



# IFSO Worldwide Survey 2016: Primary, Endoluminal, and Revisional Procedures

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## Abstract

**Background and Aim** The International Federation for the Surgery of Obesity and Metabolic Disorders (IFSO), being a Federation of 62 national societies, is the ideal network to monitor the number and type of procedures at a global level. The IFSO survey, enriched with a special section on revisional procedures, aims to report the number and types of bariatric procedures performed worldwide in 2016 and analyzes the surgical trends from 2008 to 2016.

**Methods** The 2016 IFSO Survey form was emailed to all IFSO societies. Each Society was requested to indicate the number and type of bariatric procedures performed in the country. Trend analyses from 2008 to 2016 were also performed.

**Results** The total number of bariatric/metabolic procedures performed in 2016 was 685,874; 634,897 (92.6%) of which were primary and 50,977 were revisional (7.4%). Among the primary interventions, 609,897 (96%) were surgical and 25,359 (4%) were endoluminal. The most performed primary surgical bariatric/metabolic procedure was sleeve gastrectomy (SG) ( $N=340,550$ ; 53.6%), followed by Roux-en-Y gastric bypass ( $N=191,326$ ; 30.1%), and one-anastomosis gastric bypass ( $N=30,563$ ; 4.8%).

**Conclusions** In 2016, there was an increase in the total number both of surgical and endoluminal bariatric/metabolic procedures. Revisional procedures represent about 7% of the total bariatric interventions. SG remains the most performed surgical procedure in the world.

**Keywords** Bariatric metabolic surgery · Worldwide survey · Endoluminal and revisional procedures

## Introduction

The obesity epidemic continues to grow, and bariatric and metabolic procedures remain the most effective treatment [1]. Due to its multifactorial pathogenesis, a variety of surgical options are currently offered for the treatment of obesity. Since the beginning of the third millennium, a constant evolution of

minimally invasive techniques, such as laparoscopy and flexible trans oral endoscopy, has been observed [2]. This progress took place through modifications of standard methods, development of new devices, and occasionally through experimentation of new strategies. The therapeutic armamentarium is expanding; the demand is massive and there is a serious lack of resources. The International Federation for the Surgery of

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Obesity and Metabolic Disorders (IFSO), being a Federation of 62 national societies, is the best entity to monitor the number and type of procedures at a global level. Although many surgeons do not contribute to the IFSO Registry, the trend analysis and the percentage of growth give an immediate universal view of the most frequently performed techniques and their evolution. IFSO is the only organization pursuing the aim of collecting data of bariatric and metabolic surgery worldwide. IFSO survey has been enriched with a special section on revisional procedures. Therefore, we reported the number and types of bariatric procedures (surgical and endoluminal, primary and revisional) performed worldwide in 2016 and the analysis of the surgical trends from 2008 to 2016.

## Methods

IFSO Secretariat addressed all the national societies requesting them to provide data on the surgical/endoluminal techniques performed in their country by filling-out the 2016 survey form (Fig. 1). The questionnaire asking for all bariatric procedures performed in 2016 was e-mailed to IFSO societies on February 2017. If this first contact was unanswered, reminders via email, telephone calls, and personal contacts were initiated. The most part of contacted IFSO national societies filled it in and answered within July 2017; however, few nations had some problems in the data collection and sent the form at the end of 2017. Each national society completed the form either collecting information from its members or using data coming from the National Registry.

## Results and Discussion

IFSO survey form was sent to 62 IFSO national societies. Data from 58/62 (94%) Societies were collected, with the exception of Panama, Paraguay, Philippines, and Serbia. Twenty-seven out of 58 (45.8%) reported information deriving from their own national registries; the remaining national societies provided estimated data, although they declared a completeness of data of about 80%.

The total number of bariatric/metabolic procedures performed in 2016 was 685,874; among them 634,897 (92.6%) were primary and 50,977 were revisional (7.4%). Among the primary interventions 609,897 (96%) were surgical and 25,359 (4%) endoluminal. The most performed primary surgical bariatric/metabolic procedure was sleeve gastrectomy (SG) ( $N=340,550$ ; 53.6%), followed by Roux-en-Y gastric bypass (RYGB) ( $N=191,326$ ; 30.1%), One Anastomosis Gastric Bypass (OAGB) ( $N=30,563$ ; 4.8%), Adjustable Gastric Banding (AGB) ( $N=19,332$ ; 3%) and

Biliopancreatic Diversion/Duodenal Switch (BPD/DS) ( $N=3346$ ; 0.5%) (Table 1).

Figure 2 shows the number of the main primary bariatric/metabolic surgical procedures (SG, RYGB, AGB, OAGB, and BPD/DS) from 2008 to 2016. From 2013 to 2016, the total number of bariatric/metabolic procedures increased; however, it should be taken into account that this year the response rate was higher than in 2013 (58 vs 54).

The analysis of bariatric/metabolic procedures reveals a significant fluctuation over the time, describing the evolution of each operation in the last decade (Fig. 3).

### Adjustable Gastric Banding (AGB)

AGB was the first laparoscopic bariatric procedure in 1993 and it marked the transition from the laparotomic to the minimally invasive laparoscopic era. The low rates of early and late complications, the easy surgical technique—that does not require removal of tissue or any alteration of gastric or intestinal continuity—were its main advantages [3, 4].

