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ORIGINAL CONTRIBUTIONS

From Early to Mid-Term Results of Endoscopic Sleeve Gastroplasty: A Retrospective Analysis of a Bariatric Center

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Abstract

Purpose Global obesity rates have surged, necessitating effective interventions beyond traditional bariatric and metabolic surgery (BMS). Endoscopic Sleeve Gastroplasty (ESG) has emerged as a minimally invasive alternative, addressing limitations of eligibility criteria and patient reluctance associated with BMS. This study aims to present a 3-year experience with ESG, focusing on its mid-term efficacy in weight loss.

Materials and Methods A retrospective, single-center study included 143 consecutive ESG patients (BMI > 30 kg/m^2 or > 25 kg/m^2 with obesity associated-diseases) from February 2019 to March 2023. Data on demographics, comorbidities, operative details, and follow-up outcomes were collected. The primary outcome was %TWL ≥ 15% at 12 months. Secondary outcomes were an optimal clinical response (OCR) at 24 and 36 months defined by %TWL ≥ 10% or %EWL ≥ 25%.

Results ESG demonstrated a mean %TWL of 14.37% at 12 months, aligning with previous studies. Early postoperative complications were minimal (2.1%), with no mortality. Follow-up revealed a peak in weight loss at 9 months, but mid-term OCR was achieved in 41.2% at 3 years. The learning curve showed efficiency improvements after 26 procedures.

Conclusion ESG proves effective at one year, with a %TWL of 14.37%. However, mid-term efficacy beyond 12 months remains challenging, raising questions about the durability of weight loss. Despite a low complication rate, strategies for maintaining a long-term OCR, including potential repeat ESG, warrant further investigation.

Keywords Endoscopic sleeve gastroplasty · Endosleeve · Bariatric Surgery · Endoscopy · Obesity

Introduction

The prevalence of obesity has doubled globally since 1980. Nearly two billion adults worldwide are currently overweight or severely obese. As a chronic condition, obesity is associated with a cumulative risk of cardiometabolic diseases such as type 2 diabetes, hypertension, cardiovascular diseases, liver diseases, and hormone-sensitive cancers [1]. To date, metabolic and bariatric surgery (MBS) still is the gold standard in the treatment of severe obesity [2]. Although the International Federation for the Surgery of Obesity and Metabolic Disorders (IFSO) has recently updated its guidelines, most state regulations only authorize MBS for patients with obesity class III or obesity class II with obesity associated-diseases [3]. However, in addition to patients who will not meet the eligibility criteria, only 1% undergo MBS among individuals with severe obesity [4]. The reasons why patients are reluctant are usually due to the potential morbidity, its irreversibility, its cost, and the access to non-invasive strategies [5]. In these cases, until recently, the

Key Points
- ESG demonstrates effectiveness in achieving a mean %TWL of 14.37% at 12 months.
- Despite an early optimal clinical response the study highlights challenges in sustaining weight loss beyond 12 months with ESG.
- Mid-term optimal clinical response (%TWL ≥ 10% or %EWL ≥ 25%) is achieved in only 41.2% of patients at 3 years.
- This study also outlines a learning curve for ESG, revealing efficiency improvements after 26 procedures.

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endoscopic intra-gastric balloon (IGB) was the only option. Due to its lack of efficacy and tolerability, other non-surgical techniques and medical devices have been developed [6]. These include endoscopic sleeve gastroplasty (ESG), which is an incisionless and transoral technique that uses an endoscopic suturing device to place full-thickness sutures inside the stomach. This reduces the lumen of the stomach, altering its capacity and changing its motility [7]. ESG appears to have a short learning curve, is reversible, and has few adverse events [8]. The efficacy of ESG compared to lifestyle modification was demonstrated in the MERIT trial. After one year, the mean percentage excess weight loss (%EWL) was 49.2% vs 3.2%, and the mean percentage total weight loss (%TWL) was 13.6% vs 0.8% in favor of ESG [9]. At two years, the weight loss seems consistent with an average %TWL of 15.4%, in a recent systematic literature review [10]. However, data on medium-term efficacy are scarce. So far, only two studies have reported their results [11, 12]. In this study, the results of a 3-year experience of a bariatric team are presented. To provide further data on early- and mid-term efficacy, we aimed to assess the pattern of weight loss up to 3 years after ESG.

