

Research article

Laparoscopic and Robotic Gastrojejunostomy Revision for Complications after Roux En Y Gastric Bypass: Results from a High-Volume Referral Center

Rodolfo J. Oviedo*^{1,2}, MD, FACS, FASMBS

1. Texas Bariatric Specialists

2. Metropolitan Methodist Hospital

Corresponding author: Rodolfo J. Oviedo, MD, FACS, FASMBS, 14603 Huebner Rd, Building 2 San Antonio, TX 78230, USA, E-mail: rodolfo.j.oviedo@gmail.com

Received: February 10, 2020; Accepted: March 05, 2020; Published: March 09, 2020

Abstract

Background: Gastrojejunostomy revision has become a frequent type of revisional bariatric procedure at high-volume centers to treat complications from chronic marginal ulcers. **Methods:** A retrospective chart review with IRB approval was conducted on 53 revisional bariatric surgery cases performed by a single surgeon at an accredited MBSAQIP high-volume bariatric center and community hospital from February 2019 to February 2020. A subgroup analysis of 18 gastrojejunostomy revisions was conducted with measurement of primary outcomes (30-day morbidity and mortality) and secondary outcomes (anastomotic leak, intra-abdominal abscess, recurrent marginal ulcers, need for endoscopic or surgical intervention, among others). **Results:** All patients (n=18) underwent a minimally invasive gastrojejunostomy reconstruction for complications after prior Roux en Y gastric bypass (72.2% laparoscopic and 27.8% robotic). Most of them were female (88.9%), and the mean age was 47.7 ± 9.4 years. There were no anastomotic leaks, no conversions to open, and no blood transfusions. There was one mortality (5.6%) due to a pulmonary embolus with cardiovascular compromise 2 months post-operatively. The 30-day morbidity was 22.2%. The mean pre-operative albumin was 3.9 ± 0.4 gm/dL. Half of the patients (50%) were smokers. The incidence of intra-abdominal abscess was 5.6%. The recurrent marginal ulcer rate was 38.9%, with 16.7% requiring endoscopic dilations of anastomotic strictures and completely resolved within 3 months with medical and endoscopic therapies. A second reconstruction was necessary in 11.1% of cases. **Conclusion:** Gastrojejunostomy revision is feasible as a laparoscopic or robotic procedure at a high-volume center and community hospital environment, but the morbidity and mortality rates are higher compared to primary bariatric surgery. The recurrent ulcer formation is significant, but in most cases recurrent ulcers heal within 3 months of medical therapy with or without endoscopic intervention, with a minority requiring a second reconstruction.

Keywords: gastrojejunostomy, bariatric revisions, marginal ulcers, Roux en Y gastric bypass, complications

Introduction

Metabolic and bariatric surgery has become a widely recognized surgical discipline devoted to eradication and control of obesity-related co-morbidities in addition to reliable weight loss to accomplish a better quality of life [1, 2]. In particular, the Roux en Y gastric bypass is recognized as its gold standard, but the type of technique for gastrojejunostomy anastomosis construction is not standardized. The technique that is used matters in terms of outcomes and complications, with debate and limited consensus on whether the linear-stapled, the circular-stapled, or the hand-sewn technique is superior [3-5]. What has been established is that the use of permanent suture in the lumen of the anastomosis is detrimental and a risk factor for marginal ulcer-

ation [6].

Anastomotic strictures are the most devastating complications from marginal ulcers at the gastrojejunostomy, with a lower incidence of ulceration noted when absorbable suture is used if any part of the anastomosis (or its entirety) is sewn [7-9]. On the other hand, *H. pylori* infection and pre-operative hypertension are associated with high marginal ulcer rates [10, 11].

Robotic bariatric surgery has emerged as a super-specialty dedicated to primary and revisional bariatric procedures with promising low rates of complications and with a safety profile that is replicated at academic and community hospitals [12-14]. However, whether the surgical robot is used or not, mar-

ginal ulcers continue to occur and are the subject of different decision-making algorithms and treatment modalities ranging from medical and endoscopic therapies to surgical revisions [15-17].

The utilization of proton pump inhibitors is recommended to decrease the ulcer formation rate after Roux en Y gastric bypass and has been adopted by most bariatric programs [18]. Younger patients, of white race, and with rapid weight loss are at higher risk for marginal ulceration [19]. However, all gastric bypass patients should be aware of this potential complication and educated on the possible treatment modalities that their surgeon must be able to master.

