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Efficacy and Safety of Endoscopic Gastroplasty versus Lifestyle Modification for Obesity: A Meta-Analysis of Randomized Controlled Trials with Technique-Specific Subgroup Analysis

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Abstract

Background Endoscopic gastroplasty (EG) offers a minimally invasive alternative to bariatric surgery for obesity management. While multiple randomized controlled trials (RCTs) have compared EG with lifestyle modification (LM), the extent of benefit and influence of procedural technique remain uncertain.

Materials and Methods We conducted a meta-analysis restricted to RCTs comparing EG with LM in adults with obesity. The primary outcome was total body weight loss (TBWL) at 12 months. Secondary outcomes included TBWL and excess weight loss (EWL) at 6 months, and EWL at 12 months. Pooled mean differences (MDs) were estimated using a random-effects model. Subgroup analyses were performed based on techniques, such as OverStitch ESG, Endomina, and Primary Obesity Surgery Endoluminal (POSE). Trial sequential analysis (TSA) and assessment of adverse events and publication bias were also conducted.

Results Five RCTs involving 696 participants were included. EG resulted in significantly greater TBWL at 12 months compared to LM (MD: 7.67%; 95% confidence interval [CI]: 4.38–10.96; $I^2 = 92.5\%$). TSA confirmed the conclusiveness of this finding. EG also led to superior TBWL at 6 months (MD: 6.98%; 95% CI: 3.76–10.20) and greater EWL at 6 months (MD: 24.85%; 95% CI: 13.44–36.27) and 12 months (MD: 26.24%; 95% CI: 11.19–41.29). Subgroup analysis showed highest efficacy with OverStitch ESG (MD: 10.82%), followed by Endomina (6.50%) and POSE (5.61%). The pooled incidence of any adverse event was 10.8%, while serious adverse events were rare (2.9%).

Conclusion EG is more effective than LM for weight loss at 6 and 12 months, with an acceptable safety profile. Among techniques, OverStitch ESG demonstrated the highest efficacy. These findings support the incorporation of EG into the obesity treatment algorithm, especially for patients unsuitable for surgery.

Keywords
- endoscopic gastroplasty
- obesity treatment
- lifestyle modification
- randomized controlled trials
- weight loss
- OverStitch
- Endomina
- POSE

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Introduction

Obesity is a growing global health crisis associated with substantial clinical and socioeconomic burdens.[1,2] Although lifestyle modification (LM)—comprising dietary changes and increased physical activity—remains the cornerstone of treatment, many patients are unable to achieve or maintain meaningful weight loss.[3] Bariatric surgery offers superior efficacy but is limited by invasiveness, cost, and potential complications, making it unsuitable for a significant subset of patients.[1,2,4]

Endoscopic gastroplasty (EG) has emerged as a minimally invasive bariatric option that bridges the therapeutic gap between conservative and surgical interventions.[5–7] Various EG techniques, such as OverStitch (formerly Apollo Endosurgery, now Boston Scientific),[8,9] Primary Obesity Surgery Endoluminal (POSE),[10,11] and Endomina,[12] have been developed to reduce gastric volume endoscopically, with the goal of inducing sustained weight loss. Several randomized controlled trials (RCTs) have compared EG with LM, but individual studies are often underpowered, and reported outcomes have varied.[8–12] A prior meta-analysis by Chan et al included both RCTs and observational studies, reporting favorable results for EG.[13] However, that analysis pooled heterogeneous data and did not account for differences in EG technique, limiting its clinical applicability. Furthermore, it lacked robust sensitivity analyses and did not evaluate the conclusiveness of findings using tools such as trial sequential analysis (TSA).[14]

Given these limitations, we conducted a meta-analysis restricted to RCTs to provide a more rigorous and unbiased estimate of the efficacy and safety of EG compared to LM. We performed predefined subgroup analyses based on procedural technique (POSE, Endomina, OverStitch ESG), applied leave-one-out sensitivity testing, and used TSA to determine whether current evidence is conclusive.

The primary objective of this study was to evaluate the impact of EG versus LM on total body weight loss (TBWL) at 12 months. Secondary objectives included TBWL and excess weight loss (EWL) at 6 months, and EWL at 12 months. Adverse events and publication bias were also assessed.

Materials and Methods

Protocol

This meta-analysis was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines (►**Fig. 1**). A comprehensive literature search was performed across PubMed, Embase, and the Cochrane Central Register of Controlled Trials (CENTRAL) from inception to March 2025. Search terms included: "endoscopic sleeve gastroplasty," "endoscopic gastroplasty," "POSE," "Endomina," "Apollo OverStitch," "bariatric endoscopy," "obesity," and "randomized controlled trial." Reference lists of included studies and relevant reviews were also screened to identify additional eligible trials.

