



Comparison between the circular and linear stapled technique in Laparoscopic Roux-en-Y gastric bypass.

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Abstract: Background: Obesity is considered one of the leading causes of death around the world. Sever obesity is defined as having a body mass index (BMI) of more than 35 kg/m², while the morbid obesity is having a body mass index greater than 40 kg/m² Obesity can be treated using surgical or non-surgical approaches, surgical options are the considered to be the lone option which guarantee satisfactory, long-term weight loss. Roux-en-Y gastric bypass (RYGB) is considered to be one of the commonest techniques of bariatric surgery. Gastrojejunostomy (GJ) can be done using one of three different approaches; hand-sewn, using a circular stapler (CS), or using a linear stapler (LS). **Aim of the work:** The aim of this study is to compare between the usage of the circular stapler and the linear stapler techniques regarding the outcome of the surgery and the post-operative complications. And being able to reach a conclusion regarding the best technique to be used in the laparoscopic Roux-en-Y gastric bypass bariatric surgeries. **Material and methods:** This study is a retrospective cohort study, conducted in Ain Shams University Surgery Hospital in Cairo between June 2016 and September 2018. The inclusion criteria for the patients to enter the study was to have a primary laparoscopic Roux-en-Y gastric bypass performed by CS or LS technique, to have a body mass index (BMI) of 40 kg/m² or more, aged between 25 and 60 years. The exclusion criteria was for the patient to have a history of previous weight loss, previous surgery and a cases with insufficient necessary data. The final sample size was 136 patients, 66 of them underwent LRYGB using linear stapler technique, and the other 70 underwent the circular stapler technique. **Results:** The total operative time was significantly longer in the linear staple group 149 (99-175) min vs. 85 (65-110) min in the circular stapler group ($p < 0.001$). The incidence of post-operative hemorrhage was significantly lower in the linear stapler group 2 (1.32%) comparing with 9 (5.94%) in the circular stapler group ($p = 0.02$). the mean length of the hospital stay time was significantly shorter in the linear stapler group 3(2–6) days comparing with 5 (3–7) days in the circular stapler group ($p < 0.001$). The LRYGB-LS technique was associated with less post-operative wound infections 1 (0.66%) comparing with 7 (4.62%) in the LRYGB-CS group ($p = 0.01$). there was no difference between the two groups regarding the readmission ratio ($p = 0.59$). and there was no significant difference between both groups regarding the incidence of anastomotic leakage, stricture, port side hernias and marginal ulcers. **Conclusions:** Our results suggest that both circular stapler and linear stapler Laparoscopic Roux-en-Y gastric bypass techniques are considered safe and associated with a low risk to develop any post-operative complications. The incidence of post-operative hemorrhage and infections are slightly higher with the use of circular stapler technique, while the operation time was significantly shorter.

[Mohamed Magdy, Waleed Ibrahim, Mohamed Aboul Naga. **Comparison between the circular and linear stapled technique in Laparoscopic Roux-en-Y gastric bypass.** *J Am Sci* 2019;15(12):116-121]. ISSN 1545-1003 (print); ISSN 2375-7264 (online). <http://www.jofamericanscience.org>. 13. doi:[10.7537/marsjas151219.13](https://doi.org/10.7537/marsjas151219.13).

Keywords: Comparison; circular; linear; stapled technique; Laparoscopic Roux-en-Y gastric bypass.

1. Introduction.

Obesity is considered one of the leading causes of death around the world, obesity is considered as a worldwide epidemic causing more death than starvation and it is viewed it as one of the most serious public health problem of the 21st century (1). Sever obesity is defined as having a body mass index (BMI) of more than 35 kg/m², while the morbid obesity is having a body mass index greater than 40 kg/m² or a BMI greater than 35 kg/m² with concomitant obesity-related morbidity (2). Obesity can be treated using surgical or non-surgical approaches. The non-surgical techniques have many

disadvantages like the noncompliance of the patients, and the non-satisfactory results. Another problem is the weight regaining after the success of the nonsurgical techniques. Regarding the morbidly obese patients, surgical options are the considered to be the lone option which guarantee satisfactory, long-term weight loss. (4).

Roux-en-Y gastric bypass (RYGB) is considered to be one of the commonest techniques of bariatric surgery (5). It can be done either by laparotomy or by laparoscopy. The laparoscopic approach has been found to be more feasible and associated with less post-operative complications (6). Gastrojejunostomy

(GJ) can be done using one of three different approaches; hand-sewn, using a circular stapler (CS), or using a linear stapler (LS) (7-9).

