

# The Effect of Staple Line Reinforcement on Complication Rates in Patients Undergoing Sleeve Gastrectomy

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## Abstract

**Aim:** Although many findings have been made regarding surgical technique in sleeve gastrectomy, staple line reinforcement remains controversial. In our study, we aimed to discuss the effect of staple line reinforcement on complication rates.

**Methods:** Patients who underwent sleeve gastrectomy for obesity treatment at our clinic between January 2013 and June 2025 were identified through the hospital's electronic data system. Patients over the age of 18, those who did not undergo staple line reinforcement, those who underwent staple line reinforcement involving the omentum, and those with no missing data were included in the study. Patient demographics, as well as BMI, comorbidities, staple line reinforcement techniques, and surgical complications, were recorded.

**Results:** 191 patients underwent sleeve gastrectomy between the specified dates. Of these patients, 138 (%72.2) were female and 53 (%27.7) were male. The patients' mean BMI was  $44.77 \pm 8.01$  kilograms. There were 75 (%39.2) patients with comorbidities. The number of patients in whom we reinforced the staple line was 59 (%30.8). A total of 6 (%3.1) patients developed complications. All patients who developed complications were in the group without staple line reinforcement. There were no mortality rates.

**Conclusions:** Staple line reinforcement after sleeve gastrectomy is an effective method for reducing complication rates.

**Keywords:** Morbid obesity; sleeve gastrectomy; leak rate

## 1. Introduction

Obesity is one of the biggest health problems of the 21st century. According to WHO data for 2022, 2.5 billion adults aged 18 and over are overweight worldwide, and more than 890 million are obese. Accordingly, 43 percent of adults aged 18 and over are overweight, a rate that has nearly doubled since 1990.

Weight gain leads to organ and system deterioration, leading to the development of metabolic syndrome, which includes hypertension, dyslipidemia, and insulin resistance.<sup>1,2</sup> Patients with metabolic syndrome are more likely to develop myocardial infarction, stroke, and type 2 diabetes, which increases cardiovascular risk and contributes to increased mortality.<sup>3,4</sup>

The sleeve gastrectomy technique began to take shape in the late 1980s. The first such procedure was performed in March 1988 by Dr. It was performed by Doug Hess in Bowling Green, Ohio, as part of the duodenal switch operation.<sup>5</sup> However, over time, it has become a distinct bariatric surgical technique due to its effectiveness in weight loss.

While bariatric surgery is the most effective treatment for morbid obesity, such surgical procedures carry a risk of perioperative

complications. The incidence of postoperative complications for LSG is 2.12%.<sup>6</sup> The long staple line formed after sleeve gastrectomy poses a significant risk of postoperative leakage and bleeding.<sup>7</sup> To reduce the incidence of staple line-related complications, various studies have suggested reinforcing the staple line with sutures. However, the effectiveness of this procedure remains controversial. We aimed to present our clinical experience with staple line suturing to the literature.

## 2. Materials and Methods

Patients who underwent sleeve gastrectomy for morbid obesity at our clinic between January 2013 and June 2025 were retrospectively analyzed after obtaining approval from the Başkent University Research Board. The study was conducted in accordance with the Declaration of Helsinki. Patients over 18 years of age who did not undergo staple line reinforcement, who underwent staple line reinforcement involving the omentum, who had no missing

data, and who underwent sleeve gastrectomy due to morbid obesity were included in the study. Patients under 18 years of age, who had missing data, who underwent metabolic or bariatric surgery other than sleeve gastrectomy, and who underwent staple line reinforcement using other methods were excluded.

### 2.1. Stapler selection and staple line reinforcement technique:

All surgical procedures were performed with the same surgical care and precision by two different surgeons experienced in bariatric surgery, using the same surgical technique. A double-row stapler, Endo-GIA stapler, was used in patients who did not undergo staple line reinforcement, while a three-row stapler, Tri-Stapler technology, was used in patients who underwent staple line reinforcement. Two rows of thick staples (Endo-GIA green, Tri-Stapler black cartridges) were used in the antrum, followed by short-leg staples (Endo-GIA blue, Tri-Stapler purple). The staple line was sutured over and over through the omentum with V-Loc suture.

Patients were divided into two groups: those with and without staple line reinforcement. Stapler line-related complications (leakage and bleeding) were recorded, and complication rates between the two groups were calculated and statistical differences were discussed.

## 3. Results

A total of 191 patients met the study criteria. Of these patients, 138 (%72.2) were female and 53 (%27.7) were male. Patient ages ranged from 19 to 69 years, with a mean age of  $38.32 \pm 11.97$  years. BMI ranged from 35 kg/m<sup>2</sup> to 71 kg/m<sup>2</sup>, with a mean BMI of 44.77 kg/8.01 kg. Of the patients with comorbidities, 45 (%23.5) had hypertension alone, 15 (%7.85) had diabetes mellitus alone, and 15 (%7.85) had both. Staple line reinforcement was not performed in 132 (%69.1) patients. A total of 6 (%3.1) patients developed staple line-related complications (Table 1).