Patients and Methods

Study Design

This was a retrospective, single-center study that included all consecutive patients who underwent ESG at a specialized bariatric center from February 2019 to March 2023. Our MBS department has now more than 20 years of experience and has performed endoscopic bariatric therapies since 2018. Currently, up to 300 surgical procedures (Roux-en-Y gastric bypass and sleeve gastrectomy) and 100 endoscopic procedures (ESG and IGB) are performed yearly by two specialized surgeons. An additional hundred endoscopies are performed annually for post-MBS surveillance. The database was maintained prospectively throughout the study period. The local ethics committee approved the study protocol according to local laws on ethics and human research. All procedures were in accordance with the ethical principles of the Declaration of Helsinki. Written informed consent was systematically signed by the patients.

Patient Selection

Patients eligible for ESG were 18 years old or older and had obesity. Obesity associated-diseases were arterial hypertension (AHT), diabetes, obstructive sleeve apnea disease (OSAD), or arthrosis. Patients fulfilling the requirements for MBS but declined surgery or were contra-indicated, were offered ESG. All patients underwent a standard multidisciplinary bariatric workup. We excluded those with severe gastritis, large hiatal hernia, portal hypertensive gastropathy, coagulopathy, severe systemic illnesses, family history of gastric cancer, psychiatric disorders, and prior gastric surgery. All procedures were self-pay.

Data Collection

The following data were collected. Demographic information included age, gender, post-secondary education level, size, index weight, maximum weight, index BMI, and smoking status. Medical history included previous IGB procedures, abdominal surgery, AHT, gastroesophageal reflux disease (GERD), coronaropathy, diabetes, OSAD, arthrosis, and hypothyroidism. Diabetes was defined as (i) the need for antidiabetic therapy, (ii) the evidence of fasting plasma glucose ≥ 126 mg/dL, (iii) a 2-h plasma glucose ≥ 200 mg/dL during oral glucose tolerance test, or (iv) a level of HbA1c greater than 6.5%. Hypertension was defined as (i) a systolic blood pressure of ≥ 140 mmHg, (ii) a diastolic blood pressure ≥ 90 mmHg, or (iii) the antihypertensive medication. OSAD was assessed during pneumological evaluation. GERD was defined as (i) the need for daily proton pump inhibitor agents (PPI), (ii) the presence of esophagitis on endoscopy, or (iii) abnormal manometry/pH testing. Operative data included the number of stitches used and the time of the procedure. Follow-up data included the length of stay, post-procedural symptoms, complications, and anthropometric evolution. Anthropometric data were measured at the baseline before the procedure and then during scheduled follow-up visits at 1, 3, 6, 9, 12, 24, and 36 months after the procedure. Afterward, patients were encouraged to continue to have a minimum of yearly follow-up visits.

Outcomes Measures

The primary outcome consisted of weight loss reaching an optimal clinical response (OCR) at 12 months, measured by %TWL ≥ 15%. Pre-operative and operative data were compared between success and failure of ESG at 12 months to identify potential risk factors. Secondary outcomes consisted of weight loss reaching OCR at 24 and 36 months measured by %TWL ≥ 10%, OCR at 12, 24, and 36 months measured by %EWL ≥ 25%, and the evaluation of the learning curve. %TWL was defined as follow: %TWL = [(initial weight) – (postoperative weight)] / [(initial weight)] * 100. %EWL was defined as follow: %EWL = [(initial weight) – (postoperative weight)] / [(initial weight) – (ideal body weight)] * 100 [13]. These definitions of weight loss reaching OCR are in light of data reported by previous studies and recent task force updates [9, 14–16]. It is important to note that bariatric

endoscopy and surgery guidelines may differ in the definition of OCR at one year.