However, long-term follow-up studies revealed relatively poor outcomes, describing high percentage of failure (40–50%), major complications, and reoperation (60%) rates [5, 6]. Band erosion, band leak, esophageal dilation, port or catheter leak, port infection, and patient non-compliance were the most common causes of AGB removal [6, 7].

In 2008 IFSO Survey, AGB was the second most performed procedure in the world, representing about 42.3% of all interventions. However, in the following surveys, AGB has been in constant decline, probably due to the high failure and reoperation rates. Specifically, in 2011, AGB decreased significantly (–24.5%) and was overtaken by SG. In 2016, AGB further declined, becoming the fourth procedure in the world, after SG, RYGB, and OAGB, and representing about the 3.0% of all bariatric/metabolic operations. This negative trend was confirmed by analyzing data coming from each IFSO Chapter (Figs. 4, 5, 6, and 7).

In 2008 IFSO Survey [8], Buchwald reported 145,563 AGB. Considering that the long-term failure rate of AGB is about 40–50%, we can hypothesize that, in the near future, about 58,000–72,000 band revisions will be performed in the world.

### Sleeve Gastrectomy

Sleeve gastrectomy (SG) was performed for the first time in 1988 as part of the biliopancreatic diversion with duodenal switch (BPD-DS) [9]. In 2000, Ren et al. [10] demonstrated the safety and efficacy of laparoscopic BPD-DS, although patients with BMI > 65 kg/m<sup>2</sup> had an increased morbidity and mortality. In attempt to reduce the surgical risk in superobese patients, a two-staged approach with laparoscopic SG as first stage was proposed [11]. From this first experience,

**Fig. 1** The IFSO 2016 survey form

**Society/ Country:** \_\_\_\_\_

Are these data provided by a National Registry? \_\_\_ YES NO

If not, approximately, how complete are they? (choose a percentage) \_\_

Number and Type of procedures performed in your Country in 2016	
PROCEDURES	NUMBER
Adjustable Gastric Banding	
Roux-en-Y Gastric Bypass	
Sleeve Gastrectomy	
Standars Biliopancreatic Diversion (Scopinaro)	
Duodenal Switch	
One Anastomosis Gastric Bypass	
Gastric Plication	
Vertical Banded Gastroplasty	
Endoluminal Procedures (pls indicate the number for each procedure):	<b>Total number of endoluminal procedures:</b>
Apollo Overstiches _____	
Elipse Allurion _____	
Endobarrier _____	
Heliosphere Bag _____	
Orbera/BIB _____	
Obalon _____	
POSE _____	
Spatz Adjustable Balloon System _____	
Other surgical procedure not listed above (please specify):	
<b>TOTAL</b>	
Revisional Procedures	
How many revisional procedures: _____	
Main reason for the revisions (%):	
<input type="checkbox"/> Complications (%): _____	
<input type="checkbox"/> Weight or comorbidities issues (%): _____	
<input type="checkbox"/> Both: _____	
Number of centres	
Number of centres < 50 operations	
Number of centres 50-100 operations	
Number of centres >100 operations	
<b>TOTAL</b>	

a growing number of studies were published in the following years, confirming the efficacy of SG as a stand-alone procedure [12, 13]. At the end of 2007, the First International Consensus Summit for Sleeve Gastrectomy stated the effectiveness of LSG as a sole operation [14], and a few years later, the American Society for Metabolic and Bariatric Surgery (ASMBS) published a position statement recommending LSG as an approved primary bariatric procedure [15].

SG represented only about 5% of all procedures reported by the 2008 IFSO Survey, but in the following years, it showed a steep increase (+ 22.5% in 2011; + 9.2% in 2013; + 15.7% in 2016). In 2014, SG became the most performed procedure in the world [16], and in 2016, it maintained its predominance, representing more than 50% of all primary bariatric interventions (Fig. 3). The main strengths of SG were the low rate of complications, the short operative time, the

absence of foreign material, the lack of gastrointestinal anastomosis and malabsorption, patient’s acceptance, and the feasibility to be converted into multiple other bariatric procedures [17]. The SG is the most common bariatric/metabolic procedure in each IFSO Chapter, with the exception of the Latin American Chapter, where it represents the second most performed operation (31%) after RYGB (58%) (Fig. 6).

It appears that the numbers of SG will continue to increase in the near future, but its percentage may decline with the increasing predominance of the OAGB and other procedures. As with most new procedures, there is an initial excitement, followed by a tapering off when more is known about the long-term issues of each intervention. In the case of the SG, there seems to be an early concern for GERD [18] and de novo Barrett’s esophagus. If this is the case, routine post-operative surveillance endoscopy will be necessary, as well as protocols