Methods

With IRB approval from the Ethics Committee at a 495-bed acute care community hospital serving approximately 500,000 patients on an annual basis at the Shenandoah Valley of Virginia in the United States, a retrospective chart review was conducted. The retrospective review included 53 bariatric surgery revisions from February 2019 to February 2020. Of those, this study presents the outcomes corresponding to 18 adult patients who had previously undergone a Roux en Y gastric bypass (most of them at other programs) and were subjected to minimally invasive gastrojejunostomy reconstruction. All revisions were performed by the author, a fellowship-trained metabolic and bariatric surgeon previously affiliated with this hospital and its MBSAQIP-accredited metabolic and bariatric program. An analysis of primary outcomes (30-day morbidity and mortality) in addition to secondary outcomes (anastomotic leaks, marginal ulcer recurrence, need for re-intervention with endoscopy or surgery, intra-abdominal abscess, length of stay, intraoperative time, among others) was done. All patients underwent laparoscopic or robotic gastrojejunostomy revision with adhesiolysis, upper gastrointestinal endoscopy and indicated procedures including a partial gastrectomy of the gastric remnant in some cases due to inflammation and the possibility of a future gastrogastic fistula. Due to the limited number of patients on this case series (n=18) no comparison was made to a control population, which will be the objective of a future study with a larger number of patients.

Inclusion criteria

- Prior Roux en Y gastric bypass (laparoscopic and open)
- Complications after Roux en Y gastric bypass due to chronic marginal ulcers
- Complications after recent Roux en Y gastric bypass due to acute anastomotic obstruction from a submucosal hematoma
- No prior revisional bariatric surgery
- Ages 18 to 65 years
- At least 3 endoscopic interventions with or without balloon dilation of anastomotic stricture
- Recently performed Roux en Y gastric bypass (within 48 hours) with acute obstruction of the anastomosis, without any other available therapy due to risk of perforation with balloon dilation

Surgical technique

1. Upon establishing pneumoperitoneum and inserting the

ports, either the laparoscopic or the robotic approach was used in all cases.

2. Adhesiolysis was performed especially in the epigastric region and left upper quadrant to lyse adhesions involving the gastric pouch, gastric remnant, Roux limb, liver, diaphragm, and greater omentum.
3. With a liver retractor in place, identification of the Roux en Y gastric bypass anatomy determined if an antecolic-antegastric, a retrocolic-antegastric, or a retrocolic-retrogastric configuration was present, each of them with its own challenges to address.
4. After separation of the gastric pouch, Roux limb, and gastrojejunostomy from surrounding tissues, the proximal transection occurred at 2 cm proximal to the anastomosis on the gastric pouch, and at 4 cm distal to the anastomosis on the Roux limb. All of this was done with endoscopic guidance to identify the anastomosis, the stricture (if present) and the marginal ulcers so that the transected and remaining gastric pouch or the jejunal Roux limb did not have retained ulcers.
5. A linear-stapled or hand-sewn gastrojejunostomy anastomosis was constructed while protecting its main blood supply, namely the left gastric artery, from injury in order to prevent ischemia while minimizing tension at the anastomosis with additional adhesiolysis to promote further mobilization the Roux limb. The transverse mesocolon window was opened (if a retrocolic Roux limb was present) to allow the jejunal Roux limb to reach the gastric pouch before construction of the new anastomosis.
6. With an atraumatic clamp on the Roux limb, the newly constructed anastomosis was tested endoscopically while submerging it under normal saline solution and insufflating the gastric pouch. The lack of any bubbles with maximum distension while clamping indicated a negative (and satisfactory) leak test while documenting patency and lack of intraluminal bleeding with endoscopy.
7. A surgical drain was left in place overlying the anastomosis and was removed prior to discharge usually on post-operative day #2.