Eligibility Criteria

We included RCTs comparing EG with LM alone in adults with obesity (body mass index [BMI] $\geq$ 30 kg/m^2). Trials were required to report at least one of the following outcomes: TBWL at 6 or 12 months, or EWL at 6 or 12 months. Studies involving pharmacological interventions, surgical procedures, or nonrandomized designs were excluded.

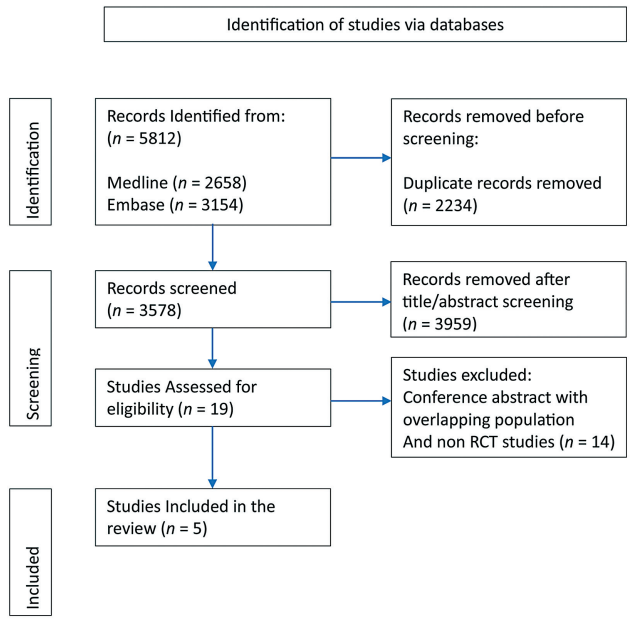

Fig. 1 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram.

Data Extraction and Quality Assessment

Two independent reviewers (N.J. and A.G.) screened titles, abstracts, and full texts and extracted data using a standardized form. Discrepancies were resolved by consensus or by consulting a third reviewer (S.J.). Extracted data included study characteristics, sample size, interventions, baseline demographics, weight loss outcomes, and adverse events. The Jadad scale was used to assess study quality.

For studies with incomplete outcome reporting at predefined time points, outcome values were estimated using linear regression based on reported trends. Specifically, in the study by Huberty et al, participants in the control arm crossed over to the intervention arm after 6 months; only pre-crossover data were used, and regression-based extrapolation was applied to estimate the 12-month control outcomes. For Abad et al, which reported only 18-month data, approximate values at 6 and 12 months were derived using regression modeling of the weight trajectory.

Trial Sequential Analysis

To assess the conclusiveness of cumulative evidence for the primary outcome, TSA was performed using TSA software version 0.9.5.10 Beta (Copenhagen Trial Unit, Denmark). The cumulative Z-statistic was plotted against O'Brien-Fleming monitoring boundaries. Assumptions included a two-sided alpha of 0.05, 90% statistical power, an anticipated mean difference (MD) of 8% in TBWL at 12 months, and a pooled standard deviation derived from included studies. The required information size (RIS) was calculated, and cumulative evidence was assessed using an inverse variance-weighted Z-curve.

