Surgical results of single-incision transumbilical laparoscopic Roux-en-Y gastric bypass

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Abstract

Background: Conventional laparoscopic Roux-en-Y gastric bypass (LRYGB) has been the reference standard for bariatric surgery but requires 5–7 trocar incisions. We have developed a new procedure—single-incision transumbilical LRYGB (SITU-LRYGB)—that results in minimal scarring and is more cosmetically acceptable. To compare the surgical results and patient satisfaction between 5-port LRYGB and the novel SITU-LRYGB at a university hospital.

Methods: We performed 5-port or SITU-LRYGB on 140 morbidly obese patients; the patients chose the operation method. We used a novel liver traction method and omega-umbilicoplasty specifically designed for SITU-LRYGB.

Results: Before surgery, the patients in the 5-port surgery group were more obese than those in the SITU group (120.8 kg versus 108.9 kg, P < 0.013). The rate of hypertension was also greater in the former group. The operative time was longer for SITU-LRYGB (101.1 versus 81.1 min, P < 0.001) without increased intraoperative complications. The total morphine dose for the SITU group seemed to be greater but the difference was not statistically significant. No difference in complications was observed. Postoperatively, the percentage of excess body weight lost the SITU and 5-port surgery groups was 21.2% and 20.9%, 40.4% and 39.4%, 55.0% and 55.2%, 64.8% and 75.2%, and 75.4% and 78.2% at 1, 3, 6, 9, and 12 months, respectively. The SITU-LRYGB patients reported greater satisfaction related to scarring than those who had undergone 5-port surgery (score 4.57 versus 3.96, respectively, P < 0.005). No patient died.

Conclusion: Compared with conventional LRYGB, SITU-LRYGB resulted in acceptable complications, the same recovery, comparative weight loss, and better patient satisfaction related to scarring. (Surg Obes Relat Dis 2012;8:201–207.) © 2012 American Society for Metabolic and Bariatric Surgery. All rights reserved.

Keywords: Laparoscopic Roux-en-Y gastric bypass; Single incision transumbilical laparoscopic surgery; Single-incision laparoscopic surgery; SILS; Gastric bypass; Laparoscopy; Bariatric surgery

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Laparoscopic Roux-en-Y gastric bypass (LRYGB) is a popular bariatric surgery in Asia. Most investigators have reported that patients lose 60–70% of their excess body weight after LRYGB and maintain their weight loss for >10 years [1–4]. However, LRYGB is also one of the most complex bariatric procedures, possibly requiring more skill than many other advanced laparoscopic procedures [5].

Nevertheless, since Wittgrove et al. [6] introduced the laparoscopic technique in 1994, more operations have been...
performed and the complications have gradually decreased [7]. One drawback of LRYGB has been that 5–7 abdominal incisions are required to place the multiple trocars. Although this represents a significant improvement compared with open surgery, it is still possible to improve on the cosmetic results.

With newer laparoscopic approaches, multiple ports are not required and no scarring will occur. Natural orifice transluminal endoscopic surgery (NOTES), which does not result in scarring and is minimally invasive, is a new approach in the advancement of laparoscopy. Since the introduction of NOTES in 2004, researchers have used it for various surgical interventions [8–10]. Even with the worldwide popularity of NOTES, the techniques and instruments used are still being developed. Recently, single-incision laparoscopic surgery (SILS) was devised for cholecystectomy, appendectomy, adjustable gastric banding, and sleeve gastrectomy [11–16]. SILS has been used in bariatric procedures, such as adjustable banding and laparoscopic sleeve gastrectomy, because these procedures require the extension of a trocar incision to place a subcutaneous port or to extract a resected gastric specimen [17–19].

SILS using an umbilical incision will result in a better cosmetic outcome than that of 5–7-port LRYGB because the umbilicus can hide the surgical wound, leaving no visible abdominal scars [18]. Despite these advantages, the small umbilical incision “crowds” the trocars, and surgeons will have a small angle to work with. Furthermore, in morbidly obese patients, the hypertrophic left hepatic lobe invariably hinders the surgeon’s view of the entire stomach. Consequently, during this surgery, traction of the liver while manipulating the instruments has been a major concern.

