Intracorporeal linear-stapled gastroduodenostomy in totally laparoscopic distal gastrectomy for gastric cancer: Consideration of the intraoperative management of the duodenal wall between the transecting staple line and anastomotic staple line (Review)

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Abstract. The first part of the duodenum consists of the intraperitoneal segment, called the duodenal bulb, and the retroperitoneal segment. Regarding the blood supplying the duodenal bulb, which is the portion utilized in anastomosing the duodenum and remnant stomach following distal gastrectomy, the arterial pedicles branching off from the gastroduodenal artery are reported to reach the posterior wall first and then spread over the anterior wall, where they anastomose. When performing intracorporeal linear-stapled gastroduodenostomy following totally laparoscopic distal gastrectomy, the blood supply of the duodenal wall between the transecting staple line and anastomotic staple line needs to be considered because both transection of the duodenal bulb and the gastroduodenostomy are performed using an endoscopic linear stapler and the duodenal wall between the staple lines can be ischemic after the anastomosis. Since it needs to be decided intraoperatively whether this duodenal site is preserved or removed, the present review discusses the technical differences among several procedures for intracorporeal linear-stapled gastroduodenostomy, classifying them into two groups on the basis of the intraoperative management of this duodenal site. When this site is preserved, the blood supply of the duodenal wall needs to be retained with certainty. On the other hand, when this site is removed, the ischemic portion of the duodenal wall needs to be identified and removed. Furthermore, in both groups, an adequate anastomotic area needs to be secured. In conclusion, surgeons need to be familiar with the anatomical features of the duodenal bulb, including its blood perfusion and shape, when carrying out intracorporeal linear-stapled gastroduodenostomy.

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Abbreviations: ART, augmented rectangle technique; BBT, book-binding technique; B-I, Billroth I; DSG, delta-shaped gastroduodenostomy; ELS, endoscopic linear stapler; GDA, gastroduodenal artery; INTACT, intracorporeal triangular anastomotic technique; mDSG, modified DSG; OG, overlap gastroduodenostomy; TLDG, totally laparoscopic distal gastrectomy

Key words: TLDG, B-I reconstruction, intracorporeal linear-stapled gastroduodenostomy, blood supply

Contents

1. Introduction

The duodenum, 25-30 cm in length, is the widest portion of the small bowel and is divided into four parts (1-3). The first part of the duodenum consists of the 2.5-cm-long intraperitoneal segment as a continuation of the pylorus, which is called the duodenal bulb, and the 2.5-cm-long retroperitoneal segment, which ends at the superior duodenal flexure (1-3). Regarding the blood supply to the duodenal bulb, which is the portion utilized in anastomosing the duodenum and remnant stomach following distal gastrectomy, Hentati *et al* (4) reported that all of the arterial pedicles reached the duodenal bulb on its posterior wall and thereafter spread along its anterior wall. In brief, the posterior wall of the duodenal bulb is considered to be the mesenteric side, in which the gastroduodenal artery (GDA) is the marginal artery and the superior duodenal arteries branching off from the GDA are the vasae rectae. In addition, as with the small intestine, it is assumed that these superior duodenal arteries branching off from the GDA reach the duodenal bulb on its posterior wall and then spread along

its anterior wall, and they anastomose at its anterior wall, which is considered the antimesenteric side (5).

Over the past 20 years, totally laparoscopic distal gastrectomy (TLDG), in which lymph node dissection, transection of the duodenal bulb and stomach, and anastomosis are carried out intracorporeally, has been developed (6-11), and intracorporeal gastroduodenostomy using an endoscopic linear stapler (ELS) has been performed since 2002 (6).

In intracorporeal linear-stapled gastroduodenostomy following TLDG, the blood supply of the duodenal wall between the transecting staple line and the anastomotic staple line needs to be considered because both transection of the duodenal bulb and the gastroduodenostomy are performed using an ELS and the duodenal wall between the staple lines can be ischemic after the anastomosis (6). Since it needs to be decided intraoperatively whether this duodenal site is preserved or removed, the present review discusses the technical differences among several procedures for intracorporal linear-stapled gastroduodenostomy following TLDG, classifying them into two groups based on the intraoperative management of the duodenal wall between the transecting staple line and anastomotic staple line. The present review was approved by the Institutional Review Board of Otori Stomach and Intestines Hospital (Sakai, Japan) and the Institutional Review Board of Hokusetsu-Miki Hospital (Suita, Japan) (both approval no. 23000001).

