-up >12 months.

Regarding the 95 studies included in the quantitative analysis, 80 studies analyzed OAGB outcomes (39 focused on

Table 1 Study data on OAGB weight loss and comorbidities

OAGB	423	Mixed	3 years (31 (7.3%))	87 (21%)	44.2±7	BMI 28.8, %EWL 70.5 %EBMIL 80.2 ΔBMI: 15.4BMI 28.8, %EWL 70.5 %EBMIL 80.2 ΔBMI: 15.4	79/79	134/136	43/43	192/ 192	18 (4.3%) minor, 7 (1.7%) major—2 anastomotic bleed, 1 duodenal ulcer with bleeding, 3 leak with abscess, 1 ileus 2 deaths (0.47%)—1 leak in patient with previous VBG, 1 sudden death18 (4.3%) minor, 7 (1.7%) major—2 anastomotic bleed, 1 duodenal ulcer with bleeding, 3 leak with abscess, 1 ileus 2 deaths (0.47%)—1 leak in patient with previous VBG, 1 sudden death	34 (8%) marginal ulcer, 41 (9.7%) anemia
OAGB	30	Primary	12 months (15(50-%))	11 (37%)	41.8 ± 4.5	BMI 30.8 ± 3.1, %EWL 67.6, %EBMIL 65.4 ΔBMI: 11BMI 30.8 ± 3.1, %EWL 67.6, %EBMIL 65.4 ΔBMI: 11	7/7	9/9	8/8	9/10	2 (6.6%) obstruction gastrojejunostomy	1 anastomotic ulcer
OAGB	100	Mixed	12 months (33 (33%))	23 (23%)	46.9±7.4	BMI 31.9 ± 5.7, %EWL 63 ± 14, %EBMIL 68.49 ΔBMI: 15	NR	NR	NR	NR	3 SBO, 1 splenic bleeding, a1 iatrogenic SB injury, 1 perianastomotic abscess, 1UGI bleed, 9 significant diarrhoea	a1 anastomotic stricture, 1 anastomotic ulcer 2 biliary reflux (Mx prokinetic medications)
OAGB	16	Primary	2 years (2(12.5-%)	2 (14%)	62.4 (60–73)	%EWL 57 [12 months], 65 [24 months]	NR	NR	NR	NR	1 intraoperative liver laceration and enterotomy (managed laparoscopically)	
OAGB	644	NR	4 years (253 (39%) [2years], (39.6%) [4years])	175 (27%)	43.1 ± 6.0	(BMI ≤ 40) %EWL 79.1 ± 23.5, (BMI 40–50) 73.1 ± 15.6, (BMI > 50) 67.2 ± 12.5 [2 years]	There were significant improvement in obesity-related metabolic complications, including glucose level, blood pressure, cholesterol, and triglyceride				23 (4.3%) minor complications, 13 (2.0%) major complications (not specified) 1 death (0.016%)	
OAGB	201	NR	5 years (NR)	58 (29%)	40.7 ± 7.5	%TBWL 32.8	87%	NR	NR	NR	51 (6.2%) minor complications, 18 (2.2%) major complications (of whole population (n = 820). (Complications not specified)	
OAGB	197	Primary	3 years (36 [5months], 89 [1year], 66 [2years],	50 (25%)	52.9	34.2 ± 3.4 [6 months], 39.4 ± 4.2 [12 months], 30.3 ± 3.6 [24 months], 28.3 ±	90%	80%	90%	70%	2 PE, 6 melaena 1 death (0.51%): pulmonary sepsis	3 anastomotic ulcers (treated with PPI)

Table 1 (continued)

OAGB	423	Mixed	3 years (31 (7.3%))	87 (21%)	44.2±7	BMI 28.8, %EWL 70.5 %EBMIL 80.2 ΔBMI: 15.4BMI 28.8, %EWL 70.5 %EBMIL 80.2 ΔBMI: 15.4	79/79	134/136	43/43	192/192	18 (4.3%) minor, 7 (1.7%) major—2 anastomotic bleed, 1 duodenal ulcer with bleeding, 3 leak with abscess, 1 ileus 2 deaths (0.47%)—1 leak in patient with previous VBG, 1 sudden death18 (4.3%) minor, 7 (1.7%) major—2 anastomotic bleed, 1 duodenal ulcer with bleeding, 3 leak with abscess, 1 ileus 2 deaths (0.47%)—1 leak in patient with previous VBG, 1 sudden death	34 (8%) marginal ulcer, 41 (9.7%) anemia
			5 [3years]			2.6 [36 months], %EBMIL 88.17 ΔBMI: 24.6						
OAGB	1000	Mixed	5 years (75 (70%))	336 (34%)	Primary 42.5 ±6.39 Revisional 41.25 ±8.34	BMI 28.4 ± 3.8, %EWL 68.6 ± 21.9, %EBMIL 80.57 ΔBMI: 14.1	The rate of complete resolution of comorbidities was superior to 70% at 6 months and to 85% at 1 year				7 leaks, 2 stenosed gastrojejunostomy, 20 bleed, 1 trocar site incarceration (a6 reinterventions), 3 major atelectasis, 1 DVT	33 (4.2%) incisional hernias, 6 stomal ulcers, a4 biliary reflux (converted to RYGB), a4 excessive weight loss
OAGB	21	Revision	2 years (5 (23.8%-))	8 (40%)	Mean 41.7 (range 30–70.8)	BMI 35.7, %EBMIL 51.6 ΔBMI: 6	NR	NR	NR	NR	2 (not specified)	
OAGB	79	Primary	12 months (NR)	18 (23%)	Prediabetic 43.73 ± 7.32, diabetic 43.19 ± 6.21	%EBMIL 80.2	Mean decrease in BGL and HbA1c	NR	NR	NR	NR	NR
OAGB	107	Primary	3 years (51 (47.7%-))	54 (50%)	25.3 ± 3.2	BMI 22.4 ± 4.1 ΔBMI: 1.9	% of HbA1C<7 % 90% at 3 years	NR	NR	NR	5 major complications, including 1 leak requiring conversion to RYGB	2 conversion to RYGB for stenosis ($n = 1$) and perforation ($n = 1$). 22 marginal ulcers, 12 anemia
OAGB	1054	Primary	6 years (86.4%)	342 (32%)	43.2 ± 7.4	BMI 26.2 ± 3.7, %EWL 85 ΔBMI: 17	93.20%	74.80%	97%	91%	4 (0.3%) wound infection, 42 (3.9%) nausea/vomitinga2 (0.1%) leaks, 4 (0.3%) bleed, a2 (0.1%) umbilical hernia obstruction, 2 (0.1%) intraabdominal abscess, 4 (0.3%) DKA	5 (0.6%) marginal ulcer, 68 (7.6%) anemia, 18 (2.0%) biliary reflux, a1 (0.1%) gallstonepancreatitis, a1 (0.1%) port site hernia, a1 (0.1%) excessive weight loss, a1 (0.1%) hypoalbuminaemia
OAGB	50	NR	12 months (35(70-%))	12 (24%)	45.4±6.6	BMI 29.1 ± 3.8, TWBL 36%, %EBMIL 79.9 ΔBMI: 16.3	NR	NR	NR	NR	NR	NR

Table 1 (continued)

OAGB	423	Mixed	3 years (31 (7.3%))	87 (21%)	44.2±7	BMI 28.8, %EWL 70.5 %EBMIL 80.2 ΔBMI: 15.4BMI 28.8, %EWL 70.5 %EBMIL 80.2 ΔBMI: 15.4	79/79	134/136	43/43	192/192	18 (4.3%) minor, 7 (1.7%) major—2 anastomotic bleed, 1 duodenal ulcer with bleeding, 3 leak with abscess, 1 ileus 2 deaths (0.47%)—1 leak in patient with previous VBG, 1 sudden death18 (4.3%) minor, 7 (1.7%) major—2 anastomotic bleed, 1 duodenal ulcer with bleeding, 3 leak with abscess, 1 ileus 2 deaths (0.47%)—1 leak in patient with previous VBG, 1 sudden death	34 (8%) marginal ulcer, 41 (9.7%) anemia
OAGB	81	Mixed	3 years (NR)	NR	47.1±8.5	%EWL 76, mean BMI 30.3, %EBMIL 76 ΔBMI: 16.8	88%	NR	NR	NR	15 (7.5%) a1 bleed (1.2%), a1 leak (1.2%)	15 (7.5%) a2 reoperations (1 ulcer, 1 abscess)
OAGB	128	Primary	7 years (84%)	46 (36%)	33.4±3.3	BMI 24.9 ± 2.4, %EWL 78.5, %EBMIL 101.2 ΔBMI: 8.5	53 (58%)	NR	NR	NR	4 (3.1%) minor—2 (1.6%) wound infection, 2 (1.6%) nausea and vomiting 2 (1.6%) major—a1 (0.8%) bleeding with shock, 1 (0.8%) diabetic ketoacidosis	12 (9.4%)—2 (1.6%) ulcers, 5 (3.9%) anemia, 1 (0.8%) low albumin, 1 (0.8%) bile reflux, 3 (2.3%) excess weight loss
OAGB (revisional vs primary)	33	Revision	5 years (30 (91%))	4 (13%)	45.5±7	BMI 32 ± 5, %EBMIL 66 ± 22 ΔBMI: 13.5	85% (81%)	58% (50%)	50% (5-0-%)	75% (82-%9	2 (6.6%)—1 perianastomotic abscess, 1 port-site hernia	a2 (6.6%)—intractable biliary reflux (convert to RYGB)
OAGB	125	Mixed	12 months (65 (52%))	39 (31%)	Mean 48.1 (34.5–7-3.8)	%EWL mean 79.5 (44.9–138.3)	13/33 stop insulin, 3/33 reduction of insulin, 8/33 remission from oral antidiabetics medications	13/45 total remission, 22/45 improvement	NR	NR	1 (0.8%) wound infection, 1 (0.8%) PR bleed, 1 (0.8%) port site bleed, a1 (0.8%) early SBO	a3 (2.4%) marginal ulcers, a1 (0.8%) perforated marginal ulcer, 1 (0.8%) nonspecific abdominal pain
OAGB	88	Primary	6 years (42%)	33 (38%)	Mean 43 (33–61)	%EWL 72	84%	NR	NR	NR	4 (4.5%)—2 bleeds, 1 reintubation, 1 readmission	
OAGB	196	Primary	12 months (87%)	30 (15%)	44.5 (IQR 40.95–4-8.9)	% EBMIL 88	NR	NR	NR	NR	11 (6%) constipation, 3 (2%) diarrhea, 1 (0.5%) dumping	
OAGB	1200	Mixed	12 years (29 (50%))	456 (38%)	Mean 46	BMI 29.95, %EWL 70%, %EBMIL 76.30 [12 years] ΔBMI: 13.5	94%	94%	90%	96%	16 (1.3%)—a9 intraabdominal bleed, a3 leaks, a2 early SBO	12 (0.8%)—a6 gastroenteric stenosis, 6 marginal ulcers
OAGB	407	Mixed		153 (38%)	41.7±5.8		NR	NR	NR	NR		