We have developed a technique for bariatric surgery using a modified LRYGB procedure: single-incision transumbilical LRYGB (SITU-LRYGB). SITU-LRYGB provides the benefits of SILS, as well as sufficient visibility during surgery. Previously, we reported that with the first patient treated using this method, an acceptable operation time with much better cosmetic results [19] were found. This operation requires a special approach for countertraction with unique modifications, including the use of tape for liver suspension and traction for jejunojejunostomal repair. However, manipulating the crowded trocars in a 4-cm umbilical wound was a difficult challenge. Therefore, we extended the omega wound to 6 cm to facilitate the surgical process and performed subsequent umbilicoplasty to hide the resulting scar. We compared the surgical outcomes of SITU-LRYGB and 5-port LRYGB in 2 groups of morbidly obese patients. We have outlined the novel intraoperative liver traction and omega-umbilicoplasty methods.

Methods

Patients

The E-Da Hospital institutional review board reviewed and approved the present study, which was registered in Current Controlled Trials (International Standard Randomized Controlled Trial no. 92780988). From November 2008 to October 2009, 140 morbidly obese patients (34 men and 106 women) underwent LRYGB using the 5-port or SITU approach. The surgical criteria for morbid obesity were determined from the 1991 report of the National Institutes of Health Consensus Development Panel. Patients with a body mass index (BMI) of 35 kg/m² with a co-morbidity or a BMI of 40 kg/m² with or without co-morbidities were included. Their age range was 19–46 years (mean 29.8); the BMI range was 35.3–55.3 kg/m² (mean 43.6). The patients were allowed to choose the surgery type; however, very obese patients (BMI >50 kg/m²) and those >180 cm in height were not permitted to undergo SITU-LRYGB. The patients completed a wound satisfaction questionnaire at 3 months postoperatively (Table 1). All patients provided informed consent.

Surgical procedures

Design of “liver suspension tape”. The Jackson-Pratt drain tube was cut to 6 cm at the drainage hole site. The drainage tube was pierced with a 2-0 Prolene suture (monofilament polypropylene suture, W8400; Endo-Surgery, Cincinnati, Ohio). A liver suspension tape of 5 cm was used to suspend and fix the liver to the abdominal wall. This tape can be used for liver suspension and traction for jejunojejunostomy repair. A piece of 5 cm tape was cut with scissors and its end was fixed to the umbilicus using 4-0 polypropylene sutures (polypropylene suture, W8400; Endo-Surgery, Cincinnati, Ohio). In this way, the hepatic lobe can be adequately exposed and manipulated.

Table 1

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Surgical method</th>
<th>5-Port LRYGB</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SITU-LRYGB (n = 40)</td>
<td>5-Port LRYGB (n = 100)</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Female</td>
<td>36 (90.0)</td>
<td>70 (70.0)</td>
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<tr>
<td>Male</td>
<td>4 (10.0)</td>
<td>30 (30.0)</td>
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<td>Age (yr)</td>
<td>30.60 ± 7.75</td>
<td>34.09 ± 9.86</td>
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<td>Height (cm)</td>
<td>162.19 ± 6.80</td>
<td>164.78 ± 8.52</td>
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<td>Weight (kg)</td>
<td>108.94 ± 17.53</td>
<td>120.82 ± 27.56</td>
<td>.013‡</td>
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<td>BMI (kg/m²)</td>
<td>41.12 ± 5.13</td>
<td>44.15 ± 5.33</td>
<td>.025‡</td>
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<td>Co-morbidities‡</td>
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<tr>
<td>Hyperlipidemia</td>
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<td>61 (61.0)</td>
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</tr>
<tr>
<td>Nonalcoholic steatohepatitis</td>
<td>22 (55.0)</td>
<td>61 (61.0)</td>
<td>.570</td>
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<td>Hypertension</td>
<td>9 (22.5)</td>
<td>46 (46.0)</td>
<td>.013*‡</td>
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<tr>
<td>Diabetes</td>
<td>9 (22.5)</td>
<td>38 (38.0)</td>
<td>.318</td>
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<td>Hyperuricemia</td>
<td>6 (15.0)</td>
<td>21 (21.0)</td>
<td>.485</td>
</tr>
</tbody>
</table>