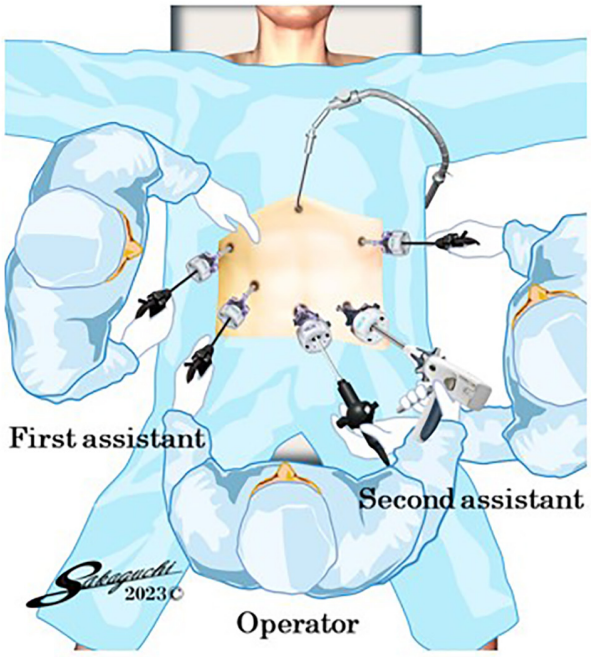

Figure 1. Port placements and positions of the operator and assistants. The operator inserted the stapler through the left lower port, and all staples, including transection of the duodenal bulb and gastroduodenostomy, were performed by the operator using their right hand. Photoshop2023 (version 24.5; Adobe Systems, Inc.) was used to generate this figure.

2. Intracorporeal linear-stapled gastroduodenostomy with preservation of the duodenal wall between the transecting staple line and anastomotic staple line

Delta-shaped gastroduodenostomy (DSG). Kanaya *et al* (6,7) first reported DSG in Billroth I (B-I) reconstruction following TLDG. Following their reports, several studies have described the performance of this anastomotic technique (8-20). When performing the transection of the duodenal bulb and gastroduodenostomy in DSG, the operator was positioned at the right side of the patient, with the first assistant at the left side and the laparoscopist between the legs of the patient. Thus, all of the linear staples were performed by the first assistant using their left hand within the surgical field set up by the operator (6-20). The duodenal bulb was transected in a posteroanterior direction, that is, from the mesenteric side to the antimesenteric side (6-20). After the operator had dissected several cranial supraduodenal vessels and created the space required for insertion of the ELS fork around the cranial wall of the duodenal bulb, this wall and the posterior wall of the remnant stomach were anastomosed by one linear staple so that the duodenal and gastric walls between the transecting staple lines and anastomotic staple became as wide as possible (6-20). Only the ELS entry hole was closed by one or two linear staples, and thus, the duodenal wall between the transecting staple line and anastomotic staple line was preserved in DSG (6-20). We hypothesized that although the blood supply via the remnant cranial supraduodenal vessels is blocked by the anastomotic linear staple, the blood supply of this area in the DSG is assumed to be retained via the caudal supraduodenal vessels because the caudal and cranial supraduodenal vessels anastomosed at the anterior wall, that is, at the antimesenteric side (4,5).

Some authors have expressed concern that an insufficient supply of blood to the duodenal wall between the transecting staple line and anastomotic staple line in DSG could be caused by unsuccessful transection of the duodenal bulb in a posteroanterior direction and the extensive dissection of supraduodenal vessels (11,17,21-25). Iwasaki *et al* (24) indicated that the twisting of the duodenal bulb at the posteroanterior transection is technically demanding. In DSG, to obtain an adequate anastomotic area for the purpose of preventing anastomotic stenosis, the unsuccessful posteroanterior transection of the duodenal bulb due to its incomplete twisting may lead to extensive dissection of the supraduodenal vessels, that is, dissection of not only the cranial but also the caudal supraduodenal vessels (24). Similarly, when the duodenal bulb diameter is relatively short, extensive dissection of the supraduodenal vessels can be performed to obtain an adequate anastomotic area (26).

Modified DSG (mDSG) with the operator positioned between the legs of the patient. Our previous study in 2020 described an mDSG technique with the operator positioned between the legs of the patient (26). In this technique, the operator was positioned between the legs of the patient, with the first assistant manipulating a laparoscope at the left side of the patient and the second assistant at the right side, when performing transection of the duodenal bulb and gastroduodenostomy in this procedure (Fig. 1). Therefore, within the surgical field set up by the two assistants, all of the linear staples were performed by the operator using their right hand with the assistance of their left hand. The operator retracted the pyloric ring externally with the left hand, while the first assistant elevated the posterior wall