Procedure Description

The procedure was performed under general anesthesia by a single bariatric surgeon (H.S.). Antibiotic prophylaxis was administered (Cefotaxime 2 g intravenously). The first 21 patients were positioned in left lateral decubitus. For the following patients, a supine decubitus was preferred, preventing the liver from falling onto the stomach. Using CO_2 insufflation, the procedure started with a standard gastroscopy to exclude any contraindications. The Overstitch endoscopic (Apollo Endosurgery, USA) suturing system device was used for this procedure. It was positioned and attached to a double-channel endoscope following the gastroscopy. After an esophageal overtube was inserted, the Overstitch was introduced. A U-shaped suture pattern was performed, from the distal angulus to the proximal fundus, in the following order: anterior wall, large curvature, posterior wall, then repeated in the opposite direction. Sutures were cut by using a cinch. Three to eight threads were performed, depending on the distance between the antrum and the fundus. Eventually, the invagination of the greater curvature led to a tubular configuration of the stomach, reducing its volume from 60 to 70%. Patients stayed until the following morning and had a liquid diet 6 h following the procedure.

Follow-up Multidisciplinary Bariatric Team

All patients were restricted to a full-liquid diet, initiated on the day before the procedure, and pursued for the first weeks after the procedure. The diet then advanced to an extended bariatric diet for 2 additional weeks, corresponding to small-solid meals. A specific exercise plan was recommended to the patient, including a walking schedule but avoiding intra-abdominal pressure exercise for the first month.

Follow-up consults were scheduled at 2, 3, 6, 12, 24, and 36 months after the procedure, allocated between the surgeon, dietician, and psychologist. A barium swallow was systematically performed on postoperative day 30.

Statistical Methods

Quantitative variables were represented by their means and standard deviations or their medians and interquartile ranges in the case of small samples (< 30 subjects). Student's t-tests or non-parametric Wilcoxon tests were chosen according to sample size. Qualitative variables were represented by their numbers and percentages. They were compared using the parametric Chi-2 test, Fischer's exact test, or the Kruskall-Wallis test when there was more than one class. Logistic regression analyses were performed to identify predictors of OCR at 12 months after ESG. Results were presented as odds ratio (OR) with their 95% confidence interval. The tests were two-tailed and the alpha risk was set at 0.05. The learning curve was generated from the procedure time. The procedure time included the initial gastroscopy and the setup of the device. It was defined by an inverse regression curve ($Y = a + b/X$), with case number (X) as the independent variable and procedure time (Y) as the dependent variable. The learning curve plateau was defined by the procedure time at the asymptote (a) of the learning curve. The learning rate was defined as the number of procedures required to reach 90% of the potential [8, 17]. The Dataset was collected in a computerized spreadsheet (Microsoft Excel 365, Microsoft Corporation, Redmond, WA, USA). Statistical analyses were performed with Prism (version 6, GraphPad Software, San Diego, CA, USA) and EasyMedStat (www.easymedstat.com, Neuilly-sur-Seine, France).

Results

Patient Characteristics

Hundred and forty-seven patients treated with ESG were prospectively included during the study period. Four patients were excluded due to non-completion of the ESG. Reasons for exclusion were anaphylactic shock upon induction (n = 2) and contra-indication upon standard gastrocopy (n = 2). The remaining 143 patients were finally analyzed. Second-generation devices were used in 130 patients and third-generation devices in 13 patients. Two patients had simultaneously laparoscopic cholecystectomy. They had a minimum and maximum follow-up time of 6 months and 3 years. The demographic data are detailed in Table 1. The mean age was 43 ± 10 years [17–66], and the initial BMI was 33.6 ± 3.4 kg/m^2 [27–50].

Post-Operative Course and Morbidities

The mean length of stay after ESG was 1 day, with only 6 staying more than 24 h, and with 3 hospitalized in an ambulatory setting. There was no per-procedural complication. Post-procedural adverse events, according to the Clavien-Dindo classification, occurred in 3 (2.1%) patients (Table 2). In two cases, it corresponded to pain and vomiting resistant to oral treatment, requiring readmission at post-operative day 2 in both cases.