LRYGB = laparoscopic Roux-en-Y gastric bypass; SITU-LRYGB = single-incision transumbilical LRYGB.

Continuous data presented as mean ± standard deviation and categorical variables as numbers, with percentages in parentheses.

* Statistically significant difference between 2 groups (P < .05).
† Independent t test.
‡ Chi-square test.
OH) according to the hole diameter. Needles were left in both sides for future liver puncture (Fig. 1).

**SITU-LRYGB technique.** SITU-LRYGB was performed with the patient in the supine position and the arms extended laterally (n = 40). The surgeon stood to the right of the patient and the assistant to the left. An omega-shaped 6.0-cm incision was made around the upper half of the umbilicus (Fig. 2). We extended the incision to the linea alba, where a 12-mm ENDOPATH Xcel bladeless trocar (Ethicon Endo-Surgery, Cincinnati, OH) was inserted with a rigid, 10-mm, 30° video laparoscope so the trocar could be directly seen. Carbon dioxide insufflation was used to create a pneumoperitoneal pressure of 15 mm Hg. Under direct visualization, 2 other 5- and 12-mm ENDOPATH Xcel bladeless trocars (Ethicon) were placed through both “arms” of the incision. The 3 trocars were arranged in a triangle (Fig. 3A).

Subsequently, we placed our liver suspension tape into the peritoneal cavity. One needle was held using the needle holder; it was curved and advanced until it penetrated the lateral edge of the left liver near the triangular ligament and was then brought out from abdominal wall just below the xiphoid process (Fig. 4A). The other needle was used to penetrate the left liver near the falciform ligament and brought out from the midline abdominal wall (Fig. 4B). Next, the liver was suspended in the appropriate position (Fig. 4C), and the sutures were fixed with a Kelly clamp (Fig. 4D).

A harmonic scalpel (Ethicon) was used to dissect the perigastric vessels. We created a 25-mL proximal gastric pouch using the ENDOPATH ETS articulating linear cutters (LTS60A, TR60B, Ethicon). Next, the proximal jejunum was traced and measured 100 cm distal to the ligament of Treitz. It was brought up for a 2.0-cm-long gastrojejunostomy at the antecolic position using an endocutter (TR60B, Ethicon). The proximal jejunum was then transected with an endocutter (TR60W, Ethicon) near the gastrojejunostomy site and brought down for a side-to-side jejunoojejunostomy with a 100-cm alimentary limb, again using an endocutter (TR60W, Ethicon). We then placed 3 stay sutures to retract the jejunoojejunostoma, and the stoma was closed with endoscopic cutters (TR60W, Ethicon). The mesenteric defect was closed with 2-0 polybutylate-coated, braided polyester sutures (W6977, Ethibond, Ethicon). The gastrojejunostoma was closed horizontally with 1 layer of 2-0 Vicryl plus antibacterial sutures (VCP333, Ethicon). Next, the liver suspension tape was removed; homeostasis was achieved by cauterization on the liver surface. All trocars were removed, and the fascial defect was closed with sutures. The original 6.0-cm omega-shaped umbilical wound was reduced to a 3.5-cm circular wound and dressed (Fig. 5).