According to a previous paper in 2008, the circular stapler technique is the most common used technique in the United States. 66% of the Roux-en-Y gastric bypass (RYGB) operations in the United States are done using the circular stapler technique, followed by the hand sewn technique 18%, and the linear stapler technique 16% (10).

Some recent studies found the circular stapler technique to be associated with more post-operative complications like strictures, infections, and marginal ulcers when compared to the linear stapler technique (11,12), while other papers found the difference to be of no statistical significance (13,14).

Aim of the work:.

The aim of this study is to compare between the usage of the circular stapler and the linear stapler techniques regarding the outcome of the surgery and the post-operative complications. And being able to reach a conclusion regarding the best technique to be used in the laparoscopic Roux-en-Y gastric bypass bariatric surgeries.

2. Material and methods:.

This study is a retrospective cohort study, conducted in Ain Shams University Surgery Hospital in Cairo between June 2016 and September 2018. We recruited morbidly obese patients who underwent primary LRYGB in Ain Shams University Surgery Hospital. The inclusion criteria for the patients to enter the study was to have a primary laparoscopic Roux-en-Y gastric bypass performed by CS or LS technique, to have a body mass index (BMI) of 40 kg/m² or more, aged between 25 and 60 years. The exclusion criteria was for the patient to have a history of previous weight loss, previous surgery and a cases with insufficient necessary data. The final sample size was 136 patients, 66 of them underwent LRYGB using linear stapler technique, and the other 70 underwent the circular stapler technique.

Pre-operative preparation of the patients included history taking focusing on age, sex, weight, BMI, Dietary habits, history of previous operations. All the patients underwent full general examination, full abdominal examination checking for scars of previous operations or abdominal wall hernias.

General pre-operative laboratory investigations for all the patients included full blood count, prothrombin and thromboplastin time, liver function tests, albumin, liver AST, ALT, serum urea, serum creatinine, sodium and potassium, free T₃, T₄, TSH, Fasting blood sugar and HBA1C.

Pre-operative investigations were ECG, CXR. Patients with cardiovascular troubles had ECHO.

Patients with respiratory troubles as sleep apnea underwent respiratory function test and arterial blood gases. A pre-operative pelvi-abdominal ultrasound was done to all patients to see any intra-abdominal and pelvic organs pathologies.

Intraoperative, In CS, the anvil of the stapler is either introduced into the pouch through a gastrotomy or passed trans-orally and placed near the distal staple line on the pouch. The circular stapler is passed through the abdominal wall, most often after removing the lateral left port, and introduced in the end of the Roux limb. (Figure 1).

After connecting the stapler to the anvil, the GJ is created and the opening in the end of the jejunum is closed with a linear stapler. In LS, a linear stapled GJ is created, with the stapler defect closed by a running suture. (Figure 2).



Figure 1.

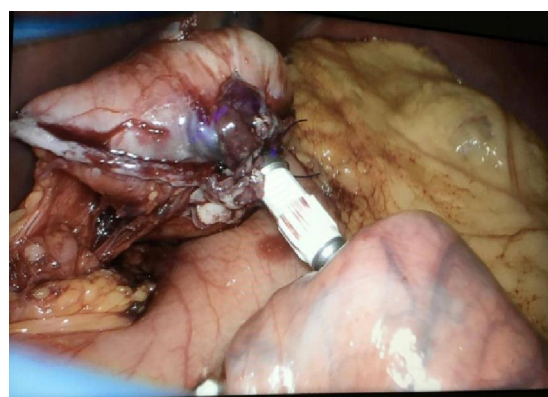


Figure 2.

The medical records of the patients were inspected to record data regarding operation time, hospital stay duration, 90 days readmission rate and post-operative complications; including leakage, post-operative hemorrhage, infections, anastomotic stricture, marginal ulcers and port side herniation.

As the two study groups were heterogeneous, we

performed a 1:1 ratio group matching. The LS group was matched with the CS group regarding the age (+ 4 years), sex and BMI, the presence of type 2 diabetes. We followed the Kawabata et al. 1:1 matching technique.

Statistical analysis .

Statistical analysis were performed using SPSS 23.0. The continuous variables were presented as mean \pm SD and 2-tailed t test, and the categorical variables were presented using the χ^2 and as a ratio or number of cases. Comparison between the variables was done using the one sample test. P value was considered statistically significant if its value was less than 0.05.

Results:.

Before matching .