Table 1 Characteristics of included randomized controlled trials

	Miller et al, 2017	Sullivan et al, 2017	Huberty et al, 2020	Abu Dayyeh et al, 2022	Abad et al, 2024
Design	Multicenter RCT	Multicenter RCT	Multicenter RCT	Multicenter RCT	Multicenter RCT
Site	Three centers, Europe	Eleven centers, USA	Two centers, Europe	Nine centers, USA	Four centers, Spain
Inclusion criteria	Age 20–60 years, obesity class I and III, failure of conservative weight loss measures, no significant weight change ($\pm$ 5.0% TBWL) in the last 6 months, had an American Society of Anesthesiologists score of $\leq$ 2, not taken any weight-loss medications for $\geq$ 6 months, agreed not to have additional weight-loss interventions or liposuction for $\geq$ 30 months after study enrollment, and been willing to cooperate with postoperative dietary recommendations and assessments	Age 22–60 years, obesity class 1 with at least one nonsevere comorbid obesity-related condition, or BMI $\geq$ 35 and $<$ 40 kg/m^2 without any condition, cannot opt other weight loss measures for the next 24 months	Age 18–65 years, class I or II obesity, must be able to comply with study protocol, must live within 75 km of treatment site, following the bariatric multidisciplinary workup	Age 21–65 years, class I or II obesity, failed nonsurgical weight loss methods interventions, willing to comply with study protocol	Age 18–70 years, histological evidence of MASH, NAS score $>$ 3, BMI $>$ 30 kg/m^2
Exclusion criteria	History of bariatric, gastric, or esophageal surgery, stricture, or other anatomy or condition that could preclude passage of endoluminal instruments, gastroesophageal reflux disease (L.A. classification of grade B, C, or D), known hiatal hernia $>$ 3 cm, pancreatic insufficiency/disease; active peptic ulcer; pregnancy or plans of pregnancy within 12 months; present corticosteroid use; inflammatory gastrointestinal disease; coagulation disorders; hepatic insufficiency or cirrhosis; >2 years type 2 diabetes mellitus (HbA1C $>$ 6.5) or uncontrolled type 2 diabetes (HbA1C $>$ 7%); diabetes treatment with insulin; quit smoking in last 6 months; immunosuppression; portal hypertension or varices; or active gastric ulcer disease, outlet obstruction, or stenosis	History of bariatric, gastric or esophageal surgery, stricture or other esophageal anatomical defect, severe GERD, hiatal hernia $>$ 3 cm, inflammatory gastrointestinal diseases, type II DM $>$ 10 years, HbA1c $>$ 7, known hormonal or gastric cause for obesity	Achalasia or any other motility disorders, severe esophagitis, gastro-duodenal ulcer, heart disease, uncontrolled diabetes mellitus or hypertension, TBWL $>$ 5% over last 6 months, severe comorbidity, GI stenosis or obstruction, previous bariatric therapy, impending gastric surgery 60 days postintervention	History of foregut, GI surgery or bariatric surgery, Inflammatory GI disease, hiatal hernia $>$ 4 cm, achalasia or any other motility disorder, severe coagulopathy, any major illness such as cardiac, pulmonary, etc.	History of prior bariatric surgery, acute cardiac event, heart failure, liver cirrhosis, $>$ 5% TBWL in 6 months, esophagogastric varices, hepatocellular carcinoma, retroviral disease, any unstable disease or medical condition that could reduce life expectancy to less than 2 years

Table 1 (*Continued*)

	Miller et al, 2017	Sullivan et al, 2017	Huberty et al, 2020	Abu Dayyeh et al, 2022	Abad et al, 2024
Sample size Active arm Control arm	 34 (POSE) 10 (lifestyle)	 221 (POSE) 111 (sham)	 49 (EndoMina) 22 (Lifestyle)	 85 (ESG) 124 (control)	 20 (ESG) 20 (sham)
Age, y, mean (SD) Active arm Control arm	 38.3 (10.3) 38.5 (12.5)	 44.2 (8.6) 45.3 (9.1)	 37.6 (9.9) 45.3 (11.7)	 47.3 (9.3) 45.7 (10.0)	 55.15 (10.9) 53.05 (11.8)
Male, *n* (%) Active arm Control arm	 9 (26.5) 1 (10.0)	 26 (11.8) 10 (9.0)	 3 (6.0) 2 (9.0)	 9 (12.0) 18 (16.0)	 11 (55.0) 11 (55.0)
Diabetes mellitus, *n* (%) Active arm Control arm	 1 (2.9) 1 (10.0)	 4 (7.0) 2 (7.4%)		 18 (23%) 36 (33%)	 9 (45.0) 11 (55.0)
Weight, kg, mean (SD) Active arm Control arm	 99.9 (11.1) 96.8 (12.1)	 99.7 (12.2) 98.7 (11.6)	 93.3 (8.8) 94.7 (9.5)	 *N* = 77, 110 98.4 (12.3) 99.1 (12.8)	 106.15 (21.85) 106.50 (18.15)
BMI, kg/m^2, mean (SD) Active arm Control arm	 36.2 (3.3) 37.2 (3.7)	 36.0 (2.4) 36.2 (2.2)	 34.8 (2.7) 34.2 (2.5)	 35.5 (2.6) 35.7 (2.6)	 37.54 (4.81) 38.17 (4.76)

Abbreviations: BMI, body mass index; DM, diabetes mellitus; GERD, gastroesophageal reflux disease; GI, gastrointestinal; HbA1C, glycated hemoglobin; MASH, metabolic dysfunction-associated steatohepatitis; NAS, nonalcoholic fatty liver disease activity score; RCT, randomized controlled trial; SD, standard deviation; TBWL, total body weight loss.