**Table 1** Number and type of bariatric/metabolic procedures performed in 2016 in the IFSO national societies

Country	Primary procedures	AGB	RYGB	SG	BPD-DS	OAGB	GP	VBG	EP	Other	SADIS	Revisional procedures	Total
North America													
Canada	6.600	900	3.400	2.000	300	0	0	0	0	0	0	400	7.000
USA	194.837	7.310	40.316	125.318	1.236	0	0	5744	5744	14.913	0	20.829	215.666
Total per area	201.437	8.210	43.716	127.318	1.536	0	0	5.744	5.744	14.913	0	21.229	222.666
Europe													
Austria	2.983	37	1.568	846	0	478	34	0	17	0	3	0	2.983
Azerbaijan	224	0	3	216	0	5	0	0	0	0	0	8	232
Belgium	14.101	398	7.055	4.594	0	1.804	250	0	0	0	0	5640	19.741
Czech Republic	1.681	70	134	681	31	0	635	0	130	0	0	85	1766
Egypt	17.060	100	600	11.000	10	3.000	50	2.000	0	0	300	1500	18.560
Finland	921	0	674	232	2	10	0	0	1	2	0	2	923
France	53.547	2.279	7.500	34.773	100	7.595	100	200	1.000	0	0	8000	61.547
Germany	10.123	153	4.041	5.079	12	481	4	1	108	244	0	982	11.105
Greece	2.624	60	112	1.682	52	420	298	0	0	0	0	234	2858
Iceland	225	123	37	55	0	0	0	0	10	0	0	5	230
Israel	8.389	589	847	5.301	28	1.589	0	35	0	0	0	1202	9591
Kazakhstan	202	7	11	12	3	112	21	0	3	33	0	5	207
Jordan	10.132	200	220	8.500	62	550	30	0	560	10	0	0	10.132
Italy	14.863	2.293	2.104	7.976	101	1.239	82	50	986	32	0	500	15.363
Lebanon	2.284	46	79	1.798	4	283	64	0	0	10	0	150	2434
Lithuania	189	29	76	8	0	0	76	0	0	0	0	5	194
Netherlands	9.661	22	6897	2074	0	651	0	0	0	12	5	1535	11.196
Norway	2.881	0	794	1287	0	0	0	0	0	800	0	43	2924
Poland	3.220	365	429	1992	5	205	0	0	220	0	4	0	3220
Portugal	1.812	8	712	677	10	147	0	0	18	226	14	154	1966
Romania	1.902	25	84	1674	6	34	18	0	61	0	0	82	1984
Russian Federation	2.166	118	385	1502	13	63	4	0	44	0	37	94	2260
Serbia	0	0	0	0	0	115	0	0	0	0	0	0	0
Slovenia	210	3	36	45	0	0	6	0	5	0	0	23	233
South Africa	587	0	438	19	128	0	0	0	0	0	2	6	593
Spain	5.198	5	2449	2078	123	232	0	0	91	0	220	507	5705
Sweden	5.473	0	3552	1872	43	0	1	0	0	5	0	186	5659
Switzerland	5.371	91	4083	1140	54	0	0	3	0	0	0	0	5371
Turkey	10.160	55	1237	6432	500	800	10	0	958	168	0	517	10.677

Table 1 (continued)

Country	Primary procedures	AGB	RYGB	SG	BPD-DS	OAGB	GP	VBG	EP	Other	SADIS	Revisional procedures	Total
Ukraine	133	0	29	68	9	7	0	0	4	7	0	2	135
UK	6,590	918	2,698	2,318	2	0	0	0	226	428	0	916	7,506
Total per area	194,912	7,994	48,884	105,931	1,298	1,690	2,289	4,442	1,977	585	22,383	217,295	
Latin America													
Argentina	1,950	27	930	653	7	282	4	3	44	0	0	67	2,017
Bolivia	254	0	26	191	0	13	0	0	10	14	0	8	262
Brazil	114,444	157	77,168	26,327	230	184	118	0	9,976	287	0	0	114,444
Chile	7,592	1	1,908	5,134	29	12	9	0	413	86	0	484	8,076
Colombia	15,300	0	6,000	9,000	0	50	100	0	150	0	0	500	15,800
Costa Rica	690	0	100	400	0	40	100	0	50	0	0	25	715
Dominican Republic	940	0	6	888	6	3	10	0	10	17	0	30	970
Ecuador	873	0	550	200	8	15	20	0	80	0	0	60	933
Guatemala	324	0	108	184	0	0	0	0	32	0	0	10	334
Honduras	135	0	10	50	0	5	0	0	70	0	0	7	142
México	7,784	121	1,752	4,235	24	508	265	0	834	0	45	478	8,262
Panama	0	0	0	0	0	0	0	0	0	0	0	0	0
Paraguay	0	0	0	0	0	0	0	0	0	0	0	0	0
Pertú	384	0	11	265	0	0	0	0	108	0	0	2	386
Venezuela	2,436	0	1,406	942	0	76	0	0	0	12	0	135	2,571
Total per area	153,106	303	89,975	48,469	304	1,175	639	3	11,777	416	45	1,806	154,912
Asia/Pacific													
Australia–New Zealand	18,587	2,199	1,990	13,681	59	0	58	0	600	0	0	3,644	22,231
China	6,240	0	1,830	4,201	0	20	32	0	0	157	0	100	6,340
Hong Kong	286	2	24	176	0	1	6	0	70	7	0	3	289
Iran	7,163	104	902	2,750	127	2,562	320	0	320	78	0	235	7,398
India	13,765	4	2,108	8,627	2	2,834	2	0	62	118	8	256	14,021
Japan	249	2	12	208	4	0	0	0	1	22	0	9	258
Korea	438	65	51	191	0	8	16	0	0	107	0	53	491
Malaysia	463	2	80	301	0	35	27	0	0	18	0	38	501
Kuwait	6,870	100	200	5,000	0	200	0	0	1,370	0	0	300	7,170
Qatar	1,827	53	116	1,018	16	53	5	0	401	165	0	91	1,918
Saudi Arabia	20,510	50	800	16,500	0	2,800	0	0	360	0	0	670	21,180
Singapore	339	0	79	248	0	0	1	0	7	4	0	6	345