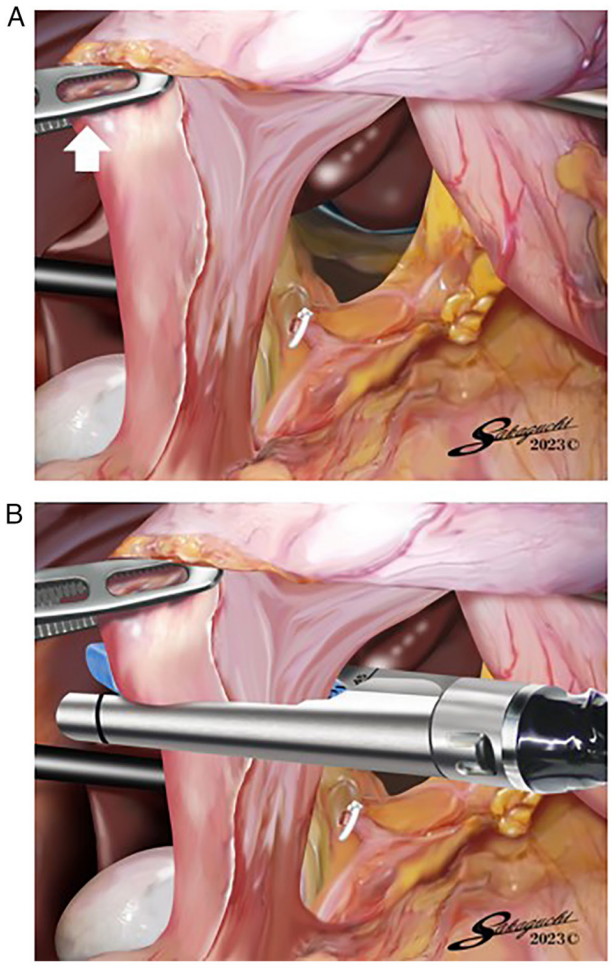

Figure 2. Transection of the duodenal bulb in a posteroanterior direction by the operator positioned between the legs of the patient. (A) The operator retracted the pyloric ring externally with the left hand (white arrow), while the first assistant elevated the posterior wall of the stomach ventrally and the second assistant elevated the liver cranially. (B) The operator transected the duodenal bulb in a posteroanterior direction with the right hand using one endoscopic linear stapler. Photoshop2023 (version 24.5; Adobe Systems, Inc.) was used to generate this figure.

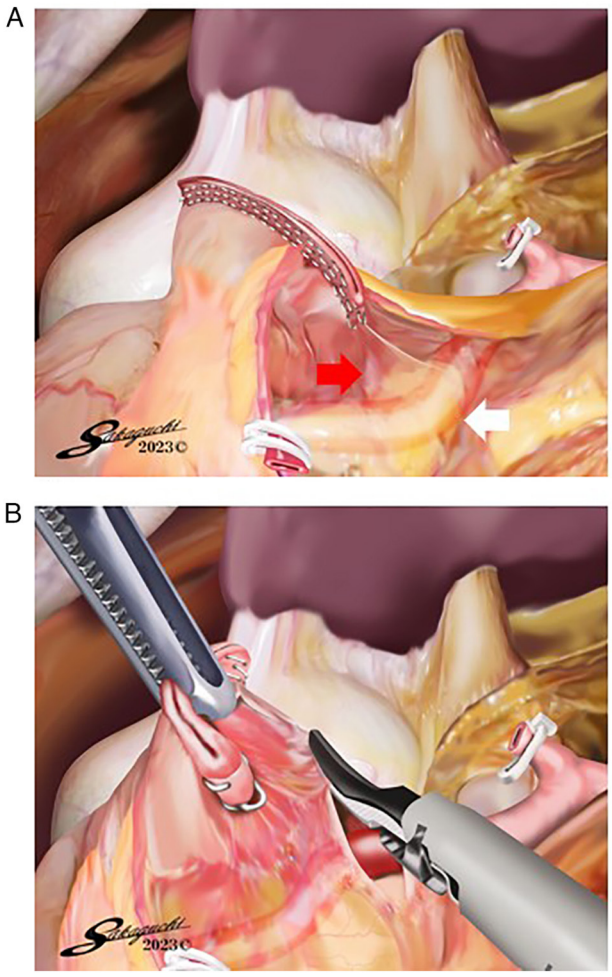

Figure 3. Creating the space required for the fork of the ELS around the cranial side of the duodenal wall. (A) The posterior wall of the duodenal bulb is the mesenteric side, in which the GDA (white arrow) is the marginal artery and the superior duodenal arteries branching from the GDA (red arrow) are the vasae rectae. (B) The operator dissected several cranial supraduodenal vessels branching off the GDA and created the space required for insertion of the ELS fork around the cranial wall of the duodenal bulb. Photoshop2023 (version 24.5; Adobe Systems, Inc.) was used to generate this figure. ELS, endoscopic linear stapler; GDA, gastroduodenal artery.

of the stomach ventrally and the second assistant elevated the liver cranially (Fig. 2A), and the operator transected the duodenal bulb with the right hand using one ELS in a posteroanterior direction, that is, from the mesenteric side to the antimesenteric side (Fig. 2B). The posterior wall of the duodenal bulb is considered to be the mesenteric side, in which the GDA is the marginal artery and the superior duodenal arteries branching off from the GDA are the vasae rectae (Fig. 3A) (4). After the operator dissected several cranial supraduodenal vessels branching off the GDA and created the space required for insertion of the ELS fork around the cranial wall of the duodenal bulb (Fig. 3B), the operator performed linear stapling of the cranial wall of the duodenal bulb and the posterior wall of the remnant stomach as follows: i) Insertion of the cartridge of one 45-mm ELS into the remnant stomach entirely with the right hand, while the first assistant pulled the staple line of the remnant stomach externally; ii) insertion of the fork of the ELS into the duodenal bulb as far as possible with the right hand, while pulling the staple line of the duodenum externally with the left hand (Fig. 4A); and iii) after the operator and first assistant changed the position of the duodenal bulb and remnant stomach without creating a gap (Fig. 4B), the operator fired the ELS with the right hand so that the duodenal and gastric walls between the transecting staple line and anastomotic staple line became as wide as possible (Fig. 4C). Subsequently, to ensure that the anastomotic area was as wide as possible, the operator closed the ELS entry hole using a single-layer full-thickness hand suturing technique with knotted sutures and a knotless barbed suture. Finally, the mDSG in TLDG was completed (Fig. 5).