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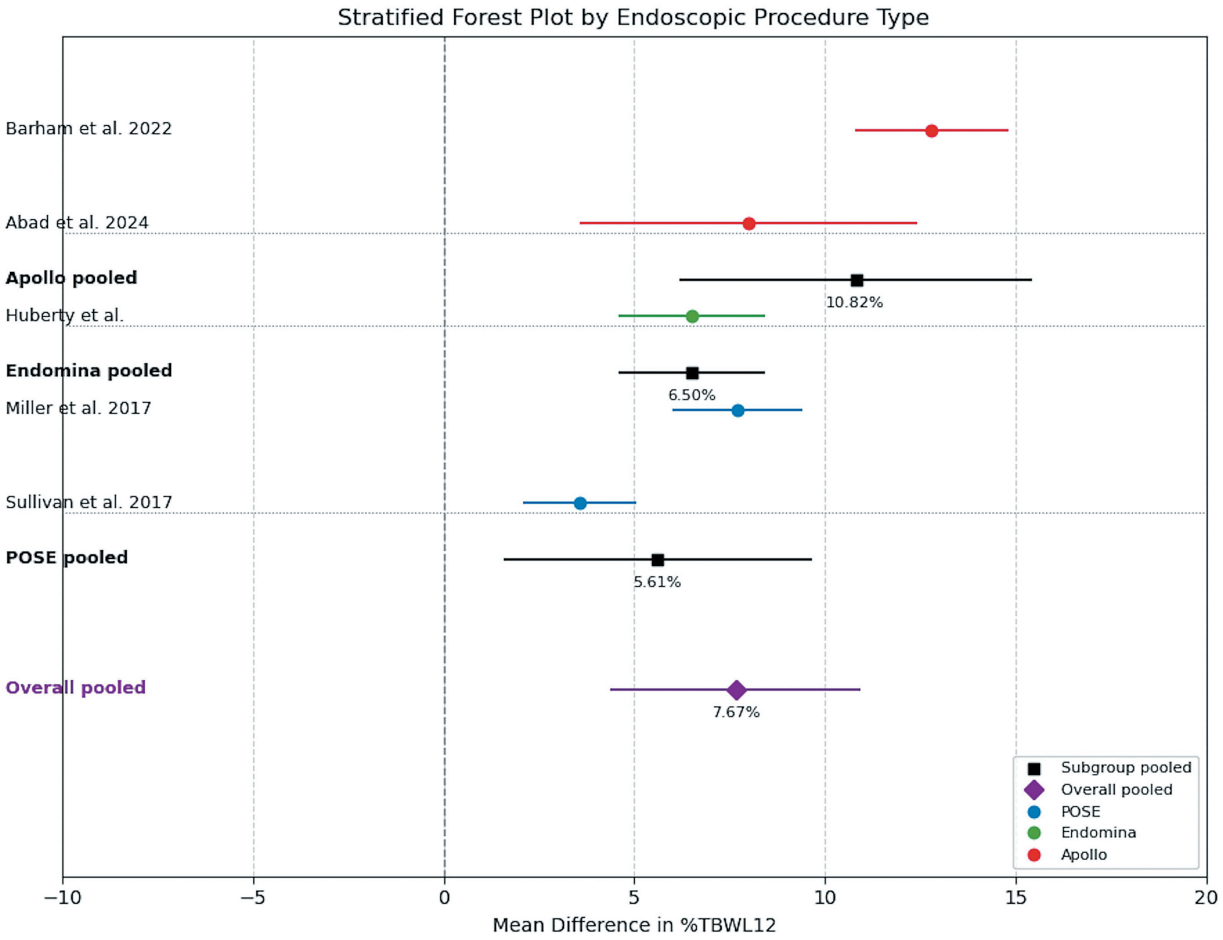

Fig. 2 Fig. 2 Forest plot — total body weight loss (TBWL) at 12 months.

Outcomes

The primary outcome was the MD in percentage TBWL at 12 months between EG and LM. Secondary outcomes included MD in TBWL and EWL at 6 months, and EWL at 12 months. Adverse events, including serious and total events, were also evaluated.

Data Synthesis and Statistical Analysis

Meta-analyses were conducted using a random-effects model (DerSimonian and Laird method) to account for between-study variability. For continuous outcomes, pooled MDs with 95% confidence intervals (CIs) were calculated. Heterogeneity was assessed using the I^2 statistic. Sensitivity analysis was performed via leave-one-out testing. Subgroup analyses were conducted by EG technique (POSE, Endomina, OverStitch ESG). Publication bias was evaluated through visual inspection of funnel plots and Egger's test. The certainty of evidence for each outcome was assessed using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach, considering study limitations, inconsistency, indirectness, imprecision, and publication bias.

Results

A total of five RCTs comprising 696 participants were included in the final meta-analysis (►**Table 1**). All studies compared EG with LM in adults with obesity (BMI $\geq$ 30 kg/m^2) and reported weight loss outcomes at 6 and/or 12 months. The trials evaluated three EG techniques: the POSE system (evaluated by Miller et al and Sullivan et al),[10,11] the Endomina platform (Huberty et al),[12] and the OverStitch system (Abu Dayyeh et al and Abad et al).[8,9] All trials were conducted in Western populations and demonstrated comparable baseline characteristics across intervention and control groups.