Table 1 (continued)

OAGB	423	Mixed	3 years (31 (7.3%))	87 (21%)	44.2±7	BMI 28.8, %EWL 70.5 %EBMIL 80.2 ΔBMI: 15.4BMI 28.8, %EWL 70.5 %EBMIL 80.2 ΔBMI: 15.4	79/79	134/136	43/43	192/192	18 (4.3%) minor, 7 (1.7%) major—2 anastomotic bleed, 1 duodenal ulcer with bleeding, 3 leak with abscess, 1 ileus 2 deaths (0.47%)—1 leak in patient with previous VBG, 1 sudden death18 (4.3%) minor, 7 (1.7%) major—2 anastomotic bleed, 1 duodenal ulcer with bleeding, 3 leak with abscess, 1 ileus 2 deaths (0.47%)—1 leak in patient with previous VBG, 1 sudden death	34 (8%) marginal ulcer, 41 (9.7%) anemia
			12 months (NR)			%EWL 85.1 ± 32, %TWL 33.6 ± 7.8					Primary OAGB—10 (3.2%): a1 (0.3%) leak, 3 (0.9%) obstruction, 6 (1.9%) bleeds, total 1 (0.3%) early reop Revision OAGB—8 (8.2%): a6 (6.1%) leaks, a2 (2.0%) bleeds, total 4 (4.1%) early reop	Primary OAGB—7 (2.1%): 2 (0.6%) dysphagia, 1 (0.3%) cholecystitis, a4 (1.2%) obstruction, total 4 (1.2%) late reop Revision OAGB—1 (1.0%): a1 (1.0%) obstruction, total 1 (1.0%) late reop
OAGB	1520	Mixed	3 years (680 (44.7%))	567 (37%)	46.8±6.6	BMI 27.5 ± 3.4, %EWL 80.2 ± 5.9, %EBMIL 88.5 ΔBMI: 19.5	84.10%	91.6%	NR	NR	50 (3.3%)—7 (0.5%) PE, 13 (0.9%) respiratory distress, 1 (0.1%) leak, 17 (1.1%) abdominal bleeding, 9 (0.6%) GI bleeding, 2 (0.1%) jejunal perforation, 1 (0.1%) DVT 1 death (0.07%): PE	92 (6.1%)—3 (0.2%) gastric pouch enlargement, 3 (0.2%) marginal ulcer, a3 (0.2%) excessive weight loss, 47 (3.1%) iron deficiency anemia, 18 (1.2%) weight gain, a18 (1.2%) intractable reflux
OAGB	74	Revision	12 months (46%)	7 (9%)	46±8.9	BMI 33.2 ± 7.34, %EWL 67 ± 19.6, %EBMIL 62.4 ΔBMI: 12.8	NR	NR	NR	NR	16 (21.6%)—1 (1.4%) port site infection, 5 (6.8%) readmission for poor oral intake, 4 (5.4%) stricture, 2 (2.7%) ulceration, 1 (1.4%) contained leak, 2 (2.7%) SBO requiring conversion to RYGB, 1 (1.4%) respiratory failure	6 (8.1%) conversion to RYGB (1 abdominal pain, 4 GERD, 1 torted bowel loop)
OAGB	407 (102 T2DM patients)	Primary	(85%) 1 year	153 (50 T2DM)	40.5 ± 6.4 (T2DM)	27.39 ± 4.65 BMI (kg/m^2) (T2DM patients) %EBMIL 84.5 ΔBMI: 13.1	91.1%	NR	NR	NR	17 on 407 (4.1%) a6 early reoperations (1.47%)	10 on 407 (2.4 %) a5 late reoperations (1.22)
OAGB	102	Primary	1 year	NR	44.85 ± 9.24	31.65 ± 5.98 BMI (kg/m^2) %EBMIL 66.5 ΔBMI: 13.2	70.59%	NR	NR	NR	NR	NR

Table 1 (continued)

OAGB	423	Mixed	3 years (31 (7.3%))	87 (21%)	44.2±7	BMI 28.8, %EWL 70.5 %EBMIL 80.2 ΔBMI: 15.4BMI 28.8, %EWL 70.5 %EBMIL 80.2 ΔBMI: 15.4	79/79	134/136	43/43	192/ 192	18 (4.3%) minor, 7 (1.7%) major—2 anastomotic bleed, 1 duodenal ulcer with bleeding, 3 leak with abscess, 1 ileus 2 deaths (0.47%)—1 leak in patient with previous VBG, 1 sudden death18 (4.3%) minor, 7 (1.7%) major—2 anastomotic bleed, 1 duodenal ulcer with bleeding, 3 leak with abscess, 1 ileus 2 deaths (0.47%)—1 leak in patient with previous VBG, 1 sudden death	34 (8%) marginal ulcer, 41 (9.7%) anemia
SAGB	29	Revision	1 year (17)	10.3%	42.58 ± 5.83	32.20 ± 5.10 BMI (kg/m^2) %EBMIL 59 ΔBMI: 10.3	NR	50%	NR	0%	3 (10.3%) - 2 leaks, 1 stenosis.	NR
OAGB-MGB	1701	Primary	1 year (1309)	384 (22.6%)	49.61 ± 6.43	29.49 ± 4.7 BMI (kg/m^2) %EBMIL 81.7 ΔBMI: 20.1	NR	NR	NR	NR	NR	NR
MGB	287	Primary	3 years [190 (66%)]	22 (14.6%)	42.7 ± 5.8	28 ± 5.1 BMI (kg/m^2) %EBMIL 83.05 ΔBMI: 14.7	74.6%	47.1%	64%	54.1%	17 (5.9%) a4 (1.4%) reoperations: 2 for bleeding, 2 for leakage	53 (19.5%). 40 (14%) iron deficiency. a22 (7.6%) reoperations: 14 conversion to RYGB (6 for bile reflux). 1 death (0.3%)
OAGB	42	Primary	2 years	8 (19.1%)	47.6±9.1	27.1±5.1 BMI (kg/m^2) %EBMIL 90.7 ΔBMI: 10.5	80%	NR	NR	NR	a1 small bowel strangulation on trocar site	7 (16.6%) iron deficiency
MGB	30	Primary	2 years	6	47.3 ± 7.9	29.65 ± 0.77 BMI (kg/m^2) %EMBIL 79.1 ΔBMI: 17.65	82%	90%	NR	80%	2 (6.6%) minor - 1 (3.3%) chest infection, 1 (3.3%) minor leak	2 (6.6%) minor - bile reflux
OAGB-MGB	519	Primary	3 years (29.6%)	169 (31.86%)	48 ± 8.01	%EWL 77%	70%	58%	99%	55%	a4 (0.75%) afferent limb obstruction; 2 (0.37%) bleeding.	8 (1.52%) stomal ulcerations. a2 (0.37%) deranged liver function - shortening of BPL; 2 (0.37%) diarrhea - reversal/shortening of BPL; 1 (0.18%) excessive weight loss - shortening of BPL; 1 (0.18%) bile reflux – RYGB
SAGB	1731 (815 RY-GB, 1107 LSG)	Primary	10 years (12.47% for SAGB, 5.7% for RYGB,	519 (30%), (232–28.-8% RYGB, 278–25.1-% LSG)	40.4 ± 7.7 (38.5 ± 6.5 RYGB, 36.4 ± 7.6 LSG)	%EWL 70.3% for SAGB, (66.40% for LRYGB, 88.3% for LSG),	77.6% (62.6% RYGB, 100% LSG at 5 years)	47.7% (48.1% RYGB, 57.5% LSG at 5 years)	NR	69.4% (75.-8% RY-GB,	SAGB 97 (5.6%) minor complications and a30 (1.7%) major complications	SAGB a70 (4%) reoperations, 43 for malnutrition; RYGB a41 reoperations (5.1%), 17 for internal hernia; LSG a58 (5.2%), 31 for reflux