In our previously reported patient series (35 cases), there was no occurrence of postoperative anastomotic leakage, and the blood supply of the preserved duodenal wall between the transecting staple line and anastomotic staple line was considered to be retained (26). The factors behind this result were hypothesized to be: i) Within the surgical field set up by the two assistants, the operator was able to transect the duodenal bulb in a posteroanterior direction with more

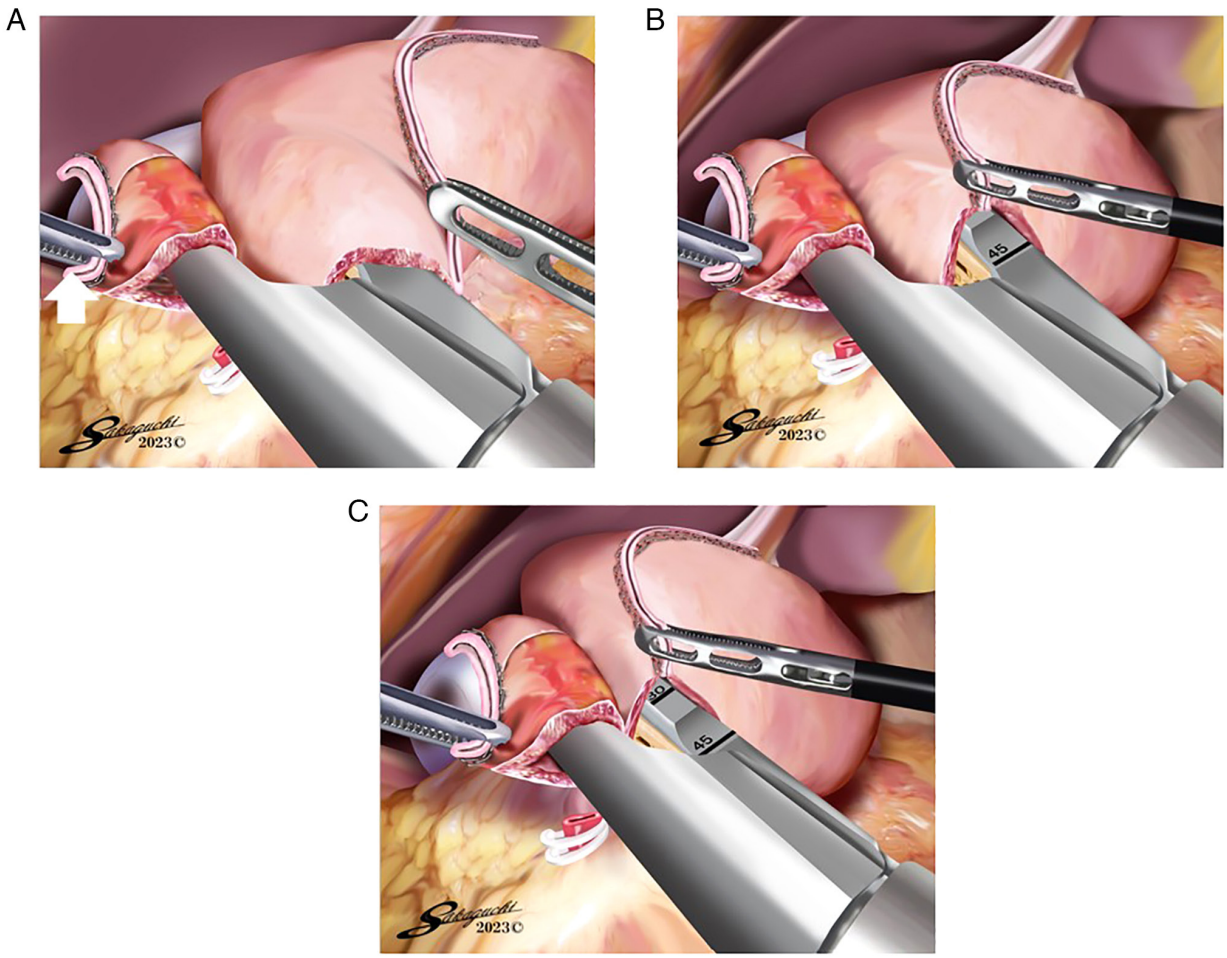

Figure 4. Linear stapling of the cranial wall of the duodenal bulb and the posterior wall of the remnant stomach. (A) The operator inserted the fork of the ELS into the duodenal bulb as far as possible with the right hand, while pulling the staple line of the duodenum externally with the left hand (white arrow). (B) The operator and first assistant changed the position of the duodenal bulb and remnant stomach without creating a gap. (C) The operator fired the ELS with the right hand so that the duodenal and gastric walls between the transecting staple lines and anastomotic staple became as wide as possible. Photoshop2023 (version 24.5; Adobe Systems, Inc.) was used to generate this figure. ELS, endoscopic linear stapler.