Total Body Weight Loss at 12 Months

The primary outcome of interest was the MD in TBWL at 12 months between the EG and LM groups. Pooled analysis revealed that EG was associated with a statistically significant improvement in TBWL at 12 months, with a MD of 7.67% (95% CI: 4.38–10.96). However, statistical heterogeneity was considerable ($I^2 = 92.5\%$), reflecting substantial variability in the magnitude of benefit across studies (►**Fig. 2**).

To explore this heterogeneity, a leave-one-out sensitivity analysis was performed. Notably, exclusion of the Sullivan et al study reduced the heterogeneity to 86.53% and increased the pooled effect size to a MD of 8.795%. While exclusion of the Abu Dayyeh et al study reduced the heterogeneity to 79.92% with pooled effect size reduced to 6.198%, suggesting that these trials introduced significant between-study variability.

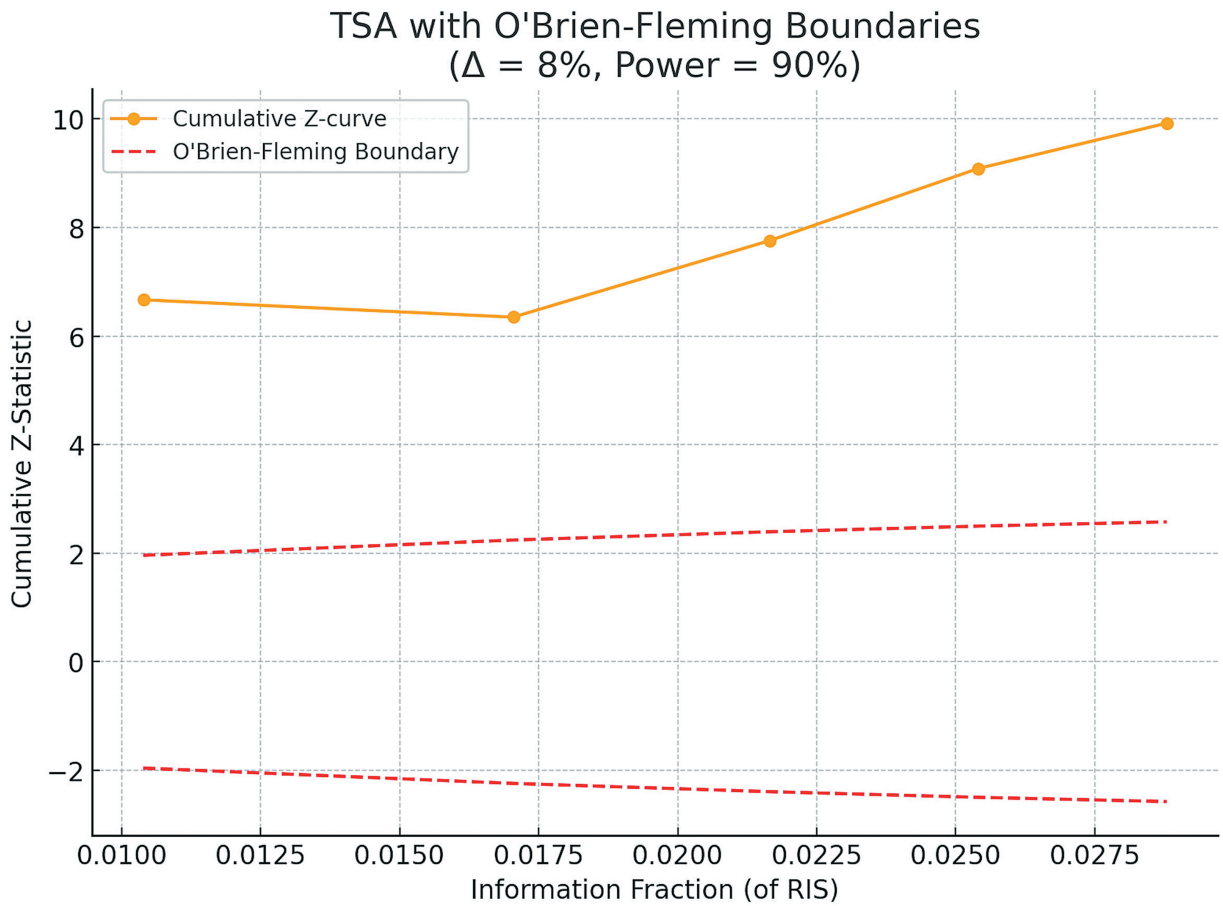

Fig. 3 Trial sequential analysis (TSA).

Despite this heterogeneity, the overall direction of effect consistently favored EG over LM across all trials (►**Supplementary Table S1**, available in the online version).