Results

A total of 18 patients underwent elective, non-emergent gastrojejunostomy revisions, 100% of them in a minimally invasive fashion, with 13 of them (72.2%) laparoscopic and 5 (27.8%) robotic. All surgeries were performed by a single fellowship-trained metabolic and bariatric surgeon from February 2019 to February 2020. The mean follow-up duration was 4.9 ± 3.3 months. While the surgical robotic platform was not available for most cases, the surgeon's preference in these challenging operations is to use the robotic platform (da Vinci surgical system, Intuitive Surgical, Xi and X models, Sunnyvale, CA) as much as possible. The reason for this preference is the robot's multiple benefits including superior instrument dexterity, wristed articulation, three-dimensional visualization, improved ergonomics in difficult regions of the abdomen, along with use of multiple arms at the same time with this computer-assisted interface that is not artificial intelligence in its most strict sense. There were no conversions to open and no anastomotic leaks. Most of the patients were female, specifically 16 (88.9%) as is expected based on primary bariat-

ric surgery populations. While almost all of them underwent a gastrojejunostomy revision for chronic marginal ulcers with complications, one (5.6%) had it due to acute obstruction of the anastomosis after Roux en Y gastric bypass 2 days earlier (see Figure 1). With the exception of this patient who underwent a revision on a semi-urgent, but not emergency basis, all patients were subjected to multi-disciplinary team discussions at the program's Bariatric Revisions Board conference prior to making the decision to proceed with revisional surgery.

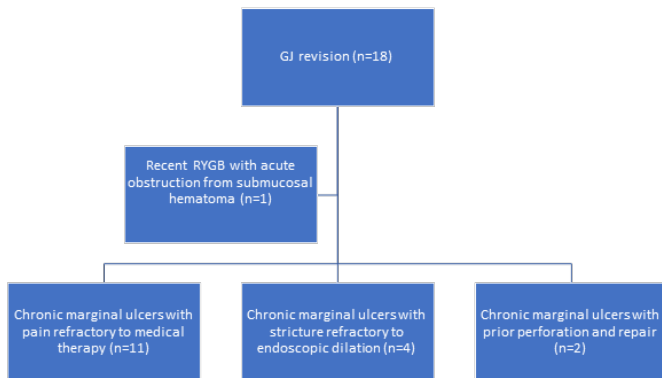


Figure 1. Patient selection based on surgical indications

GJ: gastrojejunostomy, RYGB: Roux en Y gastric bypass

The patients' demographic data along with pre-operative co-morbidities and risk factors are presented in Table 1. Except for one patient (5.56%) who had undergone a prior Roux en Y gastric bypass with a non-adjustable banded gastric pouch, all patients had a classic Roux en Y gastric bypass without any band application to their gastric pouch.

Table 1. Patient demographics and pre-operative co-morbidities (n=18)

Age (mean)	47.7 ± 9.4 years
Sex (female, male)	16 (88.9%), 2 (11.1%)
ASA class (median)	3
Pre-op BMI (mean)	37.0 ± 9.7 kg/m ²
Pre-op albumin (mean)	3.9 ± 0.4 gm/dL
Pre-op type 2 diabetes	4 (22%)
Pre-op hypertension	3 (16.7%)
Pre-op dyslipidemia	7 (38.9%)
Pre-op GERD	10 (55.6%)
Pre-op OSA	5 (27.8%)
Pre-op CKD/ESRD	2 (11.1%)
Pre-op CAD	1 (5.6%)
Tobacco use	9 (50%)

ASA: American Society of Anesthesiologists classification, Pre-op: pre-operative, BMI: body mass index, GERD: gastroesophageal reflux disease, OSA: obstructive sleep apnea, CKD: chronic kidney disease, ESRD: end stage renal disease, CAD: coronary artery disease

With respect to primary outcomes, the mortality rate was 5.6% corresponding to one patient who died 2 months after revision as a result of a significant pulmonary embolus with cardiovascular compromise. The patient had been put on post-operative deep venous thrombosis prophylaxis with low-molecular weight Heparin twice a day for 2 weeks upon discharge from the

hospital. On the other hand, the 30-day morbidity was 22.2% corresponding to four patients who developed complications.

However, complications beyond 30 days were also recorded and measured as secondary outcomes including 38.9% recurrent marginal ulcers (88.9% of which resolved within 3 months with conservative therapy with proton pump inhibitor and cytoprotection with Sucralfate, with 16.7% requiring endoscopic dilation and 11.1% needing a re-operation with complete resolution after that). Other complications included 5.6% intraabdominal abscess, 16.7% readmissions, 27.7% emergency department visits, and 5.6% toxic megacolon for severe *Clostridium difficile* infection requiring laparoscopic right hemicolectomy for segmental megacolon limited to the right side 2 days after revision in one patient.