Table 1 (continued)

OAGB	423	Mixed	3 years (31 (7.3%))	87 (21%)	44.2±7	BMI 28.8, %EWL 70.5 %EBMIL 80.2 ΔBMI: 15.4BMI 28.8, %EWL 70.5 %EBMIL 80.2 ΔBMI: 15.4	79/79	134/136	43/43	192/ 192	18 (4.3%) minor, 7 (1.7%) major—2 anastomotic bleed, 1 duodenal ulcer with bleeding, 3 leak with abscess, 1 ileus 2 deaths (0.47%)—1 leak in patient with previous VBG, 1 sudden death18 (4.3%) minor, 7 (1.7%) major—2 anastomotic bleed, 1 duodenal ulcer with bleeding, 3 leak with abscess, 1 ileus 2 deaths (0.47%)—1 leak in patient with previous VBG, 1 sudden death	34 (8%) marginal ulcer, 41 (9.7%) anemia
			0.27% for LSG)							31.7-% LSG at 5 year-s)		esophagitis. Overall mortality 0.17%
SAGB	81 (35 RY-GB)	Revision	5 years (37.1%)	21 (12)	37.8 ± 96 (37.1 ± 8.4)	27.8 ± 6.7 BMI (kg/m^2) for SAGB, [30.4 ± 3.7 BMI (kg/m^2) for RYGB] %EBMIL 78.1 (%EBMIL RYGB 55.3) ΔBMI: 10	NR	NR	NR	NR	5 (6.2%) minor for SAGB; 4 (11.2%) minor for RYGB. 9 (11.1%) major for SAGB; 3 (8.6%) for RYGB. aNR	Hb levels at 5 years: 8.2 ± 3.2 g/dl for SAGB, 12.8 ± 0.5 g/dl for RYGB.
OAGB	34 (21 RY-GB)	Revision	1 year (100%)	11 (2)	45.7 ± 8 (36.6 ± 6.9)	36.6 ± 6.3 (33.5 ± 5.6) BMI (kg/m^2) %EBMIL 43.9 (%EBMIL RYGB 26.7) ΔBMI: 9.1	100% (60%)	66.7% (0%)	80% (0-%)	61.5% (25-%)	0	*n*= 12; 35.3% (33.3%) minor complications
OAGB mesh bended	32	Primary	100% at 18mont-hs follow--up	3	41.6 ± 6.18	%EBMIL 95.32 ± 24.91 ΔBMI: 15.2	12.5	68.75	37.5	71.87	0	0

Table 2 Study data on OAGB short- and long-term complications

Study details	$n =$	Age	Male gender	BMI	Study aims	Summary of findings
Chiu et al. (2006) Taiwan, Retrospective cohort comparator [15]	610 (142 LAGB)	32.1±9.3	146 (23.9%)	39.4±7.9	Presents technique for preventing trocar-wound hernias in lap bariatric operations	Used surgical plug into trocar sites of 10-mm and 12-mm ports. Reports 2 patients with trocar wound hernias (0.33% prevalence), which developed at 3 and 5 months Used surgical plug into trocar sites of 10-mm and 12-mm ports. Reports 2 patients with trocar wound hernias (0.33% prevalence), which developed at 3 and 5 months
Rutledge et al. (2007) USA Retrospective cohort [16]	1069	39	15 (38.5%)	45±7	Compare hospitalization episodes pre- and postop for MGB vs RYGB	The rate of hospitalization in the year preceding MGB surgery was 17% compared to 11% in the year post-MGB. Pre-MGB reasons for admission: general medical problems (38%), obstetric/gynecological issues (36%), orthopedic (16%), gallbladder (9%), and renal stones (2%). Post-MGB reasons for admission: surgical complications (29%), gallbladder (20%), renal stones (14%), plastic surgery (11%), appendectomy (9%), gynecological issues (9%), and orthopedic (6%).
Lee et al. (2011) Taiwan Prospective cohort [17]	1322	31.6±9.1	326 (24.7%)	40.2±7.4	Assess revision surgerypost-MGB	Of 1322 patients who had undergone MGB between Jan 2001 and Dec 2009, 23 (1.7%) underwent revision surgery during 9 years follow-up. Reasons—malnutrition ($n = 9$, 39.1%), inadequate weight loss ($n = 8$, 34.7%), intractable bile reflux ($n = 3$, 13.0%) and dissatisfaction ($n = 3$, 13.0%). Conversion to RYGB ($n = 11$, 47.8%), SG ($n = 10$, 43.5%), normal anatomy ($n = 2$, 8.6%). Two patients underwent additional revision: 1 duodenal switch, 1 BPD.
Chen et al. (2012) Taiwan Prospective cohort [18]	120	30.9±10.5	34 (28.3%)	41.4±7.2	Investigate anemia and diet behavior	The overall proportion of anemia rose from 4.1% at baseline to 26.6% post-MGB. The prevalence of anemia in females was higher at baseline and increased by a larger proportion post-MGB, compared to males.
Chen et al. (2016) Taiwan, retrospective cohort [19]	42 [post OAGB (of 49 gastric bypasses requiring revisional sleeve gastrectomy)	30 (20–55) for all patients	8 (16.3%)	25.3±5.6	Present early results of conversion of gastric bypass (both RYGB and MGB) complications to sleeve gastrectomy	The reasons for revision to sleeve gastrectomy were malnutrition (58%—mostly anemia and protein malnutrition), intolerance (18%—including 3 marginal ulcers and 3 bile reflux) and other (14%—including gastrojejunostomy strictures). Rate of perioperative minor complications was 6.1% and the rate of major complications was 8.1% (3 leakages and 1 internal bleeding). Conversion to sleeve was significantly associated with improved hemoglobin and albumin (1 year) and increased total cholesterol (3 years).
Mishra et al. (2016), Retrospective cohort comparator [20]	47 (617 SG, 418 RYGB)	NR	NR	NR	Evaluate prevalence of gallstones and management after surgery in an Indian bariatric population	6 patients with cholelithiasis (12.8%) and 2 with symptomatic cholelithiasis (4.3%) after an overall population follow-up of 32.4 ± 7.2 months. No choledocholithiasis. Management not reported separately.
Saarinen et al. (2017) Finland, Prospective cohort [21]	9	56 (41–65)	5 (55.56%)	42.1 (34.2–54.6)	Investigate bile reflux post-MGB with hepatobiliary scintigraphy	Transient bile reflux in the gastric tube but not the esophagus was identified in 5 patients with hepatobiliary scintigraphy. 1 patient with positive scintigraphy required a reoperation due to malabsorption and nonulcerative GERD. 2 with reflux symptoms had negative scintigraphy.

Table 2 (continued)

Study details	$n =$	Age	Male gender	BMI	Study aims	Summary of findings
Salama et al. (2017) Egypt Prospective cohort [22]	50	35.5±9.39	18 (36%)	NR	Evaluate incidence of biliary reflux	Patients underwent upper gastrointestinal endoscopy and pH monitoring, 18 months after MGB. 3 (6%) with reflux esophagitis—2 (4%) with Grade A acid reflux esophagitis. 1 case with biliary reflux esophagitis.
Musella (2017) [23]	2678	OAGB	793 (30%)	45.4±3.6	Survey to analyze complications after MGB/AOGB	14 (0.52%) intraoperative complication (e.g., loop ischemia, injury to adjacent organs, and anastomotic dehiscence) 84 (3.1%) early complication—43 (1.6%) bleed, 13 leaks, 2 thermal injuries, 6 SB perforation, 4 abdo hernia, 5 anastomotic stricture, 1 gastroparesis, 3 infection, 1 bowel obstruction, 3 pulmonary. Total 49 (1.8%) reoperations.
Baig et al. (2019) India Retrospective multicentric, comparator [24]	9617 (SG 5458, RYGB 2965, OAGB 1194)	41	4078	43	Understand medium- and long-term weight loss outcomes, WR, anemia rates, and albumin deficiency with SG, RYGB, and OAGB	%EWL at 1 year was 70.24 for SG, for 64.06 RYGB, and for 72.35 OAGB, but at 5 years, %EWL was 57.28 for SG, 60.85 for RYGB, and 70.37 for OAGB. Severe albumin deficiency (defined as < 3.0 g/dL) was highest in OAGB (5.9%) patients followed by SG (2.9%) and RYGB (2.2%) at 5 years ($p = 0.023$). OAGB had lesser weight regain in comparison to SG and RYGB but had the most impact on Hb and albumin levels in the long term.
Hussain et al. (2019) UK Retrospective cohort, multicentric [25]	913	44 ± 11.23	312 (33.7%)	48 ± 7.37	Focused on complications requiring revisional surgery after MGB/OAGB	22 (2.3%) required revisional surgery. 5 (0.5%) severe diarrhea - shortening BPL, 4 (0.4%) afferent loop syndrome-conversion to RYGB, 3 (0.3%) bile reflux-conversion to RYGB, 3 (0.3%) postoperative bleeding, 2 (0.2%) liver decompensation-reversal/-shortening of BPL, 2 (0.2%) stenosis of GJ anastomosis, 1 (0.1%) perforated ulcer, 1 (0.1%) excessive weight loss, and 1 (0.1%) protein malnutrition.
Mahawar et al. (2017) UK Survey [26]	36952	NR	NR	NR	Find the magnitude of severe protein–calorie malnutrition requiring revisional surgery after OAGB and any potential relationship with biliopancreatic limb (BPL) length	101 surgeons reported data on 36,952 patients. Overall, 0.37% (138/36,952) of patients needed revisional surgery for malnutrition. The highest percentage of 0.51% (120/23,277) was recorded with formulae using >200 cm of BPL for some patients, and lowest rate of 0% was seen with 150 cm BPL.
Karimi et al. (2017) Iran Retrospective cohort [27]	196	41.34 ± 11.03	30 (15%)	44.54	Investigate the pattern of changes in serum albumin level after minigastric bypass (MGB) and its association with gender, age, and body mass index (BMI) of the patients	The trend of changes in BMI was higher in younger patients (< 40 years of age) and in patients with higher BMI (BMI ≥ 40). Trend of changes in albumin was significantly associated only with age grouping and baseline serum albumin level.
Keleidari et al. (2019) Iran Prospective cohort, comparator [28]	64 (58 RYGB)	34.11 ± 11.32 (33.72 ± 7.94 RYGB)	11 (11 RYGB)	41.73 ± 2.65 (43.93 ± 5.17 RYGB)	Compare the frequency of histologically proven bile reflux in OAGB and RYGB among patients with morbid obesity	The Sydney bile reflux index showed no statistically significant difference between the RYGB and OAGB groups. Similarly, no statistically significant difference was found in the self-reported history of bile reflux-related symptoms, bile reflux markers in esophagogastroduodenoscopy, and postoperative complications between groups.
Khalaj et al. (2019) Iran	189	NR	NR	NR	Effects of fixed 200 cm biliopancreatic limb on protein-calorie malnutrition	7 patients (3.7%), all female, mean age of 46.4 ± 8.2 years and initial BMI of 44.2 ± 4.7 kg/m2, were readmitted for signs of PCM. Hypoalbuminemia in all cases. All underwent