The total sample size was 136 patients, including 91 females (67%) and 45 males (33%), divided into two groups; linear stapler group including 66 patients and secular stapler group including 70 patients. The median age of the patients in the LRYGB-LS group was 46 (39–53) years, while in the LRYGB-CS it was 41 (35–48) years ($p < 0.001$). Regarding the median BMI in both groups; the median BMI in the LRYGB-LS group was 42.24 (39.52–44.98) kg/m^2 while in the LRYGB-CS group it was 48.15 (43.42–53.76) kg/m^2 ($p < 0.001$). The LRYGB-LS group contained fewer cases with hypertension and diabetes mellitus type 2 comparing to the LRYGB-CS group. In order to make the data more comparable we performed 1:1 matching in both groups. The baseline characteristics before matching of the sample are showed in table (1).

Table (1): baseline characteristics before matching

| | Total N= 136 | Linear stapled N= 66 | Circular stapled N= 70 | p. value N/A |
|---------------------------------|------------------------|--------------------------------|----------------------------------|------------------------|
| Female gender | 91 (67%) | 44 (76%) | 39 (56%) | < 0.001 |
| Male gender | 45 (33%) | 22 (24%) | 31 (44%) | |
| Age (year) | 43 (36–51) | 41 (35–48) | 46 (39–53) | < 0.001 |
| BMI (kg/m2) | 44.06 (40.91–48.98) | 42.24 (39.52–44.98) | 48.15 (43.42–53.76) | < 0.001 |
| Hypertension | 83 (61.5%) | 32 (48.5%) | 55 (78.4%) | < 0.001 |
| Diabetes mellitus type 2 | 46 (34%) | 13.5 (20.4%) | 35 (52%) | < 0.001 |

P-value > 0.05: Non significant; P-value < 0.05: Significant; P-value 0.01: Highly significant; NA: Not applicable.

After the 1:1 matching process, the size of both groups was (n=60 patients). The median age of patients in the LRYGB-LS group was 47 (39–54) years, while the median age of the LRYGB-CS group was 48 (40–52) years ($p = 0.212$). Regarding the BMI of the patients in both groups; the median BMI of

patients in the LRYGB-LS group was 42.71 (41.46–46.73) kg/m^2 , while in the LRYGB-CS group it was 42.45 (41.40–46.63) kg/m^2 ($p = 0.1654$). The baseline characteristics of the sample after the matching process are showed in table (2).

Table (2): baseline characteristics after matching.

| | Linear stapled N= 60 | Circular stapled N= 60 | p. value N/A |
|---------------------------------|--------------------------------|----------------------------------|------------------------|
| Female gender | 38 (63%) | 38 (63%) | - |
| Age (year) | 47 (39–54) | 48 (40–52) | 0.212 |
| BMI (kg/m2) | 42.71 . (41.46–46.73) | 42.45 (41.4046.63) | 0.1654 |
| Hypertension | 48 (79.3%) | 48 (79.3%) | - |
| Diabetes mellitus type 2 | 30 (49.4%) | 30 (49.4%) | - |

P-value > 0.05: Non significant; P-value < 0.05: Significant; P-value 0.01: Highly significant; NA: Not applicable.

The total operative time was significantly longer in the linear staple group 149 (99-175) min vs. 85 (65-110) min in the circular stapler group ($p < 0.001$). The incidence of post-operative hemorrhage was significantly lower in the linear stapler group 2 (1.32%) comparing with 9 (5.94%) in the circular stapler group ($p = 0.02$). the mean length of the hospital stay time was significantly shorter in the

linear stapler group 3(2–6) days comparing with 5 (3–7) days in the circular stapler group ($p < 0.001$).

The LRYGB-LS technique was associated with less post-operative wound infections 1 (0.66%) comparing with 7 (4.62%) in the LRYGB-CS group ($p = 0.01$). there was no difference between the two groups regarding the readmission ratio ($p = 0.59$). and there was no significant difference between both

groups regarding the incidence of anastomotic leakage, stricture, port side hernias and marginal

ulcers. Comparison between the two study groups after 1: 1 matching Table (3).