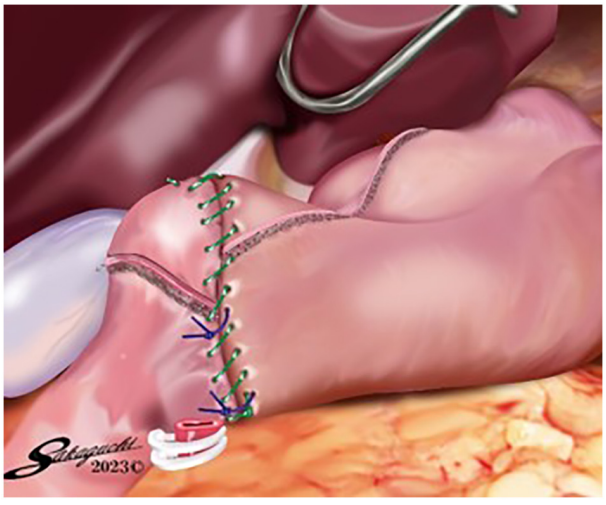

Figure 5. Modified delta-shaped gastroduodenostomy with linear stapling and single-layer hand suturing was completed. Photoshop2023 (version 24.5; Adobe Systems, Inc.) was used to generate this figure.

certainty by manipulating the ELS with the right hand with the assistance of the left hand; and ii) no additional dissection of the supraduodenal vessels was carried out even if the duodenal bulb diameter was relatively short and an adequate staple length between the cranial wall of the duodenal bulb and the posterior wall of the remnant stomach was not obtained.

Overlap gastroduodenostomy (OG). Several studies have reported OG in B-I reconstruction following TLDG (25,27-31). The duodenal bulb was transected from the greater curvature side to the lesser curvature side (25,27,29-31), or from the posterior side to the anterior side (28). Before the gastroduodenostomy, no dissection of the supraduodenal vessels aimed at creating the space required for insertion of the ELS fork around the duodenum was performed (25,27-31). The anterosuperior side or anterior wall of the first part of the duodenum and the greater curvature side or posterior wall of the remnant stomach were anastomosed by one linear staple so that the anastomotic staple line was perpendicular to the transecting staple line in the duodenum (25,27-31). Only the ELS entry hole was closed using one linear staple (25,27-29,31) or hand suturing (30), and thus, the duodenal wall between the transecting staple line and anastomotic staple line was preserved

in OG. We hypothesized that in OG, the blood supply of this area is considered to be retained because the blood supply of this area via the supraduodenal vessels branching from the GDA is not blocked by the anastomotic linear staple due to the anastomotic staple line being perpendicular to the transecting staple line (4,5). However, there is a concern that an adequate anastomotic area might not be obtained if the length of the first part of the duodenum is relatively short (1-3).

3. Intracorporeal linear-stapled gastroduodenostomy with removal of the duodenal wall between the transecting staple line and anastomotic staple line

Intracorporeal triangular anastomotic technique (INTACT). Omori *et al* (22) and Yanagimoto *et al* (23) reported the INTACT as one type of intracorporeal linear-stapled gastroduodenostomy. The duodenal bulb was transected from the greater curvature side to the lesser curvature side (22,23). Before the gastroduodenostomy, as in OG, no dissection of the supraduodenal vessels aimed at creating the space required for insertion of the ELS fork around the duodenum was performed (22,23). The posterior walls of the duodenum and the remnant stomach were anastomosed by one linear stapling so that the anastomotic staple line was parallel to the transecting staple line in the duodenum and the end of the transecting staple line in the remnant stomach (22,23). Removal of the areas between these staple lines and closure of the ELS entry hole were performed simultaneously with one or two linear staples (22,23). As a result, a physiological triangular end-to-end anastomosis with no need for twisting was completed (22,23).

In the INTACT, the extent of ischemia of the duodenal wall is considered to be clearly identifiable during the anastomosis because the blood supply of the duodenal posterior wall between the transecting staple line and anastomotic staple line via the supraduodenal vessels branching from the GDA is blocked by the anastomotic linear stapling due to these staple lines being parallel to each other (22,23). However, because it is reported that the area of the triangular end-to-end colocolostomy is considered to be prescribed by the colon diameter (32), there is a concern that, in the INTACT, an adequate anastomotic area might not be obtained if the duodenal bulb diameter is relatively short (1-3).