Table 2 (continued)

Study details	n =	Age	Male gender	BMI	Study aims	Summary of findings
Retrospective cohort [29]					(PMC)	revisional surgery. One death. A fixed limb of 200 cm may lead to severe PMC.
Komaei (2019) [30]	32 (32)	42.3 ± 9.7 (44.4 ± 9.1)	6 (7)	43.3 ± 4.4 (45.0 ± 6.9)	The aim of this observational retrospective study was to investigate whether a tailored BPL length relative to SBL is superior to a fixed BPL length of 200 cm in terms of weight loss results and nutritional deficiencies in morbidly obese patients 1 year follow-up	Regarding the nutritional deficiencies, vitamin A deficiency was noted in 31.2% and 9.4%, and vitamin D3 deficiency was present in 28.1% and 6.2% of the patients in 200-cm BPL and tailored BPL groups, respectively. Vitamin B12 deficiency was seen in 12.5% of the patients in the 200-cm BPL group and 6.2% of the patients in the tailored BPL group. Statistically significant differences were observed between the patients in two groups in terms of vitamin A deficiency (p = 0.030) and vitamin D3 deficiency (p = 0.020), whereas the difference between the two groups in terms of vitamin B12 deficiency was not statistically significant (p = 0.391). In the 200-cm BPL group, 18.7% of the patients had iron deficiency, while 12.5% of the patients in the tailored BPL group presented with iron deficiency.
Madhok (2017) [31]	200 (200)	45±11.4 (45 ±11)	61 (61)	49 ±7.3 (48±6.7)	Evaluation of anemia in patients which undergone OAGB VS RYGB	There is a marginally higher risk of being anemic following minigastric bypass compared to Roux-en-Y gastric bypass, although overall incidence of anemia is comparable.
Musella (2019) [32]	196 (104)	46.1±10.5	58 male	42.1±6 (41.4±6.8)	Intra- and postoperative data after conversion from LAGB and SG to OAGB	Compared to the LSG group, patients converted from LAGB had higher complication rates and were more frequently converted with a 2-step procedure due to poor response as the reason for revision. One-step procedures were associated with a higher and almost significant (9.5% versus 2.5%; P 5.05) early complication rate.
Nabil (2019) [33]	30 (30)	37.4 ± 10.2 (39.1 ± 10.5)	4 (6)	52.2 ± 9.7 (54.9 ± 9.2)	Comparison between two modalities of limb measurement in OAGB	To guard against excessive shortening of the small bowel that might increase the risk of nutritional consequences, measuring the total small bowel length (TSBL) is recommended.
Robert (2019), France [34]	117 (117)	43.5 ± 10.8	82 (58)	53.75 ± 6.51 (44.53 ± 3.65)	Noninferiority trial to compare OAGB vs RYGB in terms of outcomes and complications	After 2 years, mean percentage excess BMI loss was −87.9% in the OAGB group and –85.8% in the RYGB group, confirming noninferiority of OAGB. 66 serious adverse events associated with surgery were reported (24 in the RYGB group vs 42 in the OAGB group; p=0.042), of which nine (21.4%) in the OAGB group were nutritional complications versus none in the RYGB group (p=0.0034). Albumin levels, prealbumin levels and vitamin levels at 2 years were not significantly different, and malnutrition at 2 years was not significantly different (OAGB 10.8%, RYGB 16.7%).

Table 3 Study data on the OAGB operative technique

Study details	Primary or revision	LOS	Conversion rate	Pouch and bougie size	Gastro-jejunostomy	Limb length (cm)
Wang (2004) Taiwan [35]	Revision	6.4±3.2 (range 2–28) days	0	60–80 ml (just below crow's foot)	NR	200
Wang (2005) Taiwan [36]	Primary and revision	5 days	0	60–80 ml 1–2 cm diameter	Linear 35-mm stapler	200
Lee (2005) Taiwan [37]	Primary	5.5±1.4 days	1 (2.5% - hypertrophy of left hepatic lobe)	1.5 cm left of lesser curve of antrum	Linear stapler (size not specified)	"Rutledge"
Rutledge (2005) USA [38]	NR	1 days	0.0017	Below crow's foot 28Fr	NR	180
Carbajo (2005) Spain [1]	Primary and revision	36h [24, 27, 30–32, 34–36, 38–96]	2 (0.9%—uncontrollable bleeding)	Level of crow's foot 1 cm NGT	Linear 30-mm stapler, introduced so anastomosis 1.5–2-cm diameter	200
Noun (2007) Lebanon [49]	Primary	3±0.25 days	1 (3.3%)	Rutledge (divided at junction of fundus and antrum)	Linear 30-mm stapler	200
Noun (2007) Lebanon [44]	Primary	3.3±0.6 days	Minilaparotomy. Incision increased by 3 cm in 8 (6.3%)	Crow's foot diameter of the esophagus	Handsewn gastroenterostomy (no size reported)	200
Chakhtoura (2008) France [91]	Primary and revision	8.5±2.2 days	0	Proximal to crow's foot	Linear 45-mm stapler	200
Lee (2008) Taiwan [92]	NR	5 days	0	As per Wang et al. (2004)	NR	150–350
Lee (2008) Taiwan [93]	NR	6.6±5.8 days	NR	As per Wang et al. (2004)	NR	100–300
Piazza (2011) Italy [51]	Primary	5 days	0	Proximal to antrum 36Fr	Linear 60-mm stapler	180–240 (BMI)
Lee (2012) Taiwan [41]	Primary	3.7±4.1	1 (0.1%)	Antrum 2-cm wide gastric tube	NR	200
Noun (2012) Lebanon [94]	Primary and revision	1.85±0.8 (primary); 2.35±1.89 days (revision)	0	Level of crow's foot	Linear 45-mm stapler	150 + 10 for each BMI point above 40
Garcia-Caballero (2012) Spain [97]	Primary	NR	NR	One- and two-stage procedures performed (LAGB removal) Angle of lesser curve, just proximal to crow's foot 36 Fr	Linear 45-mm stapler	200
Lee (2013) Taiwan [84]	NR	NR	NR	Stomach vertically transected alongside endoscope	NR	150 + 10 per BMI category increase
	Revision	NR	0	Corner lesser curve 34Fr	Linear 45-mm stapler	200

Table 3 (continued)