Weight Loss Outcomes

Follow-up was complete and available for 137/143 (96) %, 131/143 (91%), 128/143 (90%), 118/134 (88%), 115/132 (87%), 68/88 (77%) and 34/50 (68%) patients at 1, 3, 6, 9,

Table 1 Demographic characteristics of the population

Variable	Baseline population n = 143	$\%TWL_{12} < 15\%$ n = 59	$\%TWL_{12} \geq 15\%$ n = 56	*p*
Age, y	43 ± 10	44 ± 10	43 ± 10	0.701
Female	132 (90.2) [18–66][a]	54 (91.5)	50 (90.9)	1
Medical history				
Active tobacco consumption	15 (10.5)	6 (10.2)	6 (10.9)	1
Arterial hypertension	6 (4.2)	5 (8.5)	1 (1.8)	0.208
Coronaropathy	3 (2.1)	2 (3.4)	0 (0.0)	0.496
Diabetes	3 (2.1)	2 (3.4)	1 (1.8)	1
GERD	4 (2.8)	2 (2.4)	0 (0.0)	0.496
OSAD	2 (1.4)	(1.7)	1 (1.8)	1
Arthrosis	9 (6.3)	2 (2.4)	3 (5.5)	0.671
History of intra-gastric balloon	20 (14)	11 (18.6)	4 (7.3)	0.097
Preoperative anthropometric data				
Weight, kg	92.4 ± 15.8	90.9 ± 16.1	93.0 ± 13.3	0.192
Size, cm	165 ± 0.1	164 ± 0.1	165 ± 0.1	0.733
Ideal body weight, kg	68.05 ± 9.1	67.7 ± 6.3	68.6 ± 7.8	0.725
Excess body weight, kg	23.7 ± 11.1	23.2 ± 12.1	24.4 ± 8.2	0.095
Max. body weight, kg	98.6 ± 15.1	96.1 ± 13.8	100.7 ± 16.3	0.178
BMI, kg/m^2	33.6 ± 3.4	33.5 ± 3.8	33.9 ± 2.7	0.133
BMI class				0.239
Overweight	13 (9.1)	7 (11.9)	5 (9.1)	
Class I	86 (60.1)	36 (61.0)	29 (52.7)	
Class II	41 (28.7)	14 (23.7)	21 (38.2)	
Class III	3 (2.1)	2 (3.4)	0 (0.0)	
BMI excess, kg/m^2	8.4 ± 4.5	8.47 ± 3.8	8.9 (2.7)	0.133

Qualitative data are expressed as n (%); quantitative data are expressed as mean (standard deviation); y year; [a]minimum and maximum values are showed in brackets

Table 2 Peri-operative data and follow-up of the study population

Variable	Baseline population n = 143	$\%TWL_{12} < 15\%$ n = 59	$\%TWL_{12} \geq 15\%$ n = 56	*p*
Procedure time, min	59.8 ± 19.5	62.6 ± 22.1	58.7 ± 17.7	0.488
Number of suture	5 ± 1 [3-8][a]	5.0 ± 0.8	4.9 ± 0.8	0.560
Device used				0.756
Overstitch ™	132 (92.3)	54 (91.5)	50 (89.1)	
Overstitch Sx ™	11 (7.7)	5 (8.5)	6 (10.9)	
Morbidity				
Perigastric leak / collection	0	0	0	1
Bleeding	0	0	0	1
Clavien-Dindo Class I – II, n (%)	3 (2.1)	2 (3.4)	1 (1.8)	0.999
Clavien-Dindo Class III – IV, n (%)	0	0	0	1
Mortality, n (%)	0	0	0	1
Follow-up				
Length of stay, d	1	1.1 ± 0.5	1.0 ± 0.1	0.995
Readmission	3 (2.1)	1 (1.7)	2 (3.6)	0.333

Qualitative data are expressed as n (%); quantitative data are expressed as mean (standard deviation); [a]minimum and maximum values are showed in brackets