The mean length of stay was 2.6 ± 0.8 days thanks to the Enhanced Recovery After Surgery (ERAS) protocol and pathway instituted in the hospital as part of the center's guidelines. All patients had their drains removed prior to discharge on post-operative day #2. There were no blood transfusions, and the estimated blood loss intra-operatively was 42.2 ± 16.8 mL. Finally, even with a follow-up duration of 4.9 ± 3.3 months and without the intention to perform the revision to achieve weight loss, the mean change in BMI at the time of the last appointment was -3.8 ± 4.1 BMI points. Table 2 illustrates the primary and secondary outcomes in detail.

Table 2. Primary and secondary outcomes (n=18)

Mortality	1 (5.6%)
30-day morbidity	4 (22.2%)
Conversion to open	0 (0%)
Length of stay (mean)	2.6 ± 0.8 days
EBL (mean)	42.2 ± 16.8 mL
Blood transfusions (mean)	0 (0%)
Change in BMI (mean)	-3.8 ± 4.1 BMI points
Superficial SSI	1 (5.6%)
Unexpected return to OR for toxic megacolon	1 (5.6%)
DVT/PE	1 (5.6%)
Recurrent marginal ulcers	7 (38.9%)
Anastomotic stricture from recurrent marginal ulcers requiring endoscopic dilation	3 (16.7%)
Anastomotic stricture from recurrent marginal ulcers requiring re-operation	2 (11.1%)
Acute anastomotic obstruction from submucosal hematoma after recent RYGB requiring re-operation	1 (5.6%)
Intra-abdominal abscess requiring percutaneous drain	1 (5.6%)
Readmissions	3 (16.7%)
ED visits	5 (27.8%)
C diff colitis with toxic megacolon	1 (5.6%)
Need for subsequent surgery (re-intervention)	2 (11.1%)

EBL: estimated blood loss, BMI: body mass index, SSI: surgical site infection, OR: operating room, DVT: deep venous thrombosis, PE: pulmonary embolus, RYGB: Roux en Y gastric bypass, ed: emergency department, C diff: *Clostridium difficile*

Discussion

This retrospective chart review of 18 elective, non-emergent gastrojejunostomy revisions performed at a high-volume referral center and accredited center by the MBSAQIP (Metabolic and Bariatric Surgery Accreditation and Quality Improvement Program) illustrates the challenges encountered during the clinical management of complications after Roux en Y gastric bypass. In this subgroup analysis of 18 gastrojejunostomy reconstructions from the 53 bariatric surgery revisions in total that were subjected to retrospective review, the presence of marginal gastrojejunostomy ulcers is a significant source of morbidity. This study supports the concept that revisional bariatric surgery, even when performed at high-volume referral centers, is associated with higher complication rates (22.2% 30-day morbidity and 5.6% mortality in this study) compared to primary surgery.

In this retrospective review subgroup analysis several lessons were learned. First and foremost, no matter how advanced the techniques to reconstruct the gastrojejunostomy and the technology utilized for this purpose, i.e. laparoscopy vs robotics, the pre-operative conditions and co-morbidities in addition to risk factors such as use of tobacco, age, and ASA class played a significant role in the development of post-operative complications. While there were no conversions to open, no blood transfusions, and no anastomotic leaks, these highly-demanding and technically advanced operations to reconstruct the gastrojejunostomy yield a higher rate of complications compared to first-time Roux en Y gastric bypass no matter what technique is used to address them.

As can be seen, the rate of recurrent ulceration is high (38.9%) considering that this by far the predominant indication for revisional surgery, mostly for chronic marginal ulcers with pain refractory to medical therapy (61.1%) followed by chronic ulcers with obstruction from a stricture refractory to endoscopic dilations (22.2%) and chronic ulcers with prior perforation (11.1%). However even with this high rate of recurrence, most patients (88.9%) have their ulcers resolved within 3 months with medical therapy with or without endoscopic dilations, with only a minority (11.1%) requiring re-operation with a redo anastomosis. After the second operation there was complete resolution of this significant problem.

