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Original article

Incidence of marginal ulcers and the use of absorbable anastomotic sutures in laparoscopic Roux-en-Y gastric bypass

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Abstract

Objectives: A precipitating factor for marginal ulcer formation after Roux-en-Y gastric bypass may be the prolonged irritation by foreign material, such as nonabsorbable suture at the gastrojejunostomy. This study examines the incidence of marginal ulcers before and after a change was made from using nonabsorbable suture to using absorbable suture for the inner layer of the anastomosis.
Methods: A total of 3285 laparoscopic Roux-en-Y gastric bypass operations were performed during a 5-year period. The gastrojejunostomy technique was modified in August 2002. Those patients who developed a marginal ulcer postoperatively were identified, and their charts were retrospectively analyzed for the operative technique, patient age, history of previous gastric surgery, presence of preoperative diabetes, coronary artery disease, or peptic ulcer disease, and use of nonsteroidal anti-inflammatory medications or tobacco.
Results: The incidence of marginal ulceration after Roux-en-Y gastric bypass decreased significantly from 2.6% (28/1095) with the use of nonabsorbable suture to 1.3% (29/2190) after the change to absorbable suture for the inner layer of the gastrojejunal anastomosis ($P < .001$). The incidence of visible suture adjacent to the ulcer on endoscopy was also significantly reduced (64.3% vs 3.4%; $P < .001$). When the results were corrected for length of follow-up, the difference in the incidence of ulcers occurring within 1 year of surgery remained significant between the two groups ($P = .002$). There were no other significant differences in the factors analyzed.
Conclusions: The use of nonabsorbable sutures for the inner layer of the gastrojejunal anastomosis is associated with an increased incidence of marginal ulcers, and the adoption of absorbable suture material has reduced this incidence.

Keywords: Marginal ulcer; Bariatric surgery; Laparoscopic gastric bypass; Roux-en-Y; Morbid obesity; Postoperative complications; Anastomosis

Marginal ulceration is a known complication of both open and laparoscopic Roux-en-Y gastric bypass, with an incidence of approximately 1% to 16%; most recent studies cite an incidence of approximately 2% [1–3]. Although relatively uncommon, these ulcers cause significant morbidity, including severe pain, bleeding, and dysphagia, which may result in multiple readmissions.

The etiology of marginal ulcers is often multifactorial. Possible contributing factors include local ischemia, anastomotic tension, increased gastric acidity, *Helicobacter pylori* infection, tobacco use, and nonsteroidal anti-inflammatory drug (NSAID) therapy [4–6]. Staple line dehiscence

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and gastrogastric fistula formation can also contribute to the development of marginal ulcers [7,8]. Another possible cause is the presence of residual nonabsorbable suture at the anastomosis. The chronic inflammation caused by the presence of the suture as a foreign body at the anastomosis may lead to ulcer formation, and also may be implicated in the development of stomal stenosis [9].

The present study analyzes the incidence of marginal ulcers in two groups of patients who underwent laparoscopic Roux-en-Y gastric bypass: those in whom nonabsorbable suture was used for the inner layer of the gastrojejunal anastomosis and those in whom absorbable suture was used for this same purpose. The study also examines other factors that possibly contribute to the development of marginal ulcers.

Materials and Methods

A consecutive series of patients undergoing laparoscopic Roux-en-Y gastric bypass from 1999 to 2004 was retrospectively analyzed. A total of 3285 laparoscopic Roux-en-Y gastric bypass operations were performed. In August 2002, the gastrojejunostomy technique was modified to use absorbable suture instead of nonabsorbable suture for the inner layer of the anastomosis. Before this change, 1095 cases were performed with nonabsorbable suture; after the change, 2190 cases were performed with absorbable suture. Patients who were diagnosed with a marginal ulcer based on symptoms followed by endoscopic verification were included in the study. Routine upper endoscopy was not performed, and thus only those patients in whom a marginal ulcer was discovered based on symptoms were included. In this study group, the information collected on each patient included demographics (age, gender, and preoperative body mass index), preoperative comorbidities (particularly diabetes mellitus, peptic ulcer disease, and coronary artery disease), tobacco use, NSAID use, history of previous gastric surgery, operative technique, operative time, postoperative complaints prompting endoscopic workup, and the presence of any other complications. The presence of visible suture within the ulcer was also noted.