12, 24 and 36 months respectively. The annual follow-up retrieved a mean %EWL of 58.97 ± 29.74, 39.59 ± 37.60, and 14.91 ± 42.04, and a mean %TWL of 14.37 ± 8.85, 9.82 ± 11.38, and 3.73 ± 10.65 at 1, 2 and 3 years respectively (Fig. 1). The peak of weight loss, %EWL and %TWL was reached at 9 months. The primary outcome was met for 48.7% of patients (Table 2). Mid-term OCR, defined as %TWL ≥ 10% or %EWL ≥ 25% at 3 years, occurred in 41.2% in both cases. The weight loss pattern following ESG, whether an OCR at one year is reached or not, is consistently different (Fig. 2). This difference can already be seen at one month following ESG and is persistent throughout time.

In multivariate analysis, the %TWL at one month was predictive of higher rates of weight loss success at 12 months (OR = 1.46, [1.23; 1.75], $p = 0.0001$). This was the only variable found to have an association with an OCR at 12 months (Table 3).

Learning Curve

The mean procedure time was 59.8 min. The first 10 procedures lasted 89 min (80–125), while the last 10 procedures lasted 44 min (29–48). Total procedure time was significantly lower after the 26th procedure, attaining a plateau (Fig. 1). The mean number of sutures was 5, ranging from 3 to 8. The average time per suture was 11.9 min (Fig. 3).

Discussion

ESG has become a popular incisionless transoral procedure in the decade since its initial description [18]. While early safety and efficacy results have rapidly improved, there is limited data on weight patterns beyond 12 months (see Table S1). In this study, we provide additional data on early and intermediate efficacy up to 36 months of follow-up. Our results suggest that despite a good OCR one year after ESG, intermediate efficacy is difficult to achieve. The mean %TWL at 12 months was 14.37%, consistent with similar studies. Although some retrospective studies have reported %TWL at 12 months greater than 15%, the two published randomized controlled trials have more modest results with 10.11% and 13.60% [9, 19]. When compared directly to high-intensity diet and lifestyle therapy, patients undergoing ESG achieve significantly greater weight loss [20]. Compared with IGB, ESG has better results as shown in the most recent systematic review [21]. In an indirect comparison with MBS, ESG has similar results to gastric banding but remains less efficient than sleeve gastrectomy [22]. In these last two studies, ESG resulted in 7.33% and 4.27% more %TWL at 12 months than IGB and gastric banding, respectively [21, 22]. Nonetheless, when gastric banding was at its peak of popularity, the %TWL at one year was known to be closer to 20% [23, 24]. These short-term data,

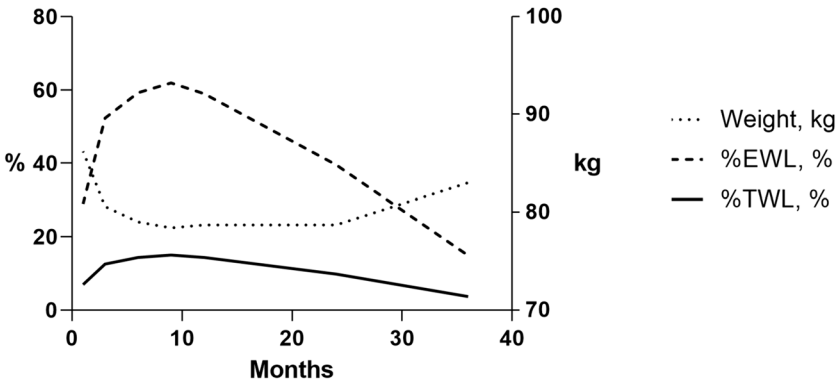

Fig. 1 Anthropometric follow-up data at 3, 6, 12, 24, and 36 months following ESG. At 12 months, %TWL ≥ 15% was reached by 56/115 (48.7%) and %EWL ≥ 25% by 98/115 (85.2%). At 24 months, %TWL ≥ 10% was reached by 31/70 (44.3%) and %EWL ≥ 25% by 41/69 (59.4%). At 36 months, %TWL ≥ 10% was reached by 14/34 (41.2%) and EWL ≥ 25% by 14/34 (41.2%)