On the other hand, while the rate of intraabdominal abscess is moderate (5.6%), the presence of pulmonary embolism carries a significant risk for patients which may lead to death, as was observed in the case of the patient who went home with post-operative anticoagulation due to risk factors and still developed this lethal complication that led to the only mortality in this group of patients. The incidence of *Clostridium difficile* colitis can also have a profound effect on the patient's recovery and prognosis since toxic megacolon can still develop after a single dose of pre-operative antibiotics. If detected early based on clinical suspicion, it must be treated with surgical resection as was done in this case, although it was a right hemicolectomy rather than a total colectomy due to the intraoperative findings in this case.

Another important lesson learned is that bariatric surgery revisions can be relatively straightforward such as simple removal of an adjustable gastric band and subcutaneous port, or very complex and technically demanding such as reconstruction of the gastrojejunostomy for chronic marginal ulcers as was done in this study. A reconstruction, therefore, was performed in all patients with the linear-stapled or the hand-sewn technique with absorbable suture material while minimizing tension and protecting the blood supply.

The fact that this type of operation was a reconstruction is worth mentioning it because by definition it involves remaking something that has failed for different reasons while using tissues that do not have the most optimal blood supply and which are prone to ischemia. This ischemia that results from a limited blood supply to the gastric pouch, the Roux limb, and the new gastrojejunostomy is a major concern for revisional bariatric surgeons. In fact, even with preservation of the left gastric artery with fine dissection techniques and with attention to detail, the new anastomosis is always at higher risk for ulcer formation compared to the original anastomosis created at the time of primary surgery. Therefore the primordial message is to be extremely meticulous, careful, delicate and gentle with the patient's tissues, blood supply, anatomy and physiology from a surgical and anesthesia perspective during and after the operation in order to maximize the patient's chances of a successful recovery while minimizing the incidence of recurrent ulceration.

This subgroup analysis study has several limitations, beginning with its number of patients (n=18). However, even with this patient population size it is possible to make some important observations and learn from the outcomes while comparing them to the literature. It would be ideal to conduct a retrospective review of this particular patient population on a larger sample size, but it is not possible at this time since the author has moved on to another practice and hospital environment where future projects like this one will be conducted on a larger scale. In addition, the fact that this is a retrospective, rather than a prospective cohort of patients is a limitation. Ideally (although not so easy in practice) this type of study should be used to promote the design of a randomized controlled trial that may examine the differences observed when the robotic technology is used compared to laparoscopy, or when the hand-sewn anastomosis is chosen over the linear-stapled approach. Finally, the fact that this is a single center study based on the experience by a single surgeon is a limitation, although it also offers the uniformity and systematic advantages that arise when a standard protocol and the same technique are applied to care for surgical patients. The follow-up should be longer, too, but for the same reasons explained before it is not possible to extend it under the circumstances. However, a follow-up that is longer than 1 year is ideal to make wider and more solid observations in this patient population.

Academic and community hospitals and programs alike are perfectly equipped to handle the challenges posed by chronic marginal ulcers and the need for reconstruction of the gastrojejunostomy. Not only is the center's ability to deal with complications of paramount importance in addition to its resources and capabilities such as imaging technology, endoscopic instrumentation, network of consultants and experts (including gastroenterologists, infectious disease specialists, intensivists, and

interventional radiologists) if complications arise after revisional surgery. In addition, the surgeon's experience and expertise (ideally with fellowship training or an equivalent) are the most fundamental resources for a successful outcome in addition to the surgical team's training and level of understanding of bariatric revisional surgery. As a result, the surgeon's responsibility goes beyond caring for the patient in need but is also centered around the surgical team's ability to function in this stressful environment. In this super-specialty of revisional metabolic and bariatric surgery the most minute maneuver may carry the most dramatic consequences due to the level of difficulty that it imposes on its practitioners.

Conclusion

Gastrojejunostomy revision is feasible as a minimally invasive procedure, both laparoscopic or robotic, but it has higher morbidity and mortality rates compared to primary bariatric surgery. The rate of marginal ulcer recurrence is significant, but most recurrent ulcers after a revision heal after 3 months of medical therapy with endoscopic surveillance, with or without dilations, with only a minority requiring a second reconstruction. This type of revisional surgery can be safely performed in a high-volume referral center and community hospital environment.