To assess the conclusiveness of the accumulated evidence, a TSA was conducted using a two-sided alpha of 0.05 and 90% power (►**Fig. 3**). The anticipated effect size was set at 8% TBWL, based on clinical relevance and prior literature. The cumulative Z-curve surpassed both the O'Brien-Fleming boundary and the RIS (67 participants), indicating that the available evidence is sufficient to establish the superiority of EG over LM for 12-month TBWL. These results mitigate concerns related to sparse data and repeated significance testing, thereby strengthening the confidence in the observed effect.

Subgroup Analysis by Procedural Technique

To determine whether the efficacy of EG varied based on the endoscopic technique used, subgroup analyses were conducted for the three procedural approaches (►**Table 2**). The OverStitch system demonstrated the greatest magnitude of effect, with a pooled MD of 10.82% (95% CI: 6.17–15.46; $I^2 = 73.3\%$). The Endomina system, evaluated in a single RCT, showed a mean TBWL difference of 6.50%, although pooled heterogeneity could not be calculated due to the single-study data. The POSE system yielded the most modest benefit, with a pooled MD of 5.61% (95% CI: 1.56–9.66; $I^2 = 80.1\%$). The test for subgroup differences was statistically significant (Q_between = 37.01; $p < 0.001$), indicating that the type of endoscopic platform plays a critical role in the degree of weight loss achieved (►**Fig. 4**).

Secondary Outcomes: TBWL and EWL at 6 and 12 Months

Secondary outcomes further supported the efficacy of EG across earlier time points and additional weight metrics. At 6 months, EG resulted in a pooled MD in TBWL of 6.98% (95% CI: 3.76–10.20; $I^2 = 95.3\%$). Sensitivity analysis excluding the Sullivan et al study reduced heterogeneity to 38.3% and increased the pooled MD to 8.54%, again highlighting this study's impact on between-study variability (►**Supplementary Fig. S1**, available in the online version).

For EWL, EG outperformed LM at both 6 and 12 months (►**Supplementary Figs. S2** and **S3**, available in the online version). The pooled MD in EWL at 6 months was 24.85% (95% CI: 13.44–36.27; $I^2 = 96.4\%$), and at 12 months was 26.24% (95% CI: 11.19–41.29; $I^2 = 98.3\%$). Leave-one-out analyses showed influence of an individual study on the overall effect size (►**Supplementary Table S1**).

Subgroup Analysis of Secondary Outcomes

Subgroup analyses of 6- and 12-month EWL by procedural technique revealed substantial differences (►**Table 2**). At 6 months, the OverStitch ESG subgroup achieved the greatest

Table 2 Outcomes by EG technique overall and subgroup analysis

Technique	Overall	Apollo OverStitch	Endomina	POSE	*p*-Value
MD TBWL 12 months (95% CI); I^2 (%)	7.67% (4.38–10.96); 92.5%	10.82% (6.17–15.46); 73.3%	6.50% (4.57–8.43); 0%	5.61% (1.56–9.66); 92.2%	0.001
MD EWL 12 months (95% CI); I^2 (%)	26.24% (11.19–41.29); 98.3%	41.75% (29.10–54.39); 56.6%	15.90% (11.59–20.11),)%	19.08% (4.31–33.86); 95.5%	0.001
MD TBWL 6 months (95% CI); I^2 (%)	6.98% (3.76–10.20); 95.3%	8.42% (4.26–12.59); 63.6%	8.30% (6.97–9.63); 0%	5.33% (0.18–10.49); 97.0%	0.001
MD EWL 6 months (95% CI); I^2 (%)	24.85% (13.44–36.27); 96.4%	32.77% (19.38–46.16); 48.8%	25.20% (22.26–28.14); 0%	19.64% (−2.21 to 41.49); 97.3%	0.001

Abbreviations: CI, confidence interval; EG, endoscopic gastroplasty; EWL, excess weight loss; MD, mean difference; POSE, Primary Obesity Surgery Endoluminal; TBWL, total body weight loss.

EWL (32.77%; 95% CI: 19.38–46.16; $I^2 = 48.8\%$), followed by Endomina (25.20%; 95% CI: 22.26–28.14; $I^2 = 0\%$) and POSE (19.64%; 95% CI: −2.21 to 41.49; $I^2 = 97.3\%$). The differences between subgroups were statistically significant (Q_between = 73.12; $p < 0.001$). Similarly, at 12 months, the OverStitch system demonstrated superior performance with a pooled EWL of 41.75% (95% CI: 29.10–54.39; $I^2 = 56.6\%$), compared with Endomina (15.90%; 95% CI: 11.59–20.21; $I^2 = 0\%$) and POSE (19.08%; 95% CI: 4.31–33.86; $I^2 = 95.5\%$). The subgroup effect remained significant (Q_between = 217.54; $p < 0.001$), reinforcing the clinical relevance of procedural selection in EG.