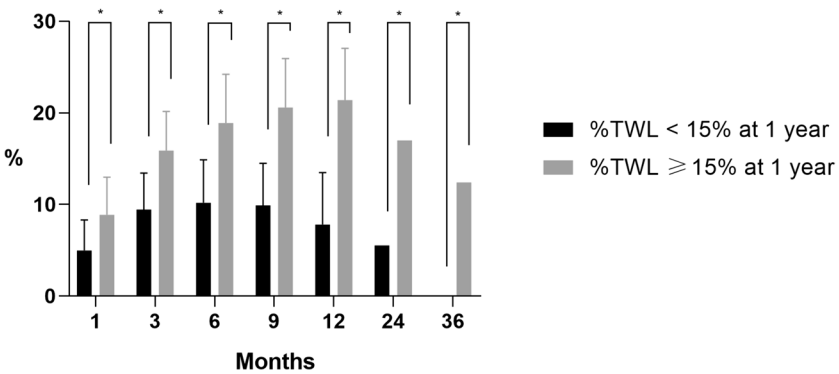

Fig. 2 Comparison of %TWL evolution depending on the success of ESG at 1 year. *$p < 0.001$. Data from months 1 to 12 are represented by their mean and standard deviation, and from months 24 to 36 by their median only due to small numbers of patients

Table 3 Multivariable analysis

Variable	Odds ratio	95% confidence interval	*p*
Age	0.99	0.95 – 1.04	0.864
Weight	1.04	0.99 – 1.09	0.119
BMI	0.86	0.69 – 1.06	0.169
History if IGB	0.54	0.12 – 2.53	0.437
Active tobacco consumption	1.01	0.27 – 3.82	0.993
Number of suture	0.86	0.48 – 1.56	0.628
%TWL at 1 month	1.46	1.23 – 1.75	**0.0001**

combined with our results, reassure that ESG is a viable solution for treating obesity.

Furthermore, ESG has a notably low rate of adverse events. Although mortality has not been associated with ESG, morbidity is primarily limited to expected post-procedural discomfort such as nausea, vomiting, heartburn, or abdominal pain. These symptoms typically resolve within a few days after the procedure is completed. Serious complications such as esophageal or gastric perforation, gastrointestinal bleeding, intra-abdominal hemorrhage, intra-abdominal abscess, or bile leakage due to gallbladder incarceration occur in less than 1% of cases [9, 25].

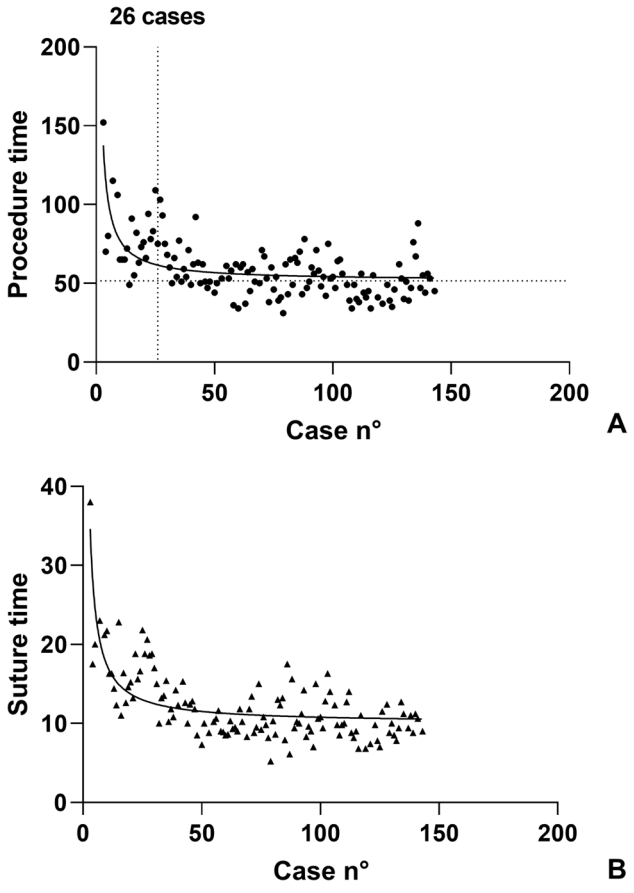

Fig. 3 Learning curve regression model showing (**A**) efficiency achieved at ESG at 26 procedures, (**B**) the pattern of time per suture