Study details	Primary or revision	LOS	Conversion rate	Pouch and bougie size	Gastro-jejunostomy	Limb length (cm)
Moszkowicz (2013) France [70]						
Darabi (2013) Iran [98]	Primary	5.2±1 days	0	NR	NR	"Rutledge"
Disse (2014) France [78]	Primary and revision	4.2 days	NR	Angle of lesser curve	NR	"Rutledge"
Garcia-Caballero (2014) Spain [81]	NR	NR	NR	12cm 36Fr	NR	120–280 (BMI)
Lee (2014) Taiwan [8]	Primary	NR	NR	"Rutledge"	Linear stapler (size not specified)	120
Greco (2014) Italy [99]	Primary and revision	NR	3 trocar or single incision for all cases	Level of incisura 40Fr	Linear 30-mm stapler	300 cm from ileocecal valve
Kim (2014) South Korea [53]	Primary	NR	NR	BMI < 25, distal lesser curve to gastric fundus. BMI > 25, distal lesser curve to gastric angle	Linear stapler	200
Musella (2014) Italy [80]	NR	4.0 ± 1.7 ICU stay 57.6 ± 50.4 h for 56 (5.7%) of patients4.0 ± 1.7 ICU stay 57.6 ± 50.4 h for 56 (5.7%) of patients4.0 ± 1.7 ICU stay 57.6 ± 50.4 h for 56 (5.7%) of patients4.0 ± 1.7 ICU stay 57.6 ± 50.4 h for 56 (5.7%) of patients	12 (1.23% - 8 adhesions, 2 spleen injuries 1 jejunal loop tear, 1 Veress needle vascular damage)	36–42Fr	Linear 30–60 mm stapler	224.6 ± 23.2
Musella (2014) Italy [85]	NR	NR	NR	4–16 cm, at level of crow's foot	Linear 60-mm stapler	200
Kim (2014) South Korea [53]	Primary	4.5±1 days	1	2 cm proximal to pylorus	Linear 45-mm staple	200
Kular (2014) India [54]	Primary	2.5±1.3 days	0	"Rutledge"	Linear 45-mm stapler	200
Chevallier (2015) France [5]	Primary and revision	NR	NR	Proximal to crow's foot 32Fr	Linear 45-mm stapler	200
Guenzi (2015) France [96]	Primary and revision	NR	NR	34–36 Fr	NR	200

Table 3 (continued)

Study details	Primary or revision	LOS	Conversion rate	Pouch and bougie size	Gastro-jejunostomy	Limb length (cm)
Luger (2015) Austria [95]	NR	NR	NR	40–70 ml	NR	200–220
Blanc (2015) France [100]	Primary and revision	Mean 3 (3–5 days)	8	37 Fr	Handsewn gastrojejunostomy	200
Milone (2015) Italy [79]	NR	NR	NR	40–70 ml 38Fr	NR	200–220
Musella (2016) Europe [90]	NR	NR	NR	15 ± 2.5 cm	NR	190 ± 25.5
Jammu 2016) India [87]	NR	NR	NR	Distal to crow’s foot 38Fr	Linear 45-mm stapler	"Rutledge"
Kular (2016) India [55]	Primary	2.2 ± 1.0	NR	"Rutledge"	Linear 45-mm stapler	200
Madhok (2016) UK [89]	Primary and revision	Median 2 days	0	Incisura 36Fr	Linear 45-mm stapler	200
Genser (2016) France [101]	Primary and revision	NR	NR	38Fr	NR	190 ± 25.5
Kruschitz (2016) Austria [88]	NR	NR	0	30–40-ml sleeve	NR	200
Salama (2016) Egypt [66]	Revision	4.8±2.2 days	NR	Incisura. 36Fr inserted. Stapled on previous staple line. If unable to insert, mesh removed. If still unable, stapled above mesh. If long enough, continued as MGB. If not, converted to RYGB	Linear stapler (size not specified)	180
Parmar (2016) UK [102]	Primary and revision	Mean 2.2 (2–17) days	NR	Incisura 36Fr	Linear 45-mm stapler	200
Peraglie (2016) USA [56]	Primary	1.2 (1–3 days)	0	Level of crow’s foot 28Fr	Linear stapler (size not specified)	180 (most commonly, but varied according to BMI)
Himpens (2016) Belgium (1119)	NR	NR	NR	S	NR	150
Kansou (2016) France [45]	Primary	NR	0	Angle of lesser curve 36Fr	NR	200

Table 3 (continued)

Study details	Primary or revision	LOS	Conversion rate	Pouch and bougie size	Gastro-jejunostomy	Limb length (cm)
Karimi (2017) Iran [27]	Primary	NR	NR	"Rutledge"	Longitudinal 45-mm blue cartridge on the posterior aspect of the pouch	"Rutledge"
Lessing (2017) Israel [103]	Primary and revision	2.2±0.84 days	0	34 Fr	Linear 60-mm stapler	200
Seetharamaiah (2007) India [104]	Primary	3.2±0.6	0	3 cm proximal to pylorus 36Fr	Linear 45-mm stapler	150–180
Ghosh (2017) Australia [72]	Revision	2.6±1.2 days	NR	Distal to crow's foot 36Fr	NR	150
Greco (2017) Italy [105]	Revision	<72h	NR	Ring at base of sleeve to create functional gastric pouch 40Fr	Linear 30-mm stapler	300 cm proximal to ileocecal valve
Musella (2017) Italy [23]	Primary and revision	4.16±1.1 days	20 (0.7%)	4.2 ± 3.4 (below crow's foot)	Musella (2014)	217 ± 13.8 (165–260)
Yeh (2017) Taiwan [106]	NR	NR	NR	Approximately 2 cm wide from antrum	Linear stapler	120
Taha (2017) Egypt [107]	Primary and revision	1.02±2.3 days	0	Level of crow's foot 36Fr	Linear stapler (size not specified)	150–300 (BMI)
Carbajo (2017) Spain [108]	Primary and revision	24h [15–22, 24–121], uncomplicated patients (97.4%); 9 (5–32) day complicated patients (2.6%)	4 (0.3%—2 bleeding, 1 perforation, 1 inflammation)	13–15 cm length 36Fr	Linear 30-mm stapler, 75% inserted, anastomosis 2–2.5 cm	250–350 (BMI dependent)
Shivakumar (2018) India [40]	Primary	3.2 ± 0.64 (3.95 ± 0.73)	NR	36fr OAGB	45-mm blue load	150–180cm
Nabil (2019) Egypt [33]	Primary					200cm (400 from ICV)
Ospanov (2019) Kazakhstan [109]	Primary	3.67 ± 1.47 (4.42 ± 1.61)	0 (0)	30–40cc (50–60cc)	2.0 ± 0.5 cm (3.5 ± 0.5 cm) 2.0 ± 0.5 cm (3.5 ± 0.5 cm)	200cm
Robert (2019), France [34]	Primary	NR	NR	37fr	Mechanical not reported the dimension of stapler	200cm
Rheinwalt (2019) Germany [42]	Primary	4±3.4 (4±3.5)	Not statistically different between the two groups	NR	Mechanical 3.5–5cm of length	200cm <50BMI; 300cm >50BMI
Carbajo (2018) Spain [43]	Primary	1	NR	13–15 cm. NR	Linear stapler	250–350 cm (tailored)

Table 3 (continued)

Study details	Primary or revision	LOS	Conversion rate	Pouch and bougie size	Gastro-jejunostomy	Limb length (cm)
Noun (2018) Lebanon [67]	Revision	NR	0	12cm	NR	150 cm distal to the ligament of Treitz for patients with BMI ≤50 kg/m^2 and 200 cm for patients with BMI >50 kg/m^2
Abouzeid Osman Abouzeid (2018) Egypt [120]	Primary	NR	0	36fr	nr	120cm
Musella (2019) Italy [32]	Revision	NR	0	15.1±6.2 cm	4.4±0.7cm	226±58cm
Komaei (2019) Italy [30]	Primary	NR	0	NR	NR	200cm VS 40% of total small bowel length
Navarrete (2018) Venezuela [46]	Primary	1.99 ± 0.85 (2 ± 0.62)	0 (0)	NR	30-mm blue load	200 cm of small intestine in patients with BMI between 35 and 50 kg/m^2, 240 cm for those > 50 kg/m^2, and 150 cm for those < 35 kg/m^2
Toh (2018) Singapore [47]	Primary	NR	NR	NR	NR	NR
Madhok (2017) UK [89]	Primary	NR	NR	NR	NR	200cm in OAGB VS 50BL/150AL cm in RYGB
Abu-abeid (2017) Israel [57]	Primary	2.2 days	NR	Crow's foot; 34 Fr	Linear stapler	160–200 cm
Ahuja (2018) India [58]	Primary	NR	NR	Crow's foot; 28 Fr	Linear stapler	200 cm
AlSabah (2018) Kuwait [73]	Revision	NR	NR	NR; 38 Fr	Linear 45-mm stapler	175-200 cm
Ansar (2019) Iran [59]	Primary	NR	NR	15–18-cm narrow gastric pouch; NR	Linear 45-mm stapler	100–280 cm (tailored)
Apers (2018) Netherlands [60]	Primary	2	NR	Crow's foot; 34 Fr	Linear stapler	150–250 cm (tailored)
Jamal (2019) Saudi Arabia [61]	Primary	2.5±0.53	NR	Incisura angularis, 36 Fr	Linear 45-mm stapler	200 cm
Abdallah (2018) Egypt [62]	Primary	2 days	NR	NR; 39 Fr	Linear 45-mm stapler	200–250 cm

Table 3 (continued)

Study details	Primary or revision	LOS	Conversion rate	Pouch and bougie size	Gastro-jejunostomy	Limb length (cm)
Hussain (2018) UK [62]	Primary	2	NR	Crow's foot, 36 Fr	Linear 45-mm stapler	150–200 cm (tailored)
Alkhalifah (2017) Taiwan [64]	Primary	NR	NR	Crow's foot; 36 Fr	Stapler	150–250 according to BMI
Almalki (2017) Taiwan [74]	Revision	4.0 ± 1.9 (2.9 ± 0.8 RYGB)	NR	Crow's foot; 38 Fr	Linear stapler	200 cm
Chiappetta (2018) Germany [75]	Revision	5	0	Crow's foot; 42 Fr	Linear 45-mm stapler	200 cm
Ospanov (2019) Kazakhstan [65]	Primary	3 (2–4)	0	32fr with a Mesh strip pulled into the retrogastric canal and gastroplication around the band	Hand sewn	150cm in BMI<40kg/m^2 and 200cm in BMI>40kg/m^2
Boyle (2020) UK [48]	Primary	NR	A total of 18 patients (15 in the OAGB-200 group and 3 in the OAGB-150 group) had been converted to Roux-en-Y configuration for symptomatic acid/volume reflux	Crow's foot 36 Fr	45-mm linear stapler	200cm VS 150cm
Elgeidie (2020) Egypt [39]	Primary	NR	NR	36Fr Bougie	After full insertion of the 60-mm blue reload into the jejunum and the gastric tube, the narrow GJ measuring 30 mm was made by applying two squeezes of the stapler, as each squeeze gives 15 mm.	200cm from Treitz's Angle

OAGB as primary procedure, 41 as revision/secondary procedure or mixed,) with a total of 23,341 patients; 7 of these studies were also included in the group focused on complications, for a total of 22 studies. The follow-up rate of the above mentioned studies were 86.4% at 1 year, 65.1% at 3 years, and 55.4% at 5 years.