Book-binding technique (BBT). Several studies have reported the BBT in B-I reconstruction following TLDG (21,33-36), whereby the duodenal bulb was transected from the greater curvature side to the lesser curvature side. Similar to the INTACT, but without dissection of the supraduodenal vessels branching off from the GDA before the gastroduodenostomy, linear stapling of the posterior walls of the duodenum and the remnant stomach was performed so that the anastomotic staple line was parallel to the transecting staple line in the duodenum and the end of the transecting staple line in the remnant stomach (21,33-36). The ischemic areas between these staple lines were removed using an energy device, and thereafter, the relatively large hole made in the anterior side was closed by two linear staples (21,33) or hand suturing (34-36). As a result, a physiological triangular end-to-end anastomosis with no need for twisting was completed (21,33-36).

In the BBT, the operator can remove the ischemic duodenal posterior wall between the transecting staple line and anastomotic staple line using the energy device (21,33-36). However, because it has been reported that the area of the triangular end-to-end colocolostomy is considered to be prescribed by the colon diameter (32), there is a concern that, in the BBT, an adequate anastomotic area might not be obtained if the duodenal bulb diameter is relatively short (1-3).

Augmented rectangle technique (ART). Fukunaga *et al* (37) first reported the ART in B-I reconstruction following TLDG in 2018. As in some of the other techniques, the duodenal bulb was transected from the greater curvature side to the lesser curvature side. Before the gastroduodenostomy, dissection of several supraduodenal vessels along the lesser curvature side of the duodenum was performed aiming to create the space required for insertion of the ELS fork. After the lesser curvature side of the duodenum was retracted externally, the posterior walls of the first part of the duodenum and the remnant stomach were anastomosed using one 60-mm ELS so that the staple length was 60 mm and the anastomotic staple line was parallel to the end of the transecting staple line in the remnant stomach. After closure of the ELS entry hole using one 30-mm ELS, the areas between the transecting staple lines and anastomotic staple line were removed using one 60-mm ELS. As a result, a physiological rectangular end-to-end anastomosis with the absence of twisting was completed.

In the ART, the range of duodenal wall ischemia is considered to be clearly identifiable during the anastomosis because the blood supply of the duodenal posterior wall between the transecting staple line and anastomotic staple via the supraduodenal vessels branching from the GDA is blocked by the anastomotic linear-staple due to the duodenal bulb being transected from the greater curvature side to the lesser curvature side and the anastomotic staple line being positioned in the duodenal posterior wall (37). Furthermore, in this procedure, it is presumed that an adequate anastomotic area is likely to be steadily obtained since the 60-mm staple length is consistently retained (37).

4. Conclusion

The present review discusses several intracorporeal linear-stapled gastroduodenostomy procedures in which not only transection of the duodenal bulb but also gastroduodenostomy is performed with an ELS, classifying them into two groups on the basis of the intraoperative management of the duodenal wall between the transecting staple line and anastomotic staple line. When this site is preserved, the blood supply of the duodenal wall needs to be retained with certainty. On the other hand, when this site is removed, the ischemic portion of the duodenal wall needs to be identified and removed. Furthermore, in both groups, an adequate anastomotic area needs to be secured. In conclusion, surgeons need to be familiar with the anatomical features of the duodenal bulb, including its blood perfusion and shape, when carrying out this characteristic type of gastroduodenostomy.

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Availability of data and materials

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Authors' contributions

TT, EN and MH contributed to conception and design of the present review. TT and EN performed the literature review and drafted the initial manuscript. EN and MH revised the manuscript. Data authentication is not applicable. All authors have read and approved the final manuscript.

Ethics approval and consent to participate

The present review was approved by the Institutional Review Board of Otori Stomach and Intestines Hospital (Sakai, Japan) and the Institutional Review Board of Hokusetsu-Miki Hospital (Suita, Japan) (both approval no. 23000001). No specific patients are mentioned in the present review.