This study was performed with the approval of the Institutional Review Board (approval # 0502034), and the data were obtained from our prospectively designed electronic database, the Bariatric Surgery Clinical Database (Access; Microsoft, Redmond, WA).

Statistical Analysis

Comparisons between groups were performed using the independent-samples t test for continuous variables and the χ^2 test and Fisher's exact test, when appropriate, for categorical variables. All statistical tests were two-tailed, and P values $<$ .05 were considered statistically significant. All analyses were performed using SPSS, version 12.0.1 (SPSS, Chicago).

Current Operative Technique

In the Roux-en-Y gastric bypass operation, the Roux limb is advanced in an antecolic, antegastric fashion toward the stomach. Multiple firings of an endoscopic stapler are used to create a 15-mL gastric pouch, and the end of the Roux limb is sutured to the posterior aspect of the gastric pouch using a nonabsorbable 2-0 suture (Fig. 1A). Enterotomies are made in the gastric pouch and in the Roux limb with the ultrasonic scalpel, and an end-to-end gastrojejunostomy is created with a linear stapler (Fig. 1B). Flexible endoscopy is performed at this time, with the endoscope passed through the anastomosis into the Roux limb. The common enterotomy is then closed, with the endoscope in place, using 2-0 absorbable glycolide/lactide copolymer suture (Polysorb; Tyco Healthcare, United States Surgical, Norwalk, CT) (Fig. 1C). In the earlier technique, this layer was performed with nonabsorbable suture. A second anterior seromuscular layer is performed with nonabsorbable 2-0 suture, which also buttresses the gastric pouch staple line (Fig. 1D and E).

Results

Of the total of 3285 patients, 57 (1.7%) developed marginal ulcers after undergoing Roux-en-Y gastric bypass. The incidence of marginal ulcers was 2.6% (28/1095) with the use of nonabsorbable suture and 1.3% (29/2190) after the switch to absorbable suture, a significant decrease ($P <$ .05). The patient demographic and comorbidity data are given in Table 1. There were no significant differences in any of these data between the two groups.

The abdominal complaints that led to the diagnosis of the marginal ulcers are listed in Table 2 and were similar across both groups. The patients with gastrointestinal bleeding were diagnosed between 3 weeks and 17 months (mean, 7.2 months). Although 37% of patients (21/57) listed osteoarthritis, degenerative joint disease, or low back pain as a preoperative complaint, only 9 patients (15.8%) reported NSAID use. All of these nine patients reported only occasional use, and many were able to discontinue use postoperatively as their complaints resolved.

Patients reported symptoms at a mean time interval of 11.2 months postoperatively (range, 0.5 to 36 months). A total of 36 patients with marginal ulcers (63.2%) presented within 12 months of surgery; 21 patients (36.8%) presented after more than 12 months. Median follow-up was 22.8 months. Only three patients (5.3%) had previous gastric surgery, and all of them underwent Roux-en-Y gastric bypass with absorbable suture. The incidence of endoscopically visible suture at the base of the ulcer was also analyzed (Figure 2). There was a statistically significant decrease in the incidence of visible suture after the technique was modified, from 64.3% (18/28) with nonabsorbable suture to 3.4% (1/29) with absorbable suture (Table 3). To correct for