**Table 1** (continued)

Country	Primary procedures	AGB	RYGB	SG	BPD-DS	OAGB	GP	VBG	EP	Other	SADIS	Revisional procedures	Total
Taiwan	2,363	22	91	1,493	0	213	0	0	22	522	0	93	2,456
UAE	6,342	222	468	4,438	0	840	6	5	183	180	0	61	6,403
Total per area	85,442	2,825	8,751	58,832	208	9,566	473	5	3,396	1,378	8	5,559	91,001
Total	634,897	19,332	191,326	340,550	3,346	30,563	2,802	2,297	25,359	18,684	638	50,977	685,874

AGB adjustable gastric banding, RYGB Roux-en-Y gastric bypass, SG sleeve gastrectomy, BPD biliarypancreatic diversion, DS duodenal switch, OAGB one-anastomosis gastric bypass, GP gastric plication, VBG vertical banded gastroplasty, EP endoluminal procedures, SADIS single-anastomosis duodeno-ileal bypass with sleeve gastrectomy

\*Qatar has not its own national society, but Qatar's bariatric surgeon, that are all IFSO members, asked to be part of this survey

developed to deal with this issue. Currently, revisional rates at  $\geq 10$  years range from 25 to 36% [19, 20]. Beside weight regain, intractable gastro-esophageal reflux (GERD) (recurrence or de novo) was an important reason of conversion to RYGB [20]. Probably, these aspects might gain a growing importance in the next years, due to longer follow-up and increasing number of patients undergoing a new bariatric procedure. Taking into account the long-term revisional rate of SG, we hypothesize that in the next decade about 84,000–122,000 SG revisions will be performed in the world.

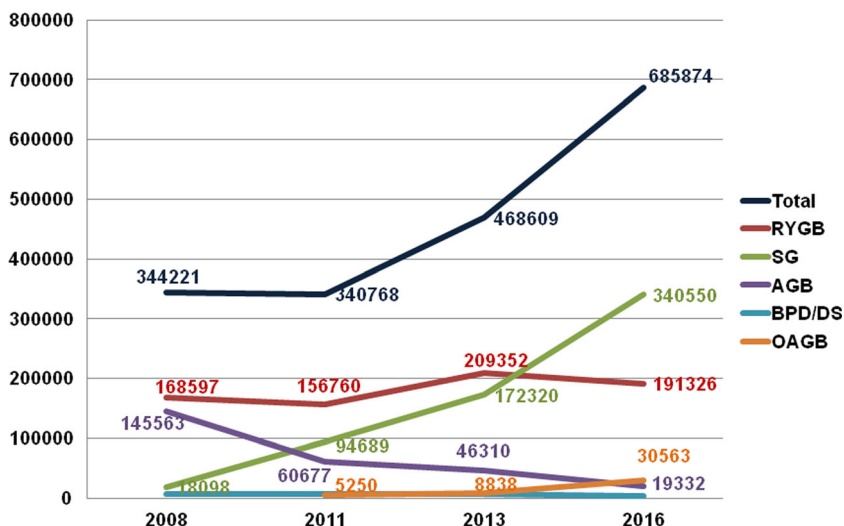
### Roux-EN-Y Gastric Bypass

Laparotomic Roux-en-Y gastric bypass (RYGB) was described for the treatment of morbid obesity in 1966 by Mason and Ito, who proposed it to treat morbid obesity [21]. Some decades later, Wittgrove et al. reported the first five cases of laparoscopic RYGB [22]. It has been routinely used for the past 15 to 20 years and it remains considered by many as the gold standard. From 2008 to 2013, the IFSO surveys revealed the constant dominance of RYGB, that was the most performed bariatric procedure in all the IFSO Chapters, with the exception of Asian Pacific Chapter (Figs. 3, 4, 5, 6, and 7). However, since 2014 [16], RYGB has decreased and was overtaken by SG (Fig. 3). The 2016 IFSO Survey confirms this negative trend, showing a decrease of about 15% compared to 2013; however, there are substantial differences among the IFSO Chapters. In the European and North American Chapters, RYGB declined, but it still accounts for about 20% of bariatric operations, representing the second most performed procedure (Figs. 4 and 5). In the Asian Pacific Chapter, RYGB slipped to third place in the IFSO 2016 Survey, after SG and OAGB (Fig. 7). The Latin American Chapter is the only one where RYGB maintains its supremacy, representing almost 60% of all performed procedures (Fig. 6). Long-term follow-up data [23] showed a failure rate of about 20% in morbidly obese patients and 35% in super obese patients. In 2008 IFSO Survey [8], Buchwald reported 168,597 RYGB. Considering the reported failure rates, we could hypothesize that in the near future about 33,700–59,000 RYGB will need a revisional intervention.