**5-Port LRYGB technique**

For 5-port LRYGB, general anesthesia was administered with the patient (n = 100) in the supine position. The surgeon stood to the right of the patient and the assistant to the left. The pneumoperitoneum was created by puncturing the peritoneal cavity with a Veress needle in the left periumbilical area. Four ports were created, and a liver retractor was introduced at the subxiphoid area (Fig. 3B). After dissection to reach the retrogastric space, we created a 25-cm3 proximal gastric pouch using a laparoscopic stapler (Endo-GIA roticator 45-3.5, Covidien, Norwalk, CT). Next, the proximal jejunum was traced and measured 100 cm distal to the ligament of Treitz. We performed a 2-cm gastrojejunostomy using a stapler (Endo-GIA roticator 45-3.5, Covidien) at the antegastric, antecolic position. The
proximal jejunum was transected with a stapler (Endo-GIA roticator 45-2.5, Covidien) near the gastrojejunostomy site and was brought down to perform a side-to-side jejunoojejunostomy with another stapler (Endo-GIA roticator 60-2.5, Covidien). The jejunojejunostomy site was closed with the same stapler. Mesenteric defects were closed with nonabsorbable sutures (2-0 Ethibond Excel Ethicon, St-Stevens-Woluwe, Belgium). Next, the gastrojejunostomy site was closed horizontally with hand-sewn sutures (2-0 Vicryl, Ethicon). The abdominal wound and skin incision were individually repaired after trocar removal.

Statistical analysis

The mean value and standard deviation were computed for the continuous variables and evaluated using independent t tests. The numbers and percentages were calculated for the categorical variables. The chi-square test was used to determine the association between 2 categorical variables. All tests were 2-sided and performed using the Statistical Package for Social Sciences, version 15.0 (SPSS, Chicago, IL). \( P < .05 \) was considered statistically significant.

Results

The mean follow-up time for the 140 patients was 14.2 months (range 7–18). Of the 100 patients, 89 (24 in the SITU and 65 in the 5-port group, respectively) achieved 1 year of follow-up. The patients in both groups were similar in height and the prevalence of co-morbidities, except for hypertension. The main co-morbidities in both groups were hyperlipidemia (SITU group, 55% and 5-port group, 61%), nonalcoholic steatohepatitis (SITU group, 55% and 5-port group, 61%), and hypertension (SITU group, 22.5% and 5-port group, 46%). However, the age (30.60 versus 34.09 yr, \( P = .047 \)), body weight (108.94 versus 120.82 kg, \( P = .013 \)), and BMI (41.12 versus 44.15 kg/m\(^2\), \( P = .025 \)) were significantly lower in the SITU group. The percentage of women was greater in the SITU group (90% versus 70%, \( P = .016 \); Table 1).

The length of postoperative hospitalization was similar between the 2 groups, as was the percentage of excess body weight loss at 1–12 months postoperatively. The frequency of morphine injections was greater (but not significantly greater) in the SITU group. Although the operation time was longer for the SITU group than for the 5-port group (101.13 versus 81.09 min, respectively, \( P < .001 \)), the overall satisfaction score was significantly greater (4.57 versus 3.96, respectively, \( P = .005 \)). Thus, the patients in the SITU-LRYGB group were more satisfied with the scar outcome than those in the 5-port group (Table 2).

One major complication of gastrojejunostomy leakage occurred in the 5-port group, and 2 minor complications of wound seroma occurred in the SITU group. The occurrence of complications did not differ between the 2 groups, and no patient died. We have not yet encountered any incision hernias in the SITU group, possibly because we repaired the 3 fascial defects individually after the trocars were removed.

Discussion

SILS has recently gained acceptance in bariatric surgery. Saber et al. [15] reported the first series of patients treated with single-incision laparoscopic sleeve gastrectomy. This procedure has many benefits. It is an alternative to NOTES, an experimental procedure whose feasibility has frequently been debated [17,18]. The surgical technique involved is almost the same as that required for conventional laparoscopic surgery. If the surgery is performed transumbilically, the surgical scar is almost completely hidden inside the navel, and the surgical site will be scarless. Although some have argued that very obese patients will not be concerned

Fig. 3. (A) Triangular position of trocars in SITU-LRYGB. (B) Position of trocars and liver retractor in 5-port LRYGB.
about scarring, ≤70% of our patients were women and
considered scarring an important factor. Scarring pigmen-
tation will also be an issue in subtropical/tropical regions
such as Taiwan.