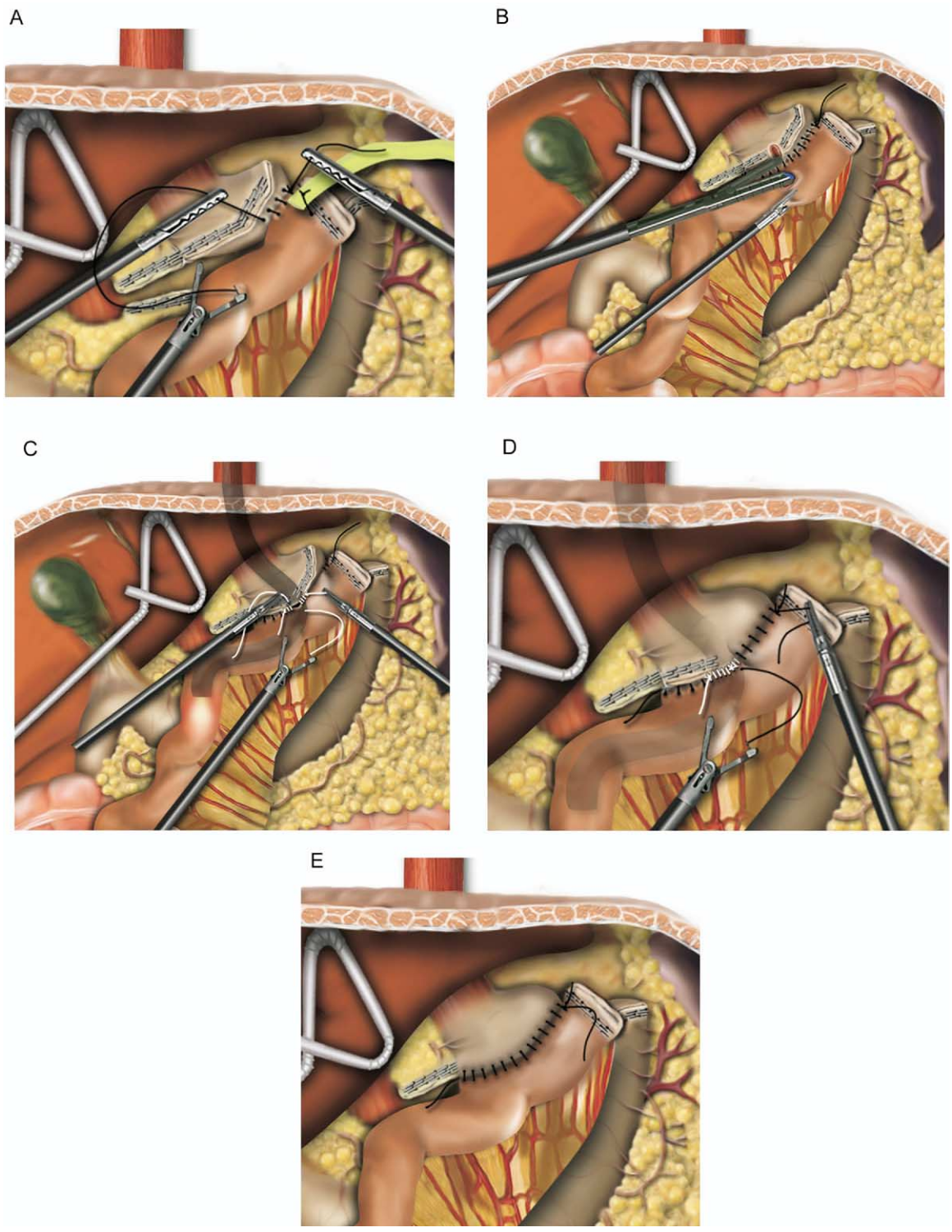

Figure 1. (A) Posterior suture line between the Roux limb and the gastric pouch. (B) Stapled end-to-end gastrojejunostomy. (C) Closure of gastrojejunostomy over flexible endoscope using absorbable suture. (D) Second, anterior layer of nonabsorbable suture. (E) Final view of the anastomosis.

length of follow-up between the two groups, the incidence of ulcers occurring within 1 year of surgery was analyzed; the difference in the two groups remained statistically significant ($P = .002$).