### One Anastomosis Gastric Bypass

The first experience on this procedure was published by Dr. Robert Rutledge in 2001, who named it “Mini-gastric Bypass,” because the operation initially was performed through a mini-laparotomy. Across the time, it was variously modified and defined as One Anastomosis Gastric Bypass, Omega Loop Gastric Bypass, and Mini-Gastric Bypass. However, to avoid confusion, the IFSO Scientific Committee recommends recognizing this procedure as “one-anastomosis gastric bypass (OAGB) and dropping the

**Fig. 2** Number of the main primary bariatric/metabolic surgical procedures from 2008 to 2016. AGB adjustable gastric banding, RYGB Roux-en-Y gastric bypass, SG sleeve gastrectomy, BPD-DS biliopancreatic diversion-duodenal switch, OAGB one-anastomosis gastric bypass



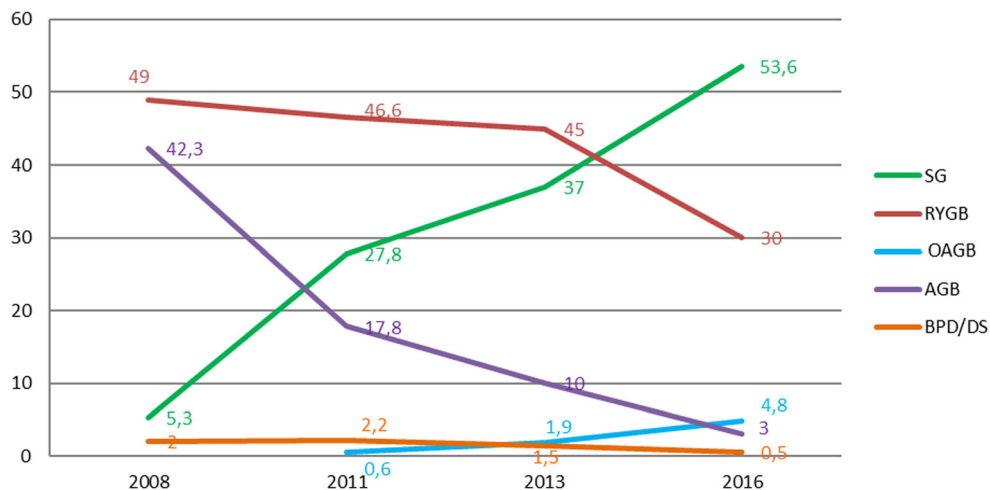
misleading descriptor: “mini” [24]. OAGB had some technical advantages: a tension-free gastrojejunal anastomosis and the absence of a Roux-en-Y limb construction. However, the absence of bile diversion raised several concerns [25] regarding bile reflux causing symptomatic gastritis and esophagitis, marginal ulceration, and a potential risk of gastric and esophageal cancer with long-term exposure. Mid-term data did not indicate high rates of bile reflux [26] neither higher gastric cancer incidence [27] and confirmed the efficacy and the safety of the procedure [28]. The initial skepticism against this procedure explains the slight increase of OAGB reported by previous surveys [29]. However, in the 2016 IFSO Survey, OAGB significantly increased by 2.9% (Fig. 3), probably due to more robust data supporting its efficacy [30]. Although not officially recognized in the USA as a bariatric procedure, the trend in the use of OAGB in Europe confirms this growth (Fig. 5). In Asia Pacific, OAGB is more frequent than RYGB (Fig. 7); on the contrary, in Latin America, it is rarely performed (Fig. 6). A recent study on the 15-year follow-up results of OAGB [30] reported an overall revision rate

of 4%, due to malnutrition, intolerance, and only in a small percentage (0.5%) weight regain.

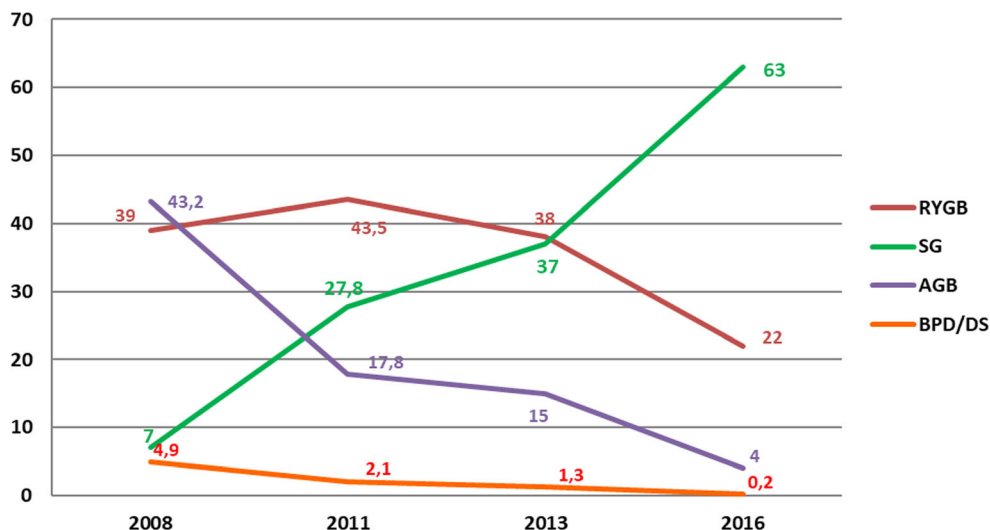
### Biliopancreatic Diversion-Duodenal Switch