The average preoperative body mass index (BMI) ranged from 25.3 to 67 kg/m^2, with a mean study BMI of 44.52 ± 5.54 kg/m^2.

In the 80 studies that reported data on weight loss, the average observed %EBMIL was 79.14 ± 14.8 (including revision operations), and 83.77 ± 13.41 (only primary operations) at a mean time of 3.2 ± 4.4 years.

In the 19 studies that reported diabetes remission the average observed remission was 75.8% ± 12.2 at a mean time of 2.9 ± 3.4 years. In the 13 studies that reported hypertension remission the average observed remission was 61.2% ± 13.3 at a mean time of 3.1 ± 3.4 years. In the 8 studies that reported dyslipidemia remission the average observed remission was 70.4% ± 8.4 at a mean time of 3.8 ± 2.8 years. In the 5 studies that reported OSAS remission the average observed remission was 79.9% ± 12,3 at a mean time of 3.9 ± 3.2 years.

Outcomes After OAGB

We summarized 9 randomized controlled trials, 17 prospective nonrandomized studies, 53 retrospective studies, and 1 case series study. Forty-one studies reported OAGB as primary procedure, 12 studies as revisional procedure, and 29 studies as mixed procedure.

Weight Loss (WL)

Data on weight loss are reported in Table 1.

Nine randomized controlled trials reported weight loss collecting 431 patients with "regular" primary OAGB, 40 patients with banded OAGB and 30 patients with "distal" OAGB. Mean follow-up was 25.33 months, mean calculated %EWL 67.85, mean calculated %EBMIL 87.54 and mean Change in BMI (ΔBMI) is 13.9.

Outcomes were reported after 1 year in three studies, with OAGB patients achieving %EWL of 66.9 ±23.7 (%EBMIL 65.7, ΔBMI 16.1) [98], 66.9 ± 10.9 [104] and 63.1 ± 8.7 (in this study, the "distal" OAGB group achieved %EWL 69.4 ± 15.4, %EBMIL 69.5, ΔBMI 16.0) [33].

Four studies reported data after 2 years of follow-up. OAGB patients achieved %EWL of 64.4 ± 8.8 (%EBMIL 83.3, ΔBMI 16.5) [37], %EBMIL 94.29 ± 23.63, ΔBMI 14.0 ("banded" OAGB, compared to %EBMIL of 77.90 ± 29.25 in "regular" OAGB, ΔBMI 12.3) [109], %EBMIL 87,9 [34] and %EWL 74.6 ± 11.8 [39].

One RCT reported %EWL 66.48 after 3 years of follow up [40].

After 5 years, one study reported %EBMIL 134.6, ΔBMI 6.9 [8].

Four prospective studies [41–44] reported data on 1713 patients who underwent a primary OAGB procedures. Mean follow-up was 31.1 months, mean calculated %EWL was 76.12, mean calculated %EBMIL was 73.15 and mean ΔBMI 14.4.

Twenty-four retrospective studies [24, 27, 30, 31, 45–64] reported data on 8531 primary OAGB patients. Mean follow-up was 27.9 months, mean calculated %EWL was 75.59, mean calculated %EBMIL was 83.41 and mean ΔBMI 14,2.

There are currently no RCT reporting on the outcomes of OAGB in the revisional setting .

One case series [65] reported %EMBIL 95.32 ± 24.91 after 18 months of follow-up and ΔBMI 15.2.

Two prospective studies reported data on 60 patients who underwent revisional OAGB. Mean follow up was 12 months; the reported %EBMIL varied from 64.8 (ΔBMI 9.6) [66] to 81.6 [67].

Ten retrospective studies [32, 35, 68–75] reported data on 711 revisional OAGB procedures. The mean follow-up was 18.5 months, mean %EWL was 71.85, mean %EBMIL was 65.03 and mean ΔBMI 10.6.

Data on weight loss from the studies reporting mixed procedures are available in Table 1 [1, 5, 36, 38, 76–96, 102, 103, 107, 108].

Type 2 Diabetes Mellitus (T2DM)

Diabetes or metabolic syndrome was reported upon as a comorbidity of interest in 52 papers, among them this outcome was reported in all RCT [8, 33, 34, 37, 39, 40, 98, 104, 109].

As reported in the previous statement [3], in the Lee trial comparing OAGB to RYGB, there was 100% resolution of the metabolic syndrome at 2 years [37]. At 12 months no other treatment for T2DM was required for 50% of T2DM participants in a study [98] and no other treatment was required for 84% of T2DM participants in another study [104]. At 5 years, 60% of participants with T2DM at baseline had a HbA1c < 6.5% without medications in the low BMI trial focusing on change in diabetes [8].

In the subsequent RCTs, T2DM remission rates at 1 year were available in 3 studies 86.63% [104], 64.3% [33], and 52.6% [109]. At 2 years follow-up, the remission rate was 95.7% and 60% [34]. At 3 years a remission rate of 89.6 % has been reported in one study [40].

In terms of progression of HbA1c, plasma values went down, reporting a value of % of HbA1C<7 in 90% of patients at 3 years in one study [53] and reduced by 2.3% over the course of 2 years in another study [34]. This significant reduction occurred in the subgroup of diabetics as well.

In the remaining studies, major improvement in T2DM management was reported (Table 1).

Hypertension (HTN)

HTN was reported upon as a comorbidity of interest in 36 papers, and among them this outcome was reported in 5 RCT [33, 40, 98, 104, 109].

Darabi et al. report HTN resolution in 2 out of 3 patients at 1 year of follow-up [98].

Seetharamaiah et al. report resolution of HTN at three months in 35,84% of affected patients [104].

Shivakumar et al. report a remission rate of 64.15% at 1 year, 67.31% at 2 years, and 74% at 3 years [40].

Nabil et al. report a resolution rate of 40% 1 year after OAGB-MGB [33], and Ospanov et al, RCT study, report remission rate of 60% at 2 year [109].

In 30 studies (no RCTs), improvement in HTN management was reported (Table 1).

Obstructive Sleep Apnea Syndrome (OSAS)

OSAS was addressed in 20 of the analyzed papers, but none of them was RCTs (Table 1).

Dyslipidemia (DL)

DL was addressed in 26 of the analyzed papers, including 3 RCTs [33, 34, 98].

Darabi et al. report a remission of DL in 4 of the nine-patient affected during the follow-up of 1 year [98].

Nabil et al. report DL remission in 82.6% of the subjects after 1 year [33].

In 22 studies (no RCTs), major improvement in DL management was reported (Table 1).

Quantitative Analysis of Complications (Table 1–Table 2)

Complications reported in the studies focused on outcomes are shown in Table 1.

Complications were divided into early complications (≤30 days after surgery) and late complications (>30 days after surgery).

Early complications included anastomotic leak, wound infection, hematomas, hemorrhage, anastomotic stricture, and organ perforation/peritonitis. A total of 1082 early complications were reported among 19,051 OAGB procedures, with an overall incidence of 5.51% and a reoperation rate of 1.01%.

Primary procedures incidence rate 4.91%, revisional procedures incidence rate 7.9%.

Eleven cases of early death (overall incidence of 0.056%) were reported. Four of them for pulmonary embolism. Three cases for complications related to leak after revisional OAGB.

Late complications included marginal ulcers, bowel obstruction, malnutrition, and gastroesophageal reflux including biliary reflux. A total of 1025 late complications were described among 18763 OAGB procedures, with an overall incidence of 5.46% and a reoperation rate of 1.34%.

Primary procedures incidence rate 6.30%, revisional procedures incidence rate 5.58%.

A total of 25.76% of total reoperations were conversions to RYGB.

In 18.34% of the cases, late reoperations were required for bile reflux and 36.46% for malnutrition.

Eight cases of late death (overall incidence of 0.042%) were reported.

Table 2 reports studies focused on complications specifically related to OAGB such as reasons for readmission [15, 16, 20, 25, 32], malnutrition, anemia, and bile reflux.