Discussion

Although the etiology of marginal ulceration remains unclear, there are several potential contributory factors. Be-

Table 1
Demographics and preoperative comorbidities of the two groups of patients with marginal ulcers

	Nonabsorbable suture (n=28)	Absorbable suture (n=29)	*P* value
Age (years)	45.2 ± 8.9	44.1 ± 11.8	0.161
Sex			
Female	24 (85.7%)	24 (82.8%)	0.760
Male	4 (14.3%)	5 (17.2%)	
BMI (kg/m^2)	49.6 ± 6.6	50.7 ± 7.2	0.575
Peptic ulcer disease	15 (53.6%)	9 (31.0%)	0.085
Tobacco use	14 (50%)	9 (31.0%)	0.145
Diabetes mellitus	3 (10.7%)	7 (24.1%)	0.297
NSAID use	5 (17.9%)	4 (13.8%)	0.730
Coronary artery disease	3 (10.7%)	2 (6.9%)	0.670

Data are presented as mean ± standard deviation or n (%). BMI = Body Mass Index; NSAID = nonsteroidal anti-inflammatory drug.

cause the ulceration occurs at the gastrojejunostal anastomosis, excess acid coming in contact with the mucosa was originally considered the primary causative mechanism. It was initially believed that a larger gastric pouch would allow for increased parietal cell volume [10]; however, it was later shown that little gastric acid is produced in the pouch [6,11]. Thus, even with smaller pouch sizes, marginal ulcers continue to occur despite the presumed absence of acid production.

Local ischemia has also been posited as a cause of marginal ulcers, although it may more commonly lead to the development of stricture formation. Techniques used in our institution to minimize tension include dissection of the tissues around the pouch, allowing for extra length; complete mobilization of the Roux limb; and splitting of the omentum for the antecolic antegastric anastomosis.

Numerous clinical and epidemiological studies have identified NSAID use as a risk factor for peptic ulcer disease [12]. NSAIDs directly injure the gastric mucosa and also inhibit the endogenous prostaglandin synthesis necessary for mucosal defense [13]. The exact significance of NSAIDs as a factor in marginal ulcer development is unknown, because it is difficult to quantify use. Most patients described use of over-the-counter NSAIDs on an as-needed basis, with very few using prescription NSAIDs, such as cyclo-oxygenase (COX)-2 inhibitors. Moreover, many of the comorbidities for which these patients were taking these medications, such as lower back pain, subsided or completely resolved after gastric bypass.

Table 2
Complaints prompting endoscopic evaluation and diagnosis of marginal ulcer

	Nonabsorbable suture	Absorbable suture	*P* value
Incidence ulcers	28/1095 (2.6%)	29/2190 (1.3%)	< 0.05
Incidence visible suture	18/28 (64.3%)	1/29 (3.4%)	< 0.001

Infection with *Helicobacter pylori* has also been shown to be predictive of peptic ulcer disease, particularly duodenal ulcers, in the general population. However, *H. pylori* infection is common, with most infected people never developing an ulcer. Thus the presence of *H. pylori* may be only one contributing factor in the development of ulcer disease. Patients who present with upper gastrointestinal symptoms undergo endoscopy before gastric bypass and are treated if *H. pylori* is diagnosed. Our patients were not routinely tested for *H. pylori*.

Tobacco use is another important factor in the development of ulcer disease; studies have demonstrated compromise of the gastric mucosal barrier and impaired wound healing [12]. Decreased tissue oxygenation has been proposed as the factor responsible for the impaired wound healing. Most studies suggest that abstinence from smoking for at least 6 to 8 weeks will reduce the incidence of wound-related and pulmonary complications postoperatively [14,15]. However, the optimal time for smoking cessation is difficult to determine, and patients' ability to maintain abstinence postoperatively is hard to quantify.