Various techniques, including variations in suture pattern, have been described to adequately restrict the gastric lumen [26]. Suture patterns can be triangular, following an M, Z, or U pattern (Fig. 4) [7, 18, 27–29]. Two studies compared different gastric sleeve patterns and both concluded that all patterns effectively achieved significant weight loss, as long as the reduction of the gastric volume was sufficient [19, 30]. In particular, the sleeve should cover a minimum of one-third of the stomach (Fig. 4) [31]. Gkolfakis et al. also showed that neither pattern was superior to the other regarding gastric emptying or satiety [19]. Other technical aspects of ESG, such as the number of sutures, did not affect the pattern of weight loss [31]. Therefore, the simplest and fastest suture pattern should be the focus of bariatric surgeons. However, since none of these studies measured technical specificities of mid- or long-term outcomes, caution should be exercised.

Despite no evidence of technical impact on weight loss, technicity met efficiency after 26 interventions in our study. Learning curves based on significant length reduction have been reported in previous studies. In Hill et al., the plateau was reached rapidly after 7 procedures, but only 21 ESGs were included in the analysis [8]. Saumoy et al. included 128 patients and found a narrower learning curve, with 38 ESGs required to reach plateau [32]. In both studies, the ESG was performed by gastroenterologists with prior endoscopic experience. Our learning curve is based on the experience of a bariatric surgeon with limited clinical endoscopic experience but with one week of ESG training. Therefore, these findings may be applicable to any surgeon interested in the initiation of an endoscopic bariatric program.

The durability of weight loss over time remains a topic of debate regarding ESG. When follow-up included endoscopic check-ups, 43.2% had intact sutures at 6 months, and only 24.4% at 12 months [33]. The same study showed a correlation between the loss of sutures over time and weight regain. Overall, with data up to 36 months, the weight loss pattern of our cohort shows a tendency toward weight regain after the first 12 months. Only two studies have reported results at 36 months, and in both cases, %TWL was lower at 36 months compared to 12 and 24 months [11, 12]. These studies continued their follow-up for a total of 4 and 5 years, respectively, and achieved good %TWL results. Notably, weight patterns could be predicted from the first month following ESG in both cases, which confirms our findings in multivariable analysis [11, 12]. If weight loss fails early on, bariatric teams should intensify their follow-up with diet and/or exercise protocols. Eating behavior and habits need to be in control by patients and bariatric teams to guarantee the best outcomes. An alternative, as used in both studies, is the use of adjunctive pharmacotherapy during follow-up to