Ten studies reported malnutrition as a direct effect of OAGB [17, 19, 24, 27, 29, 30, 33, 34, 110, 111]. Malnutrition appears to be the main cause of revisional surgery after OAGB [17, 19], and may be worse with the OAGB as compared to sleeve gastrectomy or RYGB [24].

Five studies [29, 30, 33, 110, 111] reported data on different biliopancreatic limb lengths and their effect on malnutrition and nutritional deficiencies. Two studies, one RCT consisting of 60 patients, [33], and one retrospective study consisting of 101 patients [110], confirmed a correlation between BPL length and the incidence of malnutrition. Another study that collected data on 36,952 individuals found that 92.3% of reoperations for malnutrition were associated with BPL length of over 200 cm [111].

Along the same lines, another analysis found a prevalence of 3.7% of hypoalbuminemia in patients with a BPL of 200 cm [29]. Interestingly, age > 40 years and low preoperative levels of plasma albumin (<4.0 g/dl) may worsen this condition [27]. Similarly, a fixed BPL of 200cm can be accompanied by hypovitaminosis, particularly vitamin A and vitamin D3 [30].

Regarding anemia [18, 31], one study [31] compared OAGB with RYGB, demonstrating a nonstatistically significant higher risk of being anemic following OAGB compared to RYGB (16.6% vs 12.7% after 2 years, $p<0.55$).

Several studies reported data on bile reflux [21, 22, 28, 91, 103, 107, 108], a major cause of revision after OAGB [17] although one study demonstrated no difference in histologically proven bile reflux between OAGB and RYGB [28].

Operative Technique (Table 1–Table 3)

The description of operative technique was reported in 28 of the analyzed studies, including 5 RCTs.

In order to standardize the review, we analyzed 3 steps of OAGB that may impact on the weight loss and potential intra and post-operative complications, in particular:

– Pouch and bougie size

– Gastro-jejunostomy fashioning
– Limb length

Pouch and bougie Size

Pouch and bougie size have been addressed in 22 studies, including 3 RCTs [34, 40, 109]. In the RCTs, the reported bougie size was either 36 [40, 109] or 37 French [34]. In the cohort studies, most teams use a 36 French bougie, but sizes ranged from 28 French [58] to 42 French [75]. Concerning the size of the pouch, there is a great disparity in reporting both in RCTs and in cohort studies. In the RCTs, only 2 report on the pouch size: one in terms of pouch length, i.e., 20 cm (n=180) [109], and the other in terms of pouch volume, i.e., 50–60 cc, (n=80) [104]. In the cohort studies, when mentioned, the pouch is mostly sized using anatomical landmarks (incisura angularis or crow's foot and Angle of His).

Gastro-jejunostomy

The gastro-jejunostomy technique has been reported in 23 of the analyzed studies, including 4 RCTs [34, 40, 104, 109]. In the RCTs the technique of gastro-jejunostomy was mainly mechanical using the linear stapler [34, 40, 109]. Stapler load size (45 mm) was reported in one study with 101 patients [104].

Limb Length

Limb length has been reported in 25 of the quantitative analyzed studies, including 3 RCTs [34, 40, 109]. In the RCTs, the length of the BPL was 200 cm in 227 patients [34, 109], 150 to 180 cm in 101 individuals [104], and depending on total bowel length in 180 individuals, which translated in an average BPL length of 279 cm [30, 46]. In the remaining literature there is no homogeneity regarding this item.

Qualitative Analysis

The list and description of the selected review articles and metanalysis can be found in Table 4.

In 3 metanalyses [112–114] comparing a total of 12,866 OAGB patients versus 8804 RYGB, weight loss and T2DM remission at 1, 2, and 5 years were significantly better for OAGB. One study [112] found more malnutrition after OAGB and more intestinal obstructions after RYGB. No other significant differences in outcomes were registered in these 3 meta-analyses.

In one meta-analysis comparing a total of 1998 OAGB patients versus 1864 LSG patients, weight loss (EWL) at 1 and 5 years, as well as T2DM remission and HTN remission, was significantly better in the OAGB cohort [115].

In one meta-analysis observing the outcomes in up to 12 years follow-up in 12,807 OAGB patients, EWL at 5 years was 76.6%, and T2DM remission was obtained in 83.7% and HTN remission in 66.94%. Marginal ulcer rate was 2.7%, anemia rate 7.0%, and 0.71% developed malnutrition. Approximately 2.0% of patients reported postoperative gastroesophageal reflux [112].

In a systematic review involving 318 superobese (BMI ≥ 50) patients, early mortality was 0.31% (1 patient) and major complications were 2.2 % (7 patients). The leak rate was 0%, and the mean% EWL at 60 months was 90.75% [116].

In a systematic review of 69 publications (4 RCTs, 11 review articles, 54 clinical studies) with a total of over 38,000 patients, OAGB was demonstrated to have a short operative time, low complication rate, and excellent weight loss outcomes. The longer-term issues of nutritional deficiencies and bile reflux could not be addressed due to a paucity of long-term follow up data. [117].

In a network meta-analysis of 25 eligible RCTs, covering nonsurgical treatments and 8 different surgical procedures, including 1211 patients, it appeared that BPD and OAGB achieved higher T2DM remission rates than other bariatric procedures. However, the trials regarding OAGB and BPD were in the minority of the RCTs included in the meta-analysis (2 trials and 1 trial, respectively). Moreover, the number of patients included in studies of these procedures was small [118].

Discussion

The analysis of quantitative and qualitative studies demonstrates the effectiveness of the OAGB as a weight loss procedure. The magnitude of weight loss appears to be at least equivalent to RYGB and potentially superior to SG and GB. Quantitative analysis demonstrated that weight loss was greater for patients who had OAGB as their primary operation when compared to patients who had the OAGB as revision surgery after SG and GB. There appear to be differences in terms of weight loss in relation to the different surgical techniques used, particularly in relation to the length of the BPL, but this latter finding cannot be affirmed with certainty because of the limited number of studies focusing on this particular detail.

OAGB appears to have favorable effects on T2DM remission, as detected in the quantitative analysis, as well as in the qualitative analysis, both in short-term and in medium-term follow-up studies, i.e., after 24 months and 60 months, respectively.

The effects of OAGB on HTN, OSAS and dyslipidemia also seemed favorable, but the data are too few and follow up is too short to be conclusive.

Table 4 OAGB qualitative analysis

Authors (year)	Study details	Study aims	Summary of findings
Deitel (2019), Canada [122]	Editorial article	To describe history of MGB and OAGB	MGB started in 1997 by Rutledge; in 2001 first paper on 1274 cases of MBG. International acceptance . In 2002 Carbajo started the OAGB, as a modified technique to avoid potential bile reflux. MGB and OAGB had similar excellent results. In 2015 took place the first MGB Conclave in New Delhi. In Vienna was founded the MGB-OAGB Club.
Mahawar (2017), UK [123]	Survey	To understand various perioperative practices on OAGB/MGB	Two hundred and ten surgeons from 39 countries answered survey, collecting experiences on 68442 MGB/OAGB procedures; 71% routinely perform preoperative UGI endoscopy; 94% use bougie to size the pouch. Several differences in technical aspects. PPI prophylaxis recommended in 89% of the cases. Several differences in micronutrients supplementation. Findings useful to identify areas of future research and to allow consensus statement.
Mahawar (2017), UK [26]	Consensus statement	To achieve consensus on perioperative practices on OAGB/MGB	Sixteen recognized committee members; 101 experts on OAGB/MGB from 39 countries voted 55 statements in areas of controversy or variation associated with this procedure. Consensus (>70%) on 48 statements. Among the experts, 100% felt that OAGB/MGB was an acceptable mainstream surgical option. Approximately 94.0% of the experts felt that the construction of the gastric pouch should start in the horizontal portion of the lesser curvature. Consensus of 82, 84, and 85% for routinely supplementing iron, vitamin B12, and vitamin D, respectively.
De Luca (2018) [3]	IFSO position statement, systematic review	To determine the role of OAGB/MGB as surgical option for the treatment of obesity and metabolic disease	Fifty-two studies and 16,546 patients were analyzed . Average %EWL was 74.8 ± 12. T2DM resolution in 87.4% of patients. The identifier name for the procedure is OAGB. Promising early results in terms of weight loss and T2DM resolution. The OAGB is a recognized bariatric/metabolic procedure, not an investigational one.
Parikh (2018) [117]	ASMBS review on OAGB	To report technical and outcome aspects of one anastomosi gastric bypass provided by literature	Sixty-nine studies (11 review articles, 54 clinical studies, 4 RCTs). OAGB/MGB has short operative time, low complication rate, excellent weight loss outcome. Concerns on long-term nutritional deficiencies and bile reflux due to lack of long-term follow-up.
Abou Ghazaleh, (2017), France [124]	Review	To determine the role of MGB for treatment of T2DM, in comparison with other bariatric procedures	Low number of RCTs. Regarding T2DM resolution OAGB/MGB is a noninferior (probably superior) alternative to RYGB. OAGB/MGB seems to be superior to SG and LAGB for treatment of T2DM.
Braghetto (2017), Chile [125]	Review	To report experiences after BII anastomosis and its potential adverse effects on gastric and esophageal mucosa	Fifty-seven studies analyzed from 1980 to 2016. BII is associated with higher bile reflux when compared to RYGB. OAGB/MGB modifies the BII technique to avoid bile reflux, furthermore, it achieves better results in term of weight loss when compared to RYGB. Studies focused on bile reflux are required.
Parmar (2018), UK [112]	Systematic review	To include OAGB/MGB as a mainstream bariatric procedure	Twenty-two studies analyzed, involving 12807 MGB-OAGB procedures. Overall mortality 0.10%, leak rate 0.96%. The follow-up duration ranged from 6 months to 12 years. Marginal ulceration rate of 2.7%. Anemia rate of 7.0%. Approximately 2.0% of patients reported postoperative gastro-esophageal reflux and 0.71% developed malnutrition. %EWL at 6, 12, 24 and 60 months was 60.68, 72.56, 78.2, and 76.6%, respectively. T2DM and HTN resolved in 83.7 and 66.94%, respectively.
	Systematic review		