There is little in the literature proposing that the incidence of marginal ulcers is related to the suture material used to create the anastomosis. One study found a decreased incidence when switching from staples to hand-sewn anastomoses and a further decrease when switching to only absorbable sutures [8]. In another study, the authors cited "personal observations" when describing the presence of silk suture at the base of the marginal ulcers in their series of open gastric bypass operations [16]. These studies did not quantify the appearance of visible suture at the ulcer base or examine the difference in marginal ulcer incidence between absorbable and nonabsorbable sutures, however.

Our series demonstrates that the decreased incidence of marginal ulcers after the modification to use absorbable suture was statistically significant. However, it is difficult to quantify the other factors that also may influence the incidence of ulcer development, such as smoking, NSAID use, or other comorbidities. We found no statistically significant differences between the two groups of patients (absorbable vs nonabsorbable suture) who developed marginal ulcers.

In our series, the timing of the presentation of patients with symptoms of underlying ulcer disease ranged widely. One earlier study demonstrated that most ulcers developed in the first 3 months postoperatively, with a continued much lower risk up until 1 year [15]. All patients were followed for at least 1 year; however, no ulcers were found after the first postoperative year. Another group reported a mean of 48 days for the development of marginal ulcers [16]. As described earlier, we corrected for any potential follow-up discrepancy and found that the difference in our two groups remained statistically significant.

Nausea and vomiting may be common complaints in patients with marginal ulcers and should be evaluated by endoscopy, particularly if associated with epigastric pain