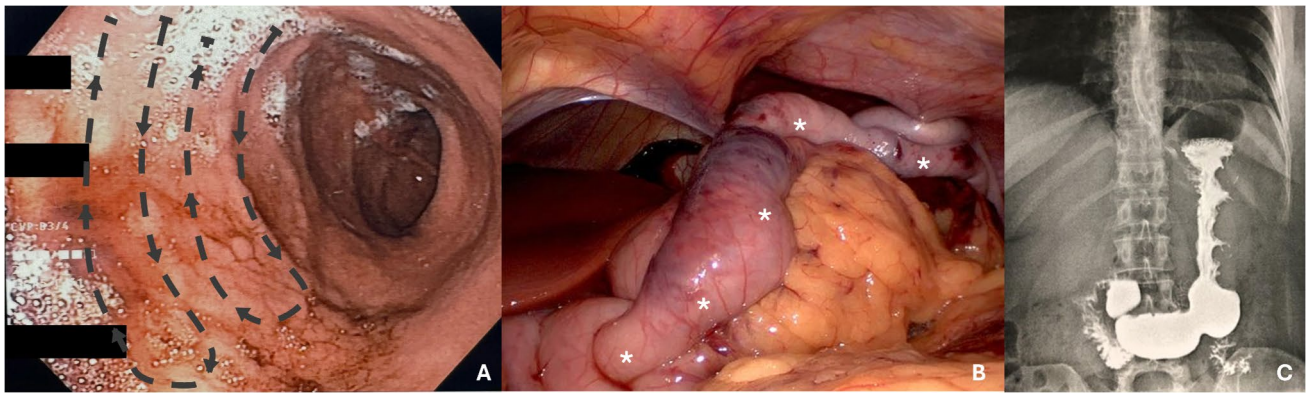

Fig. 4 U-pattern of two endo stitches during endoscopic sleeve gastroplasty (**A**). Immediate postoperative view during a laparoscopic cholecystectomy following endoscopic sleeve gastroplasty (**B**). Results at postoperative day 30 of the barium swallow (**C**). Asterisks show the aspect of the stomach after an endoscopic sleeve gastroplasty

maintain weight loss. The combination of ESG and adjunctive pharmacotherapy seems to be effective in the maintenance of weight loss over time. However, this introduces bias when comparing long-term results between studies. Specific studies should be performed to evaluate the benefit of such additional therapy. If weight regain occurs after 12 months, repeat ESG may be considered as an alternative to MBS. This option has been discussed in several publications [34, 35].

Our study has several limitations. First, there is a limitation related to its retrospective and observational nature, despite the prospective data collection. This means that we can only extrapolate our results with level III evidence. Second, we present data up to 36 months of follow-up. Although our follow-up rate is acceptable, a follow-up bias is evident and cannot be masked. Finally, the single-center nature represents an additional bias, with only one technical pattern of ESG represented in this cohort. The learning curve is also represented and therefore the outcome of the patients at the beginning of the enrollment may be different from those at the end.

Nevertheless, our study is consistent with previously published data at 12 months. Overall, ESG is considered a safe and effective solution for managing obesity. Interestingly, our multivariate analysis showed that OCR at 12 months can be predicted as early as one month after ESG. While short-term results are promising, the medium-term efficacy of ESG remains uncertain. Our analysis contributes to the lack of knowledge at 24 and 36 months and highlights the challenge of maintaining weight loss beyond the first year. However, differences in ESG indications, population ethnicity, BMI distribution, definition of OCR, and post-procedural management may complicate the extrapolation of the data. Further studies are needed to assess the long-term durability of weight loss and its impact on obesity associated-diseases over several years of follow-up. Endoscopic solutions for the treatment of obesity are now well established, and novel technical approaches or devices are advancing. Future research should focus on defining clear indications and populations for endoscopic treatment, as well as evaluating emerging devices. Finally, as therapeutic options for the treatment of obesity continue to evolve and evidence-based medicine becomes more rigorous, a multidisciplinary team approach should be promoted for the indications and the follow-up of metabolic and bariatric therapies.

Conclusion

ESG shows promise for short-term weight loss, offering a viable alternative to traditional MBS. However, challenges in sustaining mid-term efficacy highlight the need for strategies to enhance long-term outcomes. While ESG maintains a favorable safety profile, addressing mid-term sustainability and exploring repeat ESG as an alternative to MBS warrants further investigation. Overall, this study contributes valuable insights to optimize obesity management strategies.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s11695-024-07313-2.

Author Contribution Sebastien Frey: performed the literature search, participated in the design of the study, data collection and interpretation. Wrote and submitted the manuscript. Eric Sejor: participated in the design of the study and and revised the manuscript critically. Pierre-Alain Cougard: revised the manuscript critically. Dorith Benamran: participated the data collection and wrote parts of the manuscript. Hugues Sebbag: performed the literature search, participated in the design of the study and the data collection, and revised the manuscript critically. All authors approved the final version of the manuscript.

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Declarations

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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

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

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