**Table 1**

### Results

		Number	Percent(%)
Gender	Female	138	72.25
	Male	53	27.75
	Total	191	100
Age(min-max, mean±sd)	19-69, 38.32±11.97 year		
BMI(min-max, mean±sd)	35-71 kg/m <sup>2</sup> , 44.77 ±8.01 kg/m <sup>2</sup>		
Comorbidty	HT	45	60
	DM	15	20
	HT+DM	15	20
Complications	Leakage	4	2.09
	Bleeding	2	1.04
Staple line reinforcement	-	132	69.10
	+	59	30.89

DM: Diabetes mellitus HT: Hypertension

**Table 2**

### Publication on staple line reinforcement

Publications	Number of patients	Bleeding	Leakage
Aiolfi A et al. <sup>8</sup>	3994	↓	↓
Diab AF et al. <sup>9</sup>	979	↓	↓
Aboueisha MA et al. <sup>10</sup>	513.354	↓	—
Lin S et al. <sup>11</sup>	914	↓	—

**Table 3**

### Patients with complications

Patients	1	2	3	4	5	6
Age	54	29	29	52	56	24
Gender	M	M	M	M	M	FM
Complications	Leakage	+	-	+	+	-
	Bleeding	-	+	-	-	+
Complication location	F	F	C	F	F	O
BMI (kg/m <sup>2</sup> )	50	45	43	49	51	46
DM	-	-	-	-	-	-
HT	-	-	-	-	+	-
Staple line reinforcement	-	-	-	-	-	-

BMI: Body mass index C: Corpus DM: Diabetes mellitus F: Fundus FM: Female M: Male O: Omentum

## 4. Discussion

Although there is no standard technique for sleeve gastrectomy, a procedure that has been performed for approximately 30 years, surgeons have now reached a consensus on many issues. While standardizations include the use of vascular sealing devices during omental dissection, a calibration tube with a diameter of 36 f, firing the first stapler parallel to the incisura angularis, and completing the fundus dissection at least 1 cm from the angle of His, surgeons disagree, particularly regarding staple line reinforcement.

While many recent studies have yielded varying results, the effectiveness of suture reinforcement in preventing bleeding has been demonstrated in many studies (Table 2). A study by Stroka G et al. demonstrated a higher incidence of bleeding in patients without staple line reinforcement compared to those with reinforcement. This incidence was 1.4-2% in patients with reinforcement, while it was 9-13.7% in patients without reinforcement. It has also been shown that suturing alone does not provide sufficient pressure, and that overlying omental closure is effective in achieving the desired results<sup>12</sup>. We had two patients with bleeding. In the first of these, the bleeding was due to gastric breves. While vascular sealing devices often prevent such bleeding, multiple use of these devices can cause sealing problems. Unfortunately, due to the economic situation in our country, these devices are used multiple times. The cause of bleeding in our patient was also likely multiple use. The bleeding in the second patient was from a stapler line in the fundus region. An Endo-GIA stapler was used in this patient. We have not observed any such bleeding since we began using the Tri-Stapler and suturing the omentum to the staple line. We believe that omental bleeding would not have occurred in the first patient if the omentum had

been sutured to the staple line.

The problem in the other four patients who developed complications was leakage from the staple line. The staple line was not reinforced in any of these patients. A tri-stapler was used in three patients, and an endo-GIA stapler was used in one. Postoperative endoscopies revealed no pathological findings other than leaks (stenosis, etc.). The mean age of the four patients was 47.75 years, and the mean BMI was 48.25 kg/m<sup>2</sup>. Only one patient had hypertension (Table 3). The leakage site was in the fundus in three patients and in the distal corpus in one patient. The average incidence of leakage after sleeve gastrectomy is 2.4%<sup>13</sup>. Variables that may increase the risk of leakage include ischemia, incisal stenosis, excess fundus, or the use of inappropriate staple height<sup>14</sup>. Several factors have been shown to influence leakage. The bougie size used during surgery is important in determining the stenosis of the neogastric cavity. In recent years, the recommended diameter is 36 f<sup>15</sup>. In our cases, we preferred a 39 f bougie. Although the distance between the starting point of resection in the antrum and the pylorus plays a role in increasing intraluminal pressure, the effect of this distance on leakage has not been demonstrated<sup>14</sup>. Because we preferred a standard distance of 4-6 cm in our patients, it is not possible to comment on the effect of this distance on leakage. Intraoperative leak testing with methylene blue has low sensitivity and does not exclude postoperative leakage<sup>16,17</sup>. Despite routine methylene blue leak testing, we did not observe any intraoperative leaks in any patient. Different studies have yielded varying results regarding staple line reinforcement. Cunningham-Hill M et al. evaluated 189,173 patients undergoing sleeve gastrectomy and could not demonstrate any positive or negative effects of staple line reinforcement on leakage<sup>18</sup>. Studies by Dang JT et al. and Aboueisha MA et al. found that staple line reinforcement did not reduce leakage, and in fact, increased experience has led to better results in patients without staple line reinforcement<sup>10,19</sup>. In our study, no patients with staple line reinforcement experienced leakage. Staple line reinforcement was not used in all patients with leakage. We believe that poor fundal nutrition is a contributing factor to leaks, except in the patient with leakage in the corpus, but we believe that incorrect stapler selection in the corpus may have been a contributing factor.

Our study, being a retrospective study, has limitations. Because a randomized study was not designed, analysis could not be conducted on homogeneous groups, which may have negatively impacted the results. Because our clinic does not focus solely on obesity, patients included in the study were selected over a long period to ensure a sufficient number of cases. Consequently, the effects of experience gained over time could not be isolated from other parameters on the results.

## 5. Conclusion

Reinforcement of the staple line with reinforcing suture resulted in a significant reduction in bleeding and leakage rates. Prospective randomized studies are needed to understand the effectiveness of experience, technology, and surgical technique in this reduction.

## Statement of ethics

This study was approved by the Scientific Research Ethics Committee of Baskent university E-94603339-604.01-475729-2025

## genAI

No artificial intelligence-based tools or generative AI technologies were used in this study. The entire content of the manuscript was originally prepared, reviewed, and approved by both authors.

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## Conflict of interest statement

The authors declare that they have no conflict of interest.

## Availability of data and materials

This Data and materials are available to the researchers.

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