Biliopancreatic diversion (BPD) was described by Scopinaro in 1976 [31] and consisted of an horizontal distal gastrectomy with a proximal gastric pouch with closure of the duodenal stump, a gastroileostomy, with a 250-cm limb of distal ileum, and a biliopancreatic limb anastomosed to the distal ileum, creating a 50-cm common channel. Some years later, other authors [9, 32] modified the distal gastrectomy with a vertical gastrectomy (sleeve) in attempt to reduce some complications and introduced a new variant of procedure: the Duodenal Switch (DS), which was performed laparoscopically since 1999 [10]. In the previous surveys, BPD-DS represented less than 2% of the bariatric surgeries performed worldwide [8, 33]. In the 2016 IFSO Survey, this percentage further decreased (Fig. 3). The higher complications and mortality rates, the technical complexity compared to other bariatric

**Fig. 3** Long-term trend in the world’s main bariatric/metabolic surgical procedures. AGB adjustable gastric banding, RYGB Roux-en-Y gastric bypass, SG sleeve gastrectomy, BPD-DS biliopancreatic diversion-duodenal switch, OAGB one-anastomosis gastric bypass



**Fig. 4** Long-term trend in the USA/Canada of bariatric/metabolic surgical procedures



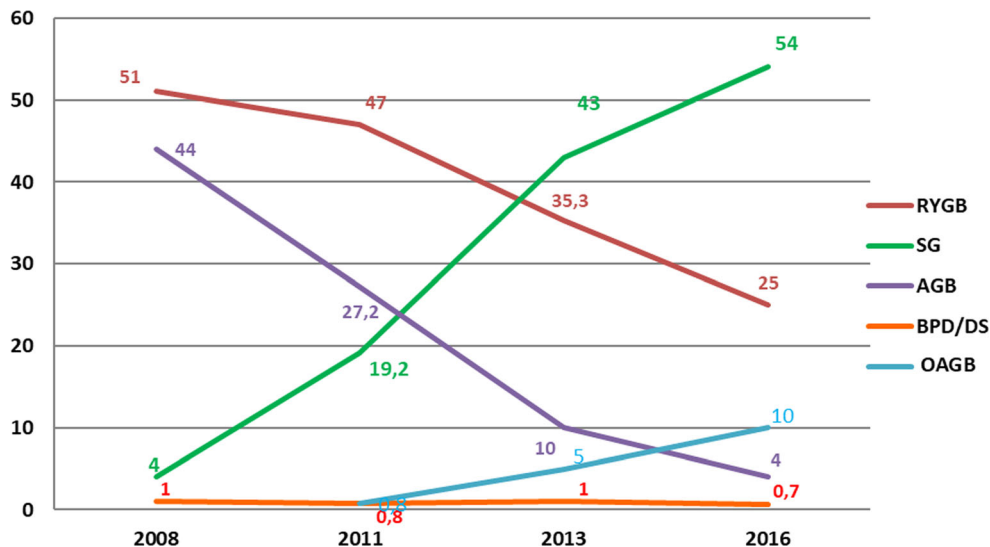
procedures certainly has played a role; furthermore, after the introduction of the two stages approach, BPD-DS maintained its indication only in patients with insufficient weight loss after SG [10, 34]. Nevertheless, BPD and BPD-DS are actually considered among the best options for selected morbidly obese patients with associated diseases, such as patients with refractory diabetes [35] and in super-obese [36].

**Miscellanea**

- Single-anastomosis duodeno-ileal bypass with sleeve gastrectomy (Sadi-S)/stomach intestinal pylorus sparing surgery (SIPS) single anastomosis was introduced in 2007 by Sánchez-Pernaute and Torres [37, 38]. SADI-S/SIPS compared with DS eliminates the Roux-en-Y gastric bypass by creating an omega loop by means of a duodeno-ileal anastomosis. Moreover, it is associated with a reduced risk of internal hernias since it does not