Patient consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

References

1. Jayaraman MV, Mayo-Smith WW, Movson JS, Dupuy DE and Wallach MT: CT of the duodenum: An overlooked segment gets its due. Radiographics 21: S147-S160, 2001.
2. Reghunath A, Kabilan K and Mittal MK: Exploring the neglected segment of the intestine: The duodenum and its pathologies. Pol J Radiol 85: e230-e244, 2020.
3. Terra C, Ramos-Andrade D, Sá-Marques I, Brito J, Caseiro-Alves F and Curvo-Semedo L: Duodenal imaging on the spotlight: From A to Z. Insights Imaging 12: 94, 2021.
4. Hentati N, Fournier HD, Papon X, Aube C, Vialle R and Mercier P: Arterial supply of the duodenal bulb: An anatomoclinical study. Surg Radiol Anat 21: 159-164, 1999.
5. von Trotha KT, Butz N, Grommes J, Binnebösel M, Charalambakis N, Mühlenbruch G, Schumpelick V, Klinge U, Neumann UP, Prescher A and Krones CJ: Vascular anatomy of the small intestine-a comparative anatomic study on humans and pigs. Int J Colorectal Dis 30: 683-690, 2015.
6. Kanaya S, Gomi T, Momoi H, Tamaki N, Isobe H, Katayama T, Wada Y and Ohtoshi M: Delta-shaped anastomosis in totally laparoscopic Billroth I gastrectomy: New technique of intraabdominal gastroduodenostomy. J Am Coll Surg 195: 284-287, 2002.
7. Kanaya S, Kawamura Y, Kawada H, Iwasaki H, Gomi T, Satoh S and Uyama I: The delta-shaped anastomosis in laparoscopic distal gastrectomy: Analysis of the initial 100 consecutive procedures of intracorporeal gastroduodenostomy. Gastric Cancer 14: 365-371, 2011.
8. Kim JJ, Song KY, Chin HM, Kim W, Jeon HM, Park CH and Park SM: Totally laparoscopic gastrectomy with various types of intracorporeal anastomosis using laparoscopic linear staplers: Preliminary experience. Surg Endosc 22: 436-442, 2008.
9. Song KY, Park CH, Kang HC, Kim JJ, Park SM, Jun KH, Chin HM and Hur H: Is totally laparoscopic gastrectomy less invasive than laparoscopy-assisted gastrectomy?: Prospective, multicenter study. J Gastrointest Surg 12: 1015-1021, 2008.
10. Ikeda O, Sakaguchi Y, Aoki Y, Harimoto N, Taomoto J, Masuda T, Ohga T, Adachi E, Toh Y, Okamura T and Baba Hz: Advantages of totally laparoscopic distal gastrectomy over laparoscopically assisted distal gastrectomy for gastric cancer. Surg Endosc 23: 2374-2379, 2009.
11. Kim MG, Kawada H, Kim BS, Kim TH, Kim KC, Yook JH and Kim BS: A totally laparoscopic distal gastrectomy with gastroduodenostomy (TLDG) for improvement of the early surgical outcomes in high BMI patients. Surg Endosc 25: 1076-1082, 2011.
12. Kinoshita T, Shibasaki H, Oshiro T, Ooshiro M, Okazumi S and Katoh R: Comparison of laparoscopy-assisted and total laparoscopic Billroth-I gastrectomy for gastric cancer: A report of short-term outcomes. Surg Endosc 25: 1395-1401, 2011.
13. Noshiro H, Iwasaki H, Miyasaka Y, Kobayashi K, Masatsugu T, Akashi M and Ikeda O: An additional suture secures against pitfalls in delta-shaped gastroduodenostomy after laparoscopic distal gastrectomy. Gastric Cancer 14: 385-389, 2011.
14. Kim MG, Kim KC, Kim BS, Kim TH, Kim HS, Yook JH and Kim BS: A totally laparoscopic distal gastrectomy can be an effective way of performing laparoscopic gastrectomy in obese patients (body mass index≥30). World J Surg 35: 1327-1332, 2011.
15. Kim DG, Choi YY, An JY, Kwon IG, Cho I, Kim YM, Bae JM, Song MG and Noh SH: Comparing the short-term outcomes of totally intracorporeal gastroduodenostomy with extracorporeal gastroduodenostomy after laparoscopic distal gastrectomy for gastric cancer: A single surgeon's experience and a rapid systematic review with meta-analysis. Surg Endosc 27: 3153-3161, 2013.
16. Okabe H, Obama K, Tsunoda S, Tanaka E and Sakai Y: Advantage of completely laparoscopic gastrectomy with linear stapled reconstruction: A long-term follow-up study. Ann Surg 259: 109-116, 2014.
17. Kitagami H, Morimoto M, Nozawa M, Nakamura K, Tanimura S, Murakawa K, Murakami Y, Kikuchi K, Ushigome H, Sato L, *et al*: Evaluation of the delta-shaped anastomosis in laparoscopic distal gastrectomy: Midterm results of a comparison with Roux-en-Y anastomosis. Surg Endosc 28: 2137-2144, 2014.
18. Lee HH, Song KY, Lee JS, Park SM and Kim JJ: Delta-shaped anastomosis, a good substitute for conventional Billroth I technique with comparable long-term functional outcome in totally laparoscopic distal gastrectomy. Surg Endosc 29: 2545-2552, 2015.
19. Jeong O, Jung MR, Park YK and Ryu SY: Safety and feasibility during the initial learning process of intracorporeal Billroth I (delta-shaped) anastomosis for laparoscopic distal gastrectomy. Surg Endosc 29: 1522-1529, 2015.
20. Man-I M, Suda K, Kikuchi K, Tanaka T, Furuta S, Nakauchi M, Ishikawa K, Ishida Y and Uyama I: Totally intracorporeal delta-shaped B-I anastomosis following laparoscopic distal gastrectomy using the Tri-Staple™ reloads on the manual Ultra handle: A prospective cohort study with historical controls. Surg Endosc 29: 3304-3312, 2015.
21. Ikeda T, Kawano H, Hisamatsu Y, Ando K, Saeki H, Oki E, Ohga T, Kakeji Y, Tsujitani S, Kohnoe S and Maehara Y: Progression from laparoscopic-assisted to totally laparoscopic distal gastrectomy: Comparison of circular stapler (i-DST) and linear stapler (BBT) for intracorporeal anastomosis. Surg Endosc 27: 325-332, 2013.
22. Omori T, Masuzawa T, Akamatsu H and Nishida T: A simple and safe method for Billroth I reconstruction in single-incision laparoscopic gastrectomy using a novel intracorporeal triangular anastomotic technique. J Gastrointest Surg 18: 613-616, 2014.
23. Yanagimoto Y, Omori T, Fujiwara Y, Demura K, Jeong-Ho M, Shinno N, Yamamoto K, Sugimura K, Miyata H, Ushigome H, *et al*: Comparison of the intracorporeal triangular and delta-shaped anastomotic techniques in totally laparoscopic distal gastrectomy for gastric cancer: An analysis with propensity score matching. Surg Endosc 34: 2445-2453, 2020.
24. Iwasaki K, Cho H, Ogawa R, Ishida H, Oguri Y, Maezawa Y, Tsuchida K, Nagakawa Y, Katsumata K and Tsuchida A: Comparison of intracorporeal trapezoidal-shaped gastroduodenostomy and delta-shaped anastomosis after laparoscopic distal gastrectomy for gastric cancer: A single-center retrospective study. Surg Laparosc Endosc Percutan Tech 32: 292-298, 2022.