Adverse Events

Safety profiles across the studies were favorable. The pooled incidence of any adverse event in the EG group was 10.8% (95% CI: 6.2–17.8%; $I^2 = 48.6\%$). Serious adverse events were infrequent, with a pooled incidence of 2.9% (95% CI: 1.3–6.1%; $I^2 = 0\%$). Most reported events were mild to moderate in severity and included gastrointestinal bleeding, transient nausea, dehydration, and abdominal discomfort. No serious device-related complications were reported in the POSE or Endomina trials. In the OverStitch ESG subgroup, isolated cases of perigastric fluid collections and prolonged pain were noted, but all were self-limiting or managed conservatively. No serious adverse events were observed in the LM control groups.

Publication Bias

Publication bias was assessed using funnel plots and Egger's test. Visual inspection of funnel plots demonstrated overall symmetry, and Egger's test did not detect statistically significant small-study effects for any of the primary or secondary outcomes (►**Supplementary Fig. S4**, available in the online version; $p > 0.05$). These findings suggest a low risk of publication bias in the included studies. GRADE assessment showed moderate certainty of evidence for TBWL at 6 and 12 months, and low certainty for EWL outcomes due to heterogeneity and imprecision. These ratings support the overall robustness of the primary outcome while highlighting the need for further studies on secondary endpoints (►**Supplementary Table S2**, available in the online version).

Discussion

In this meta-analysis of five RCTs involving a total of 696 participants, EG was found to be significantly more effective than LM alone in achieving weight loss at both 6 and 12 months. EG led to a pooled MD of 7.67% in TBWL at 12 months, and similarly favorable outcomes were observed for EWL at both 6- and 12-month follow-up intervals. The robustness of these findings were confirmed through leave-one-out sensitivity analyses, and TSA demonstrated that the cumulative evidence was both adequately powered and conclusive, crossing the O'Brien-Fleming monitoring boundary and surpassing the RIS.[14] LM forms the cornerstone of all bariatric and nonbariatric weight management strategies.

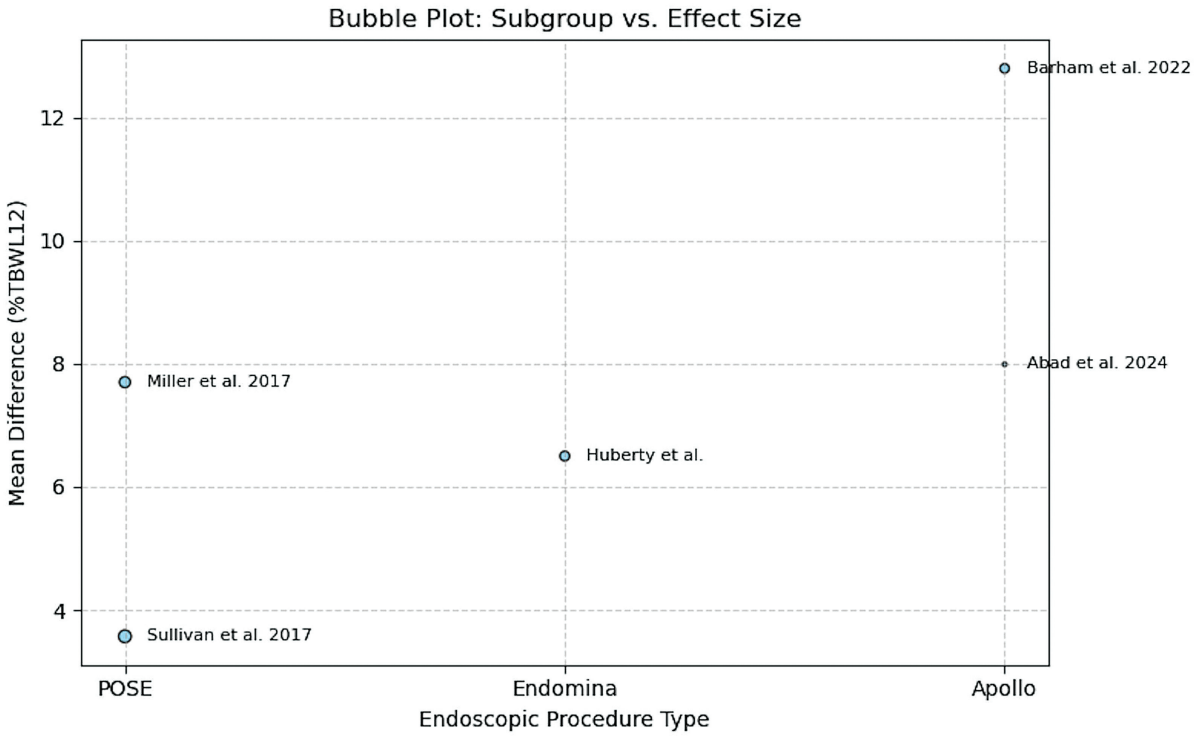

Fig. 4 Bubble plot — total body weight loss (TBWL) at 12 months.