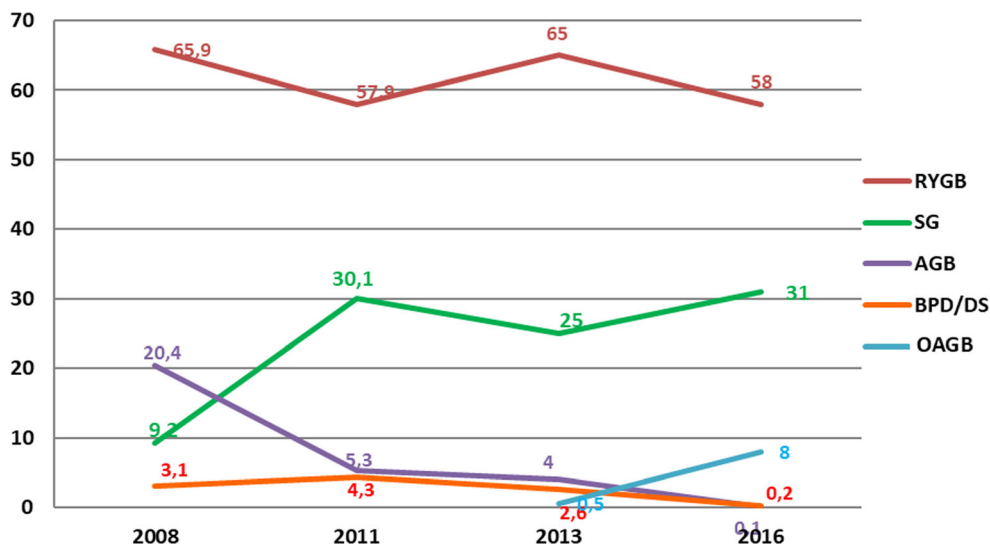
require any mesenteric opening. It also represents a valid option for revisional surgery after failed SG. Moreover, SADIS-S/SIPS is a versatile procedure. According to patient characteristics and surgeon preference, it can be performed either with a narrow gastric pouch and a long common channel (300 or 350 cm) or it can simply remain a malabsorptive procedure with a short common channel (200 or 250 cm) and a wider gastric pouch. The 2016 IFSO Survey reported for the first time the number of primary SADIS/SIPS performed in the world. This number is probably underestimated, but it gives a clear perception of how this new intervention is spreading. Among the 685 SADIS/SIPS reported, about 85% (N= 585) were performed in Europe. SADIS/SIPS could be a promising revisional procedure and we hypothesize a further increase in the next years. IFSO currently recognizes these procedures, therefore they should not be considered investigational.

**Fig. 5** Long-term trend in Europe of bariatric/metabolic surgical procedures





**Fig. 6** Long-term trend in Latin/ South American of bariatric/ metabolic surgical procedures



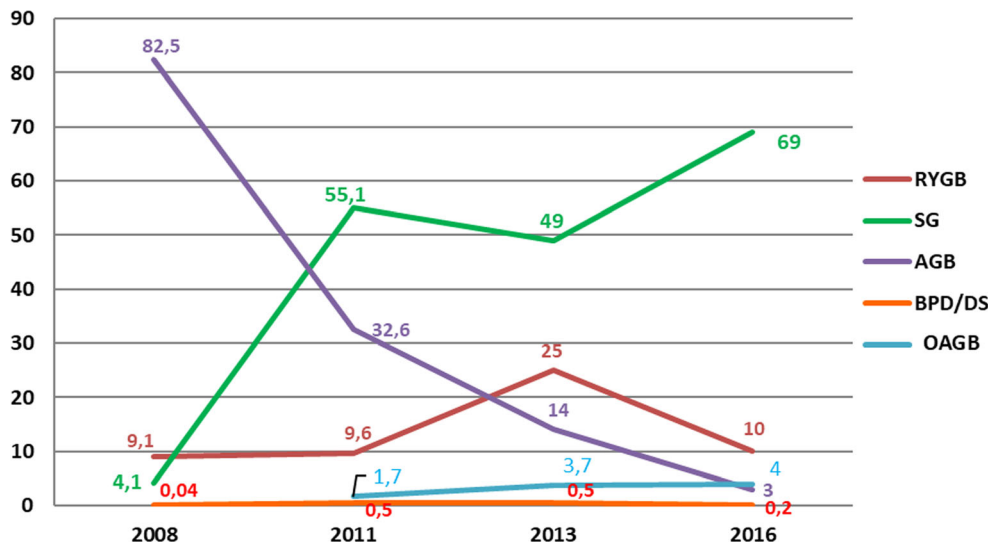
- Sleeve ileal (SASI) bypass is based on mini gastric bypass operation and Santoro’s operation in which a sleeve gastrectomy is followed by a side to side gastro-ileal anastomosis [39]. The 2016 IFSO Survey reported 76 SASI, mainly performed in Iran.
- Other procedures: The 2016 IFSO Survey reported 284 gastric transit bipartitions, mainly performed in Bolivia and Turkey, and 120 SG with jejunal bypass (SG + JJB), mainly performed in China.

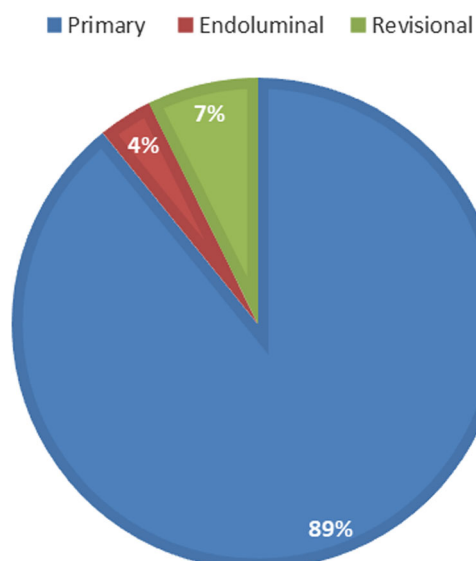
interventions. In this survey, the number of EP increased up to 4% ( $N = 25,359$ ), but they are probably still underestimated (Fig. 8). The most part of reported EP were mainly primary, since intragastric balloons (IGB), especially Orbera BIB, represent about 97% of all IGB. However, since some IFSO national societies do not specify the type of EP performed, we cannot exclude that some procedures (i.e., Apollo Overstiches) could be revisional. EP are gaining an increasing importance as they have shown better results than lifestyle interventions or obesity medications. Moreover, due to the low morbidity and complication rate, the reversibility of the procedures might be appealing to some patients and may encourage primary care physicians to refer patients to a bariatric surgeon. The recent introduction of devices that do not require endoscopy both for placement and removal (Eclipse Intra-Gastric Balloon, Allurion Technologies, Wellesley, MA, USA) [40] enhances the concept of “easy to perform” and could be appealing for different obesity