Table (3): Comparison between the two study groups after 1: 1 matching

| | Linear stapled | Circular stapled | p. value |
|---|-----------------------|-------------------------|-----------------|
| | N= 60 | N= 60 | N\A |
| Length of hospital stay, median (IQR) [days] | 3(2–6) | 5 (3–7) | < 0.001 |
| Operative time, median (IQR) [min] | 149 (99-175) | 85 (65-110) | < 0.001 |
| Anastomotic leakage, n (%) | 1 (0.66%) | 1 (0.66%) | 1.00 |
| Postoperative hemorrhage, n (%) | 2 (1.32%) | 9 (5.94%) | 0.02 |
| Wound infection, n (%) | 1 (0.66%) | 7 (4.62%) | 0.01 |
| Port site hernia, n (%) | 4 (2.64%) | 1(0.66%) | 0.18 |
| Anastomotic stricture, n (%) | 1 (0.66%) | 1 (0.66%) | 1.00 |
| Marginal ulcer, n (%) | 1 (0.66%) | 1 (0.66%) | 1.00 |
| Readmissions, n (%) | 6 (3.96%) | 5 (3.3%) | 0.59 |
| Fatal cases, n (%) | 1 (0.66%) | 0 (0.0%) | - |

4. Discussion:.

During the last decade, Laparoscopic Roux-en-Y gastric bypass (LRYGB) has become one of the most popular bariatric operations used in the management of morbid obesity around the world. However, after reviewing the literature we found no standard technique to perform the LRYGB operations around the world (1, 15-18).

Many studies have tried to determine the best approach to perform the LRYGB operations by performing an analysis of the post-operative period and the incidence of post-operative complications in patients treated with different surgical techniques. However such an analysis is not easy to perform as there are many factors affecting the outcome of the surgery other than the surgical technique (19-21).

A previous study performed by Shope et al. have studied the difference between two different surgical techniques, they compared between the circular and linear stapled LRYGB in 61 patients and reported no difference between the two techniques except for the operation time, where it was significantly shorter in the linear stapled LRYGB group (22). Many other studies compared between the circular and linear stapled techniques regarding the operation time and reported similar results (11,23-25). However, in the present study, when we compared between both techniques regarding the operation time we found the circular stapled group to be associated with significantly shorter operation time 85 (65-110) min compared to the linear group 149 (99-175) min.

In our study, we found the most common post-operative complication to be post-operative hemorrhage. We found that the use of the circular stapler technique was significantly associated with increased incidence of post-operative hemorrhage (5.94%) comparing to (1.32%) in the linear stapler group. Many other studies reported similar findings.

In a meta-analysis conducted by Penna et al., the use of the circular stapler technique was associated with a 117% increase in the incidence of post-operative hemorrhage (26). Edholm and Sundbom have also reported an increased risk of post-operative hemorrhage when using the circular stapler technique (25).

Regarding the post-operative wound infection rates, we found the risk of post-operative wound infections to be higher in the circular stapler group (4.62%) when compared with the linear stapler group (0.66%). This results are similar to the results reported by Finks et al. (11) (3.20%) and Bendewald et al. (27). Penna et al. (26) and Edholm and Sundbom (25). Such an increase in the rate of post-operative infections can be explained by the difference in the technique used to insert the staple in both groups; in the circular staple technique the staple is introduced directly through the wound, while it is introduced through a laparoscopic trocar in the linear staple technique.

In our study, the most common late post-operative complication was port-side hernia, with no significant difference in the incidence between the two groups, and the previous studies.

In the previous study by Edholm and Sundbom, the use of the circular staple was associated with increased risk of anastomotic leakage when compared with the linear staple (25). Penna et al. reported no significant difference in the incidence of anastomotic leakage between the two techniques (26). In the present study, we found no significant difference between the two groups regarding the incidence of anastomotic leakage.

Regarding the incidence of anastomotic stricture, we found no significant difference between the two techniques, Lee et Al, reported the risk of anastomotic stricture to be higher in the circular stapler group (28), on the other hand, Qureshi et al. reported the risk of

stricture to be higher in the linear stapler group (29).

Edholm and Sundbom reported the risk of marginal ulcer to be higher with the use of the circular stapler (25), many other studies reported no significant difference between the two techniques regarding the incidence of marginal ulcers (11, 13, 24). In the present study, we found the technique of the operation to have no significant effect on the incidence of marginal ulcers.

Our study has some limitations, the non-randomized design of the study makes the results more possible to be biased, and the relatively small sample size and the relatively few aspects studied may lower the power of the study. To improve the precision of our results we performed a matching technique to compensate for our heterogeneous sample, and to make the two studied groups more comparable.

Conclusions.

Our results suggest that both circular stapler and linear stapler Laparoscopic Roux-en-Y gastric bypass techniques are considered safe and associated with a low risk to develop any post-operative complications. The incidence of post-operative hemorrhage and infections are slightly higher with the use of circular stapler technique, while the operation time was significantly shorter.

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11/27/2019.