Structured LM programs incorporating dietary optimization, physical activity, behavioral support, and psychological counseling have consistently demonstrated modest but clinically meaningful weight loss. In fact, LM remains an essential cointervention even in trials evaluating endoscopic or surgical therapies, reinforcing its foundational role in obesity care.

A key strength of this study lies in its technique-specific subgroup analysis, which revealed important differences in efficacy among the three EG platforms. The OverStitch system showed the greatest magnitude of weight loss benefit, followed by Endomina and POSE. These findings highlight the clinical relevance of device selection in endoscopic bariatric interventions and suggest that OverStitch ESG may offer superior outcomes where available. These differences may partly reflect the technical and design variations among the platforms.

The OverStitch system is the most widely adopted platform and enables full-thickness suturing via a dedicated double-channel endoscope, allowing robust gastric plication.[8,9] POSE uses a proprietary endoscope-mounted system, but the earlier version (POSE 1.0) had limited depth of tissue capture and plication strength. Since then, POSE 2.0 has been developed with improved anchors, a shorter procedure time, and better intragastric remodeling, potentially enhancing clinical efficacy.[15,16] Endomina differs by using an external triangulation platform, which allows use with a standard single-channel endoscope and offers internal suturing, potentially increasing its accessibility in centers without advanced equipment.[12,17] These anatomical, technological, and logistical differences may influence both procedural adoption and clinical outcomes, and should be carefully considered when interpreting the comparative effectiveness of EG techniques.

Our findings are broadly consistent with prior meta-analyses that support the superiority of EG over LM for weight loss. However, most earlier studies included heterogeneous designs and observational data, which can introduce bias and dilute technique-specific insights. For example, the meta-analysis by Chan et al demonstrated overall efficacy of EG but combined randomized and non-randomized studies and did not account for differences in EG platforms. In contrast, our meta-analysis exclusively included RCTs and corrected for crossover effects and incomplete data reporting using validated regression-based estimation. This methodologically rigorous approach provides a more precise and clinically applicable evaluation of EG efficacy.

In addition to efficacy, the safety profile of EG was favorable across trials. The pooled rate of serious adverse events was low (2.9%), and most complications were mild and self-limiting, including abdominal discomfort, transient nausea, and perigastric fluid collections. No serious device-related events were reported in studies using the POSE or Endomina platforms. While minor complications were more frequent with OverStitch ESG, they were manageable with conservative treatment. No adverse events occurred in the LM arms. These findings support the overall safety and tolerability of EG, especially in patients who are not suitable candidates for bariatric surgery.[18]

This study has several notable strengths. It represents the most current and comprehensive meta-analysis limited to RCTs evaluating EG versus LM. Subgroup analyses based on procedural technique offer novel insight into platform-specific efficacy, and the application of TSA strengthens the internal validity of the primary outcome. Risk of bias and

certainty of evidence were formally evaluated using the GRADE framework, and publication bias was not evident.

There are few limitations in the current study. The number of included RCTs was relatively small, and moderate to high heterogeneity was observed for several outcomes. Although this heterogeneity was partially explained by subgroup and sensitivity analyses, residual variation likely reflects differences in operator experience, procedural technique, and population characteristics. We could not perform subgroup analysis according to baseline BMI due to nonavailability of data. Two of the included trials required extrapolation of data at 6 or 12 months using regression modeling, which, although conservative and sensitivity-tested, may introduce some uncertainty. Additionally, all included trials were conducted in Western populations, limiting the generalizability of findings to other geographic and ethnic groups, including Asian and Indian populations.[6,7,19,20]

In conclusion, EG is significantly more effective than LM alone for short- and intermediate-term weight loss, with an acceptable safety profile. Among currently available techniques, OverStitch ESG appears to provide the greatest benefit, although platform-specific characteristics should be considered when choosing an intervention. These findings support the integration of EG into obesity treatment pathways, particularly for patients who are ineligible or unwilling to undergo bariatric surgery. Future research should focus on evaluating long-term durability of weight loss, metabolic improvements, cost-effectiveness, and broader applicability across global populations.

Supplementary Table S1 Leave-one-out sensitivity analysis

Supplementary Table S2 GRADE summary of findings: EG vs. LM for obesity management

Authors' Contributions

Concept and design: N.J., R.K., D.N.R. Supervision: R.K., D.N.R. Resources: V.H., I.B., R.K. Data collection and/or processing: N.J., A.G., S.J. Analysis and interpretation: N.J., A.. Literature search: A.G., S.J. Writing – original draft: N.J., A.G. Writing – review and editing: S.J., I.B., V.H. Critical review and final approval: All authors.

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None.

Conflict of Interest

None declared.

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