25. Chen G, Li W, Yu W, Cen D, Wang X, Luo P, Yan J, Chen G, Zhu Y and Zhu L: Application of overlap gastroduodenostomy in Billroth i anastomosis after totally laparoscopic distal gastrectomy for gastric cancer. Can J Gastroenterol Hepatol 2022: 9094934, 2022.
26. Tokuhara T, Nakata E, Tenjo T, Kawai I, Kondo K and Hatabe S: Modified delta-shaped gastroduodenostomy consisting of linear stapling and single-layer suturing with the operator positioned between the patient's legs: A technique preventing intraoperative duodenal injury and postoperative anastomotic stenosis. PLoS One 15: e0230113, 2020.
27. Song HM, Lee SL, Hur H, Cho YK and Han SU: Linear-shaped gastroduodenostomy in totally laparoscopic distal gastrectomy. J Gastric Cancer 10: 69-74, 2010.
28. Jang CE and Lee S: Modified intracorporeal gastroduodenostomy in totally laparoscopic distal gastrectomy for gastric cancer: Early experience. Ann Surg Treat Res 89: 306-312, 2015.
29. Byun C, Cui LH, Son SY, Hur H, Cho YK and Han SU: Linear-shaped gastroduodenostomy (LSGD): Safe and feasible technique of intracorporeal Billroth I anastomosis. Surg Endosc 30: 4505-4514, 2016.
30. Watanabe Y, Watanabe M, Suehara N, Saimura M, Mizuuchi Y, Nishihara K, Iwashita T and Nakano T: Billroth-I reconstruction using an overlap method in totally laparoscopic distal gastrectomy: Propensity score matched cohort study of short- and long-term outcomes compared with Roux-en-Y reconstruction. Surg Endosc 33: 3990-4002, 2019.
31. Wang B, Son SY, Shin HJ, Hur H and Han SU: The learning curve of linear-shaped gastroduodenostomy associated with totally laparoscopic distal gastrectomy. J Gastrointest Surg 24: 1770-1777, 2020.
32. Kosuge M, Eto K, Hashizume R, Takeda M, Tomori K, Neki K, Mitsumori N and Yanaga K: Which is the safer anastomotic method for colon surgery? -Ten-year results. In Vivo 31: 683-687, 2017.
33. Oki E, Tsuda Y, Saeki H, Ando K, Imamura Y, Nakashima Y, Ohgaki K, Morita M, Ikeda T and Maehara Y: Book-binding technique for Billroth I anastomosis during totally laparoscopic distal gastrectomy. J Am Coll Surg 219: e69-e73, 2014.
34. Kim JS, Park EY, Park DJ and Kim GY: Modified book binding technique (MBBT) for intracorporeal gastroduodenostomy in totally laparoscopic distal gastrectomy: Initial experience. J Gastric Cancer 19: 355-364, 2019.
35. Kikuchi S, Kuroda S, Nishizaki M, Kuwada K, Takata N, Kakiuchi Y, Yano S, Noma K, Kagawa S and Fujiwara T: Intracorporeal semi-hand-sewn Billroth I reconstruction in total laparoscopic distal gastrectomy. Asian J Endosc Surg 14: 640-643, 2021.
36. Waki Y, Masayoshi O, Sato K and Yagi S: Modification of book-binding technique during totally laparoscopic distal gastrectomy with Billroth I reconstruction. J Minim Access Surg 18: 625-628, 2022.
37. Fukunaga T, Ishibashi Y, Oka S, Kanda S, Yube Y, Kohira Y, Matsuo Y, Mori O, Mikami S, Enomoto T and Otsubo T: Augmented rectangle technique for Billroth I anastomosis in totally laparoscopic distal gastrectomy for gastric cancer. Surg Endosc 32: 4011-4016, 2018.