References

1. Chang SH, Stoll CRT, Song J, et al. Bariatric surgery: an updated systematic review and meta-analysis, 2003-2012. *JAMA Surg.* 2014; 149(3):275-287.
2. Oviedo Barrera RJ. Metabolic and bariatric surgery: evolution, techniques, and management. In: Neri, V, Ed. *Gastrointestinal Surgery – New Technical Proposals.* London, UK. Intech. 2018:1-26.
3. Bendewald FP, Choi JN, Blythe LS, et al. Comparison of hand-sewn, linear-stapled, and circular-stapled gastrojejunostomy in laparoscopic Roux-en-Y gastric bypass. *Obes Surg.* 2011; 21(11):1671-5.
4. Lois AW, Frelich MJ, Goldblatt MI, et al. Gastrojejunostomy technique and anastomotic complications in laparoscopic gastric bypass. *Surg Obes Relat Dis.* 2015; 11(4):808-13.
5. Jiang HP, Lin LL, Jiang X, et al. Meta-analysis of hand-sewn versus mechanical gastrojejunal anastomosis during laparoscopic Roux-en-Y gastric bypass for Morbid Obesity. *Int J Surg.* 2016; 32:150-7.
6. Sacks BC, Sacks BC, Mattar SG, et al. Incidence of marginal ulcers and the use of absorbable anastomotic sutures in laparoscopic Roux-en-Y gastric bypass. *Surg Obes Relat Dis.* 2006; 2(1):11-6.
7. Almby K, Edholm D. Anastomotic strictures after Roux-en-Y gastric bypass: a cohort study from the Scandinavian Obesity Surgery Registry. *Obes Surg.* 2019; 29(1):172-177.
8. Carrodegua L, Szomstein S, Zundel N, et al. Gastrojejunal anastomotic strictures following laparoscopic Roux-en-Y gastric bypass surgery: analysis of 1291 patients. *Surg Obes Relat Dis.* 2006; 2(2):92-7.
9. Vasquez JC, Overby DW, Farrell TM, et al. Fewer gastrojejunostomy strictures and marginal ulcers with absorbable suture. *Surg Endosc.* 2009; 23(9):2011-5.
10. Rasmussen JJ, Fuller W, Ali MR, et al. Marginal ulceration after laparoscopic gastric bypass: an analysis of predisposing factors in 260 patients. *Surg Endosc.* 2007; 21(7):1090-4.
11. Bhayani NH, Oyetunji TA, Chang DC, et al. Predictors of marginal ulcers after laparoscopic Roux en Y gastric bypass. *J Surg Res.* 2012; 177(2):224-7.
12. Oviedo Barrera RJ. The surgical robot: applications and advantages in general surgery. In: Kucuk, S, Ed. *Surgical Robotics.* Rijeka, Croatia-EU. Intech. 2018:39-64.
13. Buchs NC, Pugin F, Azagury DE, et al. Robotic revisional bariatric surgery: a comparative study with laparoscopic and open surgery. *Int J Med Robot.* 2014; 10(2):213-7.
14. Stefanidis D, Bailey SB, Kuwada T, et al. Robotic gastric bypass may lead to fewer complications compared to laparoscopy. *Surg Endosc.* 2018; 32(2):610-616.
15. Carr WRJ, Mahawar KK, Balupuri S, et al. An evidence-based algorithm for the management of marginal ulcers following Roux-en-Y gastric bypass. *Obes Surg.* 2014; 24(9):1520-7.
16. Moon RC, Teixeira AF, Goldbach M, et al. Management and treatment outcomes of marginal ulcers after Roux-en-Y gastric bypass at a single high volume bariatric center. *Surg Obes Relat Dis.* 2014; 10(2):229-34.
17. Chau E, Youn H, Fielding CJR, et al. Surgical management and outcomes of patients with marginal ulcer after Roux-en-Y gastric bypass. *Surg Obes Relat Dis.* 2015; 11(5):1071-5.
18. Ying VWC, Kim SHH, Khan KJ, et al. Prophylactic PPI help reduce marginal ulcers after gastric bypass surgery: a systematic review and meta-analysis of cohort studies. *Surg Endosc.* 2015; 29(5):1018-23.
19. Pyke O, Yang J, Cohn T, et al. Marginal ulcer continues to be a major source of morbidity over time following gastric bypass. *Surg Endosc.* 2019; 33(10):3451-3456.

To cite this article: Oviedo RJ. Laparoscopic and Robotic Gastrojejunostomy Revision for Complications after Roux En Y Gastric Bypass: Results from a High-Volume Referral Center. *British Journal of Gastroenterology.* 2020; 2:2.

© Oviedo RJ. 2020.