Table 4 (continued)

Authors (year)	Study details	Study aims	Summary of findings
Parmar (2019), UK [126]		To evaluate the role of OAGB/MGB in patients with BMI ≤ 35 kg/m2	9 studies on 376 OAGB/MGB procedures on patients with BMI ≤ 35 kg/m2. Median limb length was 120 cm (range 100–200 cm). Mean HbA1c came down from 9.13% preoperatively to 6.14% postoperatively. Total cholesterol levels came down from a mean of 197.8 mg/dL preoperatively to 120.6 mg/dL postoperatively. Mortality was 0%. Marginal ulceration rate was 6.3% and anemia rate was 4.7%. Low albumin was reported in 1 (0.2%) patient. Mean BMI came down to 23.76 kg/m2 at 12 months.
Parmar (2019), UK [116]	Systematic review	To explore the role of OAGB/MGB in super-obese patients (BMI ≥ 50 kg/m2)	8 studies involving 318 superobese patients undergone MGB/OAGB. The biliopancreatic limb (BPL) varied from 190 to350 cm(median 280 cm). Early mortality was 0.31% with seven complications (including 1 revisional surgery). Leak rate was0%. Mean %EWL at 12, 18–24 and 60 months was 67.7%, 71.6%, and 90.75%, respectively. Weight loss is comparable or even better to that of RYGB and SG.
Wang (2017), China [115]	Meta-analysis and systematic review	To compare safety and effectiveness between laparoscopic MGB and laparoscopic SG	14 studies analyzed (2 RCTs), 3862 patients (1998 MGB, 1864 SG). MGB resulted in statistically higher %EWL at 1-year and at 5-years, higher remission rate of T2DM, HTN, and OSAS. Early complications rate was similar between the two techniques (leak rate was higher in SG). Late complications were higher in the SG group. Bile reflux and malnutrition not analyzed.
Wang (2018), China [113]	Meta-analysis and systematic review	To compare outcomes between MGB and RYGB	11 studies analyzed (1 RCT), 8492 patients (4558 MGB, 3934 RYGB). 1- and 2-years %EWL was greater after MGB. MGB achieved a higher T2DM remission rate. No differences in HTN resolution, mortality, leak rate and GERD was found between the two techniques.
Jia (2020), China [114]	Meta-analysis and systematic review of randomized controlled trials	To compare efficacy and safety outcomes of OAGB with RYGB	3 RCTs were analyzed, with a total of 733 patients (364 OAGB, 369 RYGB). %EBMIL after 2 years was greater for OAGB. T2DM resolution was greater after OAGB. No statistically significant difference was found between both surgical groups in adverse events (including malnutrition).
Magouliotis (2018), Greece [127]	Meta-analysis and systematic review	To compare clinical outcomes of OAGB with RYGB	11 studies analyzed (3 RCTs), 12445 patients (4501 RYGB, 7944 OAGB). %EWL at 5 years and T2DM resolution rate greater in the OAGB group. No differences in HTN and dyslipidemia resolution. Leak rate, ulcer rate, dumping and mortality rate similar between 2 groups. More malnutrition in OAGB. More small bowel obstructions and internal hernias after RYGB.
Kodama (2018), Japan [118]	Network meta-analysis of randomized controlled trials	To determine the efficacy of different bariatric procedures for diabetes remission	25 eligible randomized controlled trials, covering nonsurgical treatments and eight surgical procedures. Results indicated that BPD and OAGB/MGB achieved higher diabetes remission rates than the other procedures. (Results to be interpreted with caution because these procedures were in the minority).

The current literature suggests that OAGB is a safe procedure. The percentage of early perioperative complications is low, even in comparison with RYGB. Major perioperative complications, such as need for blood transfusion, return to the operating room and/or prolonged length of hospital stay, are seen in 2-3% of the patients and perioperative mortality is <0.5%.

There are only a few studies with long-term (10 years) follow-up reporting on long-term outcomes. Some studies do report medium (5 years) follow-up, but in the majority of the studies follow up is limited to <5 years. Given the short-term nutritional outcomes and the anatomical changes that are made with this operation, it will be important in the future to document the risk of protein malnutrition, anemia and hypovitaminosis. On the basis of current knowledge, the impact of factors such as the BPL length and patient starting BMI will be important variables to consider.

Bile reflux is described as a reason for conversion from OAGB to RYGB in several studies, however this does not seem to be a frequent problem in the quantitative and qualitative studies analyzed.

In the quantitative studies we reviewed, no cases of cancer were reported, although this may represent inadequate endoscopic follow up and the lag time between the procedure and the cancer developing. It is hoped that the recent IFSO position statement recommending 2–3 yearly gastroscopies following OAGB will provide the opportunity for early detection should there be an issue, as well as better data in the future to help address this important issue [119].

It's interesting to compare the findings of this current systematic review to a recent IFSO publication presenting data gathered from 101 experts on OAGB from 39 countries who voted on 55 statements in areas of controversy or variation associated with OAGB. In this study, all of the experts felt that OAGB was an acceptable mainstream surgical option. Approximately 94% of the experts felt that the construction of the gastric pouch should start in the horizontal portion of the lesser curvature. There was a consensus of 82, 84, and 85% for routinely supplementing iron, vitamin B12, and vitamin D, respectively [26].

Recommendation of the IFSO OAGB Taskforce

1. OAGB should remain the official IFSO-approved identifier for this procedure. MGB and OAGB may be different operations in the mind of some authors, but both operations are similar as they both have a single gastro-jejunal anastomosis and furthermore, most studies report on an operation that is not a pure MGB or a pure OAGB, but rather a mixed technique. We have learned from other procedures (e.g., RYGB, BPD, DS) that it is essential to define each type of intervention under a single name. For these reasons, IFSO selected OAGB as the approved identifier for this procedure.
2. The outcomes from OAGB are promising in terms of short operative time, low perioperative complication rate, good weight loss and good comorbidities remission (T2DM, HTN, OSAS, and DL) and appear at least equivalent to other bariatric surgery procedures.
3. OAGB in the primary setting provides better weight loss, comorbidity reduction and fewer complications when compared to the outcomes when OAGB is performed as a revisional procedure. Patients should be aware of these differences if undertaking OAGB as revisional procedure.
4. At this stage, bile reflux does not seem to be a major issue for patients who have undergone OAGB and there have not been increased reports of esophageal or gastric cancer. Due to the risk of under reporting and the time lag for carcinogenesis following OAGB, we recommend that patients should remain under the care of their multidisciplinary bariatric team and have regular endoscopic examinations as per the IFSO position statement on endoscopy [119].
5. While the data is currently lacking, long-term nutritional deficiencies due to the malabsorptive nature of OAGB procedures should be considered and patients should have at least an annual nutritional review and appropriate micro- and macronutrient supplementation. Long-term observational studies should be undertaken, potentially using national registries, to better understand nutritional requirements. Given that BPL length appears to be an important variable, RCTs are warranted to address this important issue.
6. The majority of the studies included in this review are case studies with <5 years follow up. In order to increase the body of evidence, patients should be encouraged to remain in long-term multidisciplinary care, and clinics should be encouraged to participate in registries, as well as longer-term follow-up studies, and possibly RCTs.

Abbreviations OAGB, One anastomosis gastric bypass; MGB, Minigastric bypass; SAGB, Single anastomosis gastric bypass; OLGB, Omega loop gastric bypass; BAGUA, Bypass gastrico de una anastomosis; SG, Sleeve gastrectomy; RYGB, Roux-en-Y gastric bypass; AGB, Adjustable gastric banding; RCT, Randomized controlled trials; CS, Cohort studies; BPL, Biliopancreatic limb; CL, Common limb; TSBL, Total small bowel length; BII, Billroth II; T2DM, Type 2 diabetes mellitus; HTN, Hypertension; OSAS, Obstructive sleep apnea syndrome; DL, Dyslipidemia; PCM, Protein-calorie malnutrition; ICV, Ileocecal valve; BMI, Body mass index; EWL, Excess weight loss; EBMIL, Excess body mass index loss; ΔBMI, Mean change (Δ) in BMI; TWL, Total weight loss

Declarations

No ethical review is required for this activity.

Conflict of Interest Maurizio De Luca reports grants from Johnson and Johnson, grants from Medtronic, and consultancy fees from Novo Nordisc. All were outside the submitted study.

Jacques Himpens reports consultancy fees from Johnson and Johnson and Medtronic.

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Scott Shikora reports consultancy fees from Medronic. Scott Shikora is the editor-in-chief for Obesity Surgery.

The rest of the authors declare no conflict of interest.

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