**Endoluminal Procedures**

The 2014 IFSO Survey reported for the first time 14,275 endoluminal procedures (EP) in the world such as Orbera/BIB, Obalon, Elipse, Spatz Adjustable Balloon System, Heliosphere Bag, POSE, Stomaphix, Apollo Overstiches, and EndoBarrier [16], representing only 2% of the total

**Fig. 7** Long-term trend in Asia/ Pacific of bariatric/ metabolic surgical procedures





**Fig. 8** The number of endoluminal, primary, and revisional procedures

classes patients; however, caution is always recommended because complications might occur also with this type of devices [41].

### Revisional Procedures

The 2016 IFSO Survey showed for the first time the number of revisional procedures performed worldwide. We reported 50,977 revisions representing 7.4% of all bariatric interventions (Fig. 8), but there are substantial variations across the IFSO Chapters. In North America and Europe, they represent a substantial percentage (10% and 11%, respectively); on the contrary, in Latin America revisions are only 1% of all bariatric interventions. Among 51 IFSO national societies that reported revisional procedures, 29 (56.9%) specified the items about the reason of revision. Twenty-six percent of procedures were performed for complications, 63% for weight or comorbidities issues, and 11% for both.

The effectiveness of bariatric surgery has been largely demonstrated. The real challenge of bariatric surgery is to obtain sustained weight loss. Long-term follow-up studies demonstrate that all bariatric interventions might have a failure rate due to insufficient weight loss, weight regain, or complications. Failures depend on nutritional, psychological, and surgery-related factors. Furthermore, failure percentages might vary according to the type of procedure and the criteria considered. Although, we do not have enough data to identify a trend, we believe that revisional procedures will be the next challenge of bariatric surgery, because the management of these patients requires not only a skilled surgeon, but also an experienced multidisciplinary team (nutritionist, gastroenterologist, endocrinologist, psychologist, anesthetist, and specialized nurse).

### Summary

This survey reveals a further increase in the total number of bariatric/metabolic procedures in 2016; the higher prevalence of bariatric/metabolic procedures declared in this survey might be also linked to the higher number of responding countries. In fact, compared to 2013, Kazakhstan, Jordan, Norway, Honduras, Malaysia, and Iran added their contributions.

Furthermore, endoscopic and surgical procedures performed in private not academic institutions are usually not reported; therefore, the reported number is probably underestimated. We hypothesize that one million bariatric metabolic procedures have already been performed in the world. This survey confirms that SG is the most performed bariatric procedure in the world. As we have already emphasized [17], its simpler surgical technique (of SG compared to RYGB), its versatility, together with the promising long-term weight loss outcomes can explain this result.

This is the first survey showing the increase of endoluminal procedures and describing revisional procedures in the world, although there are significant differences among the IFSO Chapters.

Despite the large amount of information provided by IFSO surveys [8, 16, 29, 33, 42, 43], there are several limitations that influence bariatric surgery's scenario worldwide. One of the main critical factors is the method of data collection. Since 2003 [43], an emailed questionnaire has been used to gather input from IFSO societies or national groupings. Although this approach is not flawless, it currently represents the best way to obtain a reliable picture of the real situation. In the last surveys [16, 29, 33], indeed, IFSO questionnaire has been improved, adding emerging surgical procedures such as OAGB and endoluminal procedures. Following the enormous expansion of bariatric surgery, it should be taken into consideration that, together with enthusiastic results, the surgeons have to face failures due to insufficient weight loss, weight regain, or complications. A large number of long-term outcome studies have been published that describe different failure percentages for every surgical procedure. Although the criteria of failure are not unanimously defined, it is possible to forecast an increase in the number of revisional interventions in the immediate future.

This report is offered to clinicians, scientists, government institutions, and third party payers in the field of obesity. We encourage the creation of national registries and their continuous updates, taking into account all new bariatric procedures including the endoscopic and revisional procedures that are continually evolving and that will gain more importance in the near future.

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IFSO Nation President  
Argentina Mario Antozzi  
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 Ukraine Andriy Lavryk  
 UAE Ali Khammas  
 UK Roger Ackroyd  
 USA Stacy Brethauer  
 Venezuela Salvador Navarrete

## Compliance with Ethical Standards

**Conflict of Interest** The authors declare that they have no conflicts of interest.

**Statement of Informed Consent** This is a survey in which we do not directly involve human subjects; it is limited to an analysis of bariatric procedures performed around the world.

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