The main difficulty in performing SILS has been the
crowding of trocars in a very limited surgical field. The
resulting small degree of instrument triangulation and the
inability to retract tissue by the assistant surgeon has made
this procedure arduous. In addition, handling a hypertrophic
liver and abundant visceral fat will also been critical in
morbidly obese patients.

Therefore, patient selection is important for the single-
incision procedure. Because of the longer-than-normal
working distance between the gastric pouch and umbilicus
in the SITU procedure, we used 43-cm-long instruments,
including the endoscope, graspers, and a long endocutter.
However, some patients will not be well suited to the pro-
cedure. For example, we would not recommend this proce-
dure for extremely obese patients or those with a BMI >50
kg/m². Patients >180 cm in height will also be poor can-
didates because of the abundant abdominal fat and that the
long distance between the umbilicus and gastric pouch will

Fig. 4. (A) One needle was held using needle holder; it was curved and advanced until it had penetrated lateral edge of left liver near triangular ligament and was
then brought out from abdominal wall just below xiphoid process. (B) Other needle used to penetrate left liver near falciform ligament and brought out from midline
abdominal wall. (C) Liver suspended in correct position. (D) Extracorporeal fixation of “liver suspension tape”; tape fixed with Kelly clamps after liver suspension.

Fig. 5. Cosmetic outcome of SITU wound 6 months postoperatively.
Comparison of surgical results

<table>
<thead>
<tr>
<th>Variable</th>
<th>Surgical method</th>
<th></th>
<th></th>
<th>P value*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SITU-LRYGB (n = 40)</td>
<td>5-port LRYGB (n = 100)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operation time (min)</td>
<td>101.13 ± 19.49</td>
<td>81.09 ± 28.97</td>
<td>&lt;.001†</td>
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<tr>
<td>Hospital stay (d)</td>
<td>1.12 ± .43</td>
<td>1.08 ± .27</td>
<td>.702</td>
<td></td>
</tr>
<tr>
<td>Frequency of morphine</td>
<td>2.40 ± 1.89</td>
<td>1.95 ± 1.59</td>
<td>.174</td>
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<tr>
<td>injections</td>
<td></td>
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<td></td>
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<tr>
<td>Follow-up %EWL</td>
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<td></td>
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<tr>
<td>1 mo</td>
<td>21.17 ± 7.70</td>
<td>20.85 ± 6.56</td>
<td>.819</td>
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<tr>
<td>3 mo</td>
<td>40.39 ± 9.51</td>
<td>39.39 ± 9.88</td>
<td>.670</td>
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<tr>
<td>6 mo</td>
<td>54.99 ± 9.23</td>
<td>52.18 ± 11.23</td>
<td>.443</td>
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<td>9 mo</td>
<td>64.84 ± 11.56</td>
<td>75.22 ± 10.05</td>
<td>.076</td>
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<td>12 mo</td>
<td>75.41 ± 8.45</td>
<td>78.20 ± 10.32</td>
<td>.213</td>
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<tr>
<td>Wound satisfaction score‡</td>
<td>4.57 ± .55</td>
<td>3.96 ± .67</td>
<td>.005†</td>
<td></td>
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</table>

%EWL = percentage of excess weight loss; other abbreviations as in Table 1.

Data presented as mean ± standard deviation.

† Statistically significant difference between the 2 groups (P < .05).
‡ Statistical significance of mean difference between the 2 groups.

Conclusion

The results of our study have shown that SITU-LRYGB is a safe, technically feasible, and reproducible procedure for select morbidly obese patients. With the rapid development of more flexible articulating instruments, endoscopes, and robotic assistance, this approach will undoubtedly have wider applications.

Disclosures

The authors have no commercial associations that might be a conflict of interest in relation to this article.

References