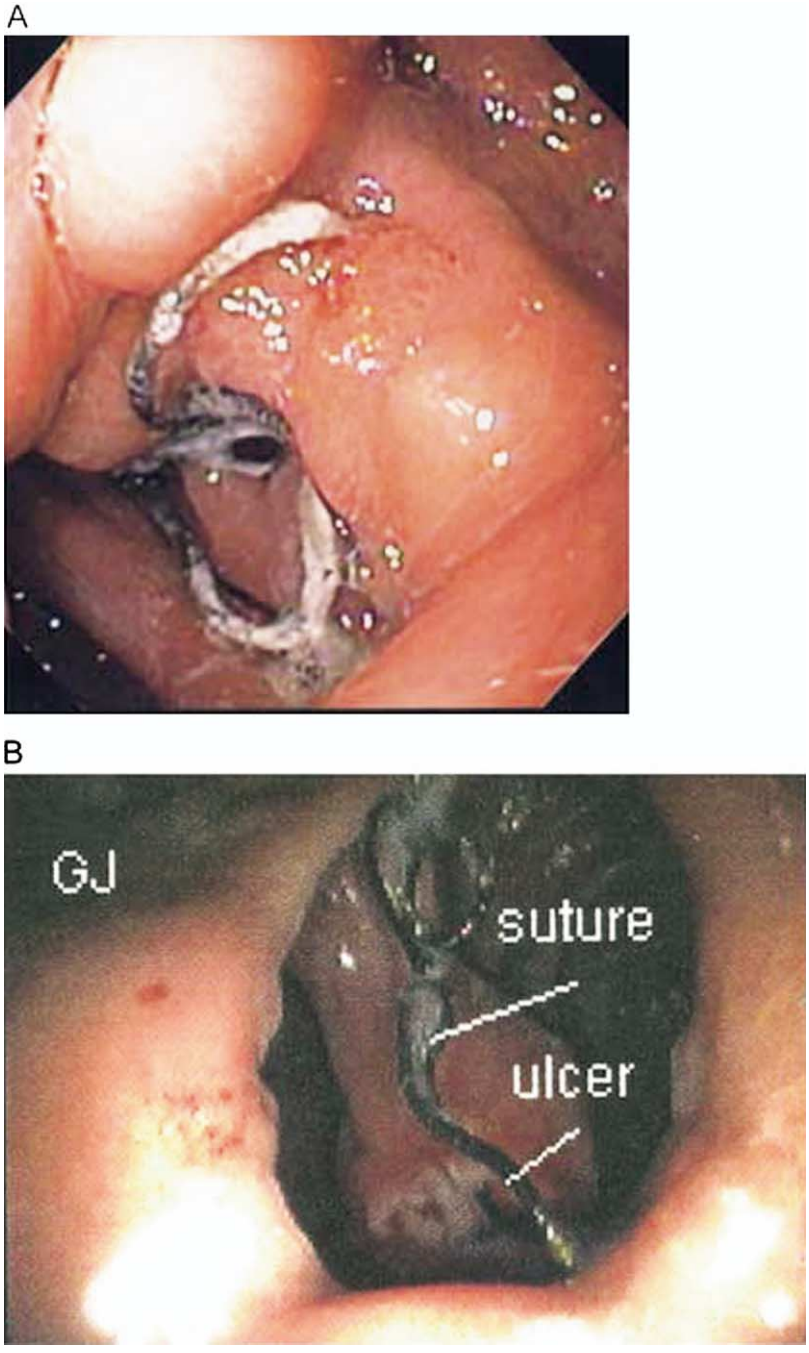

Figure 2. Endoscopic views showing a marginal ulcer with a visible suture at the base.

and dysphagia. Early postoperative hemorrhage is uncommon and usually originates from the gastrojejunostomy, gastric remnant, or jejunojejunostomy staple lines [17]. A marginal ulcer at the gastrojejunal anastomosis is the more common cause of late gastrointestinal hemorrhage [18]. In our series, seven patients (12.3%) diagnosed as a result of gastrointestinal bleeding at a mean of 7.2 months. Gastrointestinal bleeding may occur at any time after gastric bypass. Bleeding occurring several years after surgery is usually due to ulcers that develop in the excluded stomach [18]. In addition to marginal ulcers, postoperative endoscopy for symptoms after gastric bypass may also reveal stenosis of the gastrojejunostomy and staple line dehiscence [19]. These findings can be concomitant with the presence of a marginal ulcer.

Treatment is primarily medical, consisting of antisecretory therapy with proton-pump inhibitors and sucralfate. Unlike the more common peptic ulcers, these lesions tend to require prolonged therapy, usually for 3 to 4 months, and repeat endoscopy is recommended to con-

Table 3
Incidence of marginal ulcers and incidence of ulcers with visible suture at the base both before and after the technical modification to utilize absorbable anastomotic sutures

	Nonabsorbable suture (n=28)	Absorbable suture (n=29)	*P* value
Abdominal/epigastric pain	12 (42.9%)	13 (44.8%)	0.881
Epigastric pain with nausea and/or vomiting	10 (35.7%)	8 (27.6%)	0.186
Upper gastrointestinal bleeding or melena	2 (7.1%)	5 (17.2%)	0.684
Dysphagia	1 (3.6%)	2 (6.9%)	1.000
Perforation	3 (10.7%)	0 (0%)	0.074
Stricture	0 (0%)	1 (3.4%)	1.000

Data are presented as n (%).

firm ulcer resolution. An attempt is made to identify the causative factor, such as NSAID use, smoking, or the presence of a remnant of suture at the ulcer base. If a suture is present and the patient is not improving on medical therapy, then additional endoscopy can be performed to remove the suture remnant.

One potential flaw in our study is that we were not able to obtain data on the different comorbidities and risk factors for the entire cohort of 3285 patients. The study also carries the limitation of being a retrospective study, rather than a prospective study. We also recognize that we cannot rule out the influence of other factors on the incidence of marginal ulcers, and we have no data on the incidence of negative endoscopies. Nonetheless, this study does demonstrate that the presence of nonabsorbable suture may be a contributing factor in the etiology of ulcers in postoperative gastric bypass patients.

Conclusions

Marginal ulceration is an uncommon and poorly understood complication of Roux-en-Y gastric bypass. Multiple factors are believed to contribute to the development of marginal ulcers, many of which are known to be ulcerogenic in the general population. Our findings suggest that the presence of a foreign body resulting from the use of nonabsorbable suture material at the gastrojejunal anastomosis may be a factor contributing to the development of the ulcers in this patient population, and that the use of absorbable suture material may reduce the incidence of this complication.

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