

Original Article



# Intracorporeal Esophagojejunostomy during Reduced-port Totally Robotic Gastrectomy for Proximal Gastric Cancer: a Novel Application of the Single-Site® Plus 2-port System

Seohee Choi <sup>1,2</sup>, Taeil Son <sup>1,2,3,\*</sup>, Jeong Ho Song <sup>1,2</sup>, Sejin Lee <sup>1,2</sup>,  
Minah Cho <sup>1,2,3</sup>, Yoo Min Kim <sup>1,2,3</sup>, Hyung-Il Kim <sup>1,2,3</sup>, Woo Jin Hyung <sup>1,2,3</sup>

<sup>1</sup>Department of Surgery, Yonsei University College of Medicine, Seoul, Korea

<sup>2</sup>Gastric Cancer Center, Yonsei Cancer Center, Yonsei University Health System, Seoul, Korea

<sup>3</sup>Robot and MIS Center, Severance Hospital, Yonsei University Health System, Seoul, Korea

OPEN ACCESS

Received: Jan 25, 2021

Revised: Apr 27, 2021

Accepted: May 14, 2021

Correspondence to

Taeil Son

Department of Surgery, Yonsei University  
College of Medicine, 50-1 Yonsei-ro,  
Seodaemun-gu, Seoul 03722, Korea.  
E-mail: taeil419@gmail.com

\*Current affiliation: Gumdan Top General  
Hospital, Incheon, Korea.

Copyright © 2021. Korean Gastric Cancer  
Association

This is an Open Access article distributed  
under the terms of the Creative Commons  
Attribution Non-Commercial License (<https://creativecommons.org/licenses/by-nc/4.0>)  
which permits unrestricted noncommercial  
use, distribution, and reproduction in any  
medium, provided the original work is properly  
cited.

ORCID iDs

Seohee Choi   
<https://orcid.org/0000-0002-9384-8646>

Taeil Son   
<https://orcid.org/0000-0002-0327-5224>

Jeong Ho Song   
<https://orcid.org/0000-0002-2356-7152>

Sejin Lee   
<https://orcid.org/0000-0002-9634-8313>

## ABSTRACT



**Purpose:** Intracorporeal esophagojejunostomy during reduced-port gastrectomy for proximal gastric cancer is a technically challenging technique. No study has yet reported a robotic technique for anastomosis. Therefore, to address this gap, we describe our reduced-port technique and the short-term outcomes of intracorporeal esophagojejunostomy.

**Materials and Methods:** We conducted a retrospective review of patients who underwent a totally robotic reduced-port total or proximal gastrectomy between August 2016 and March 2020. We used an infra-umbilical Single-Site® port with two additional ports on both sides of the abdomen. To transect the esophagus, a 45-mm endolinear stapler was inserted via the right abdominal port. The common channel of the esophagojejunostomy was created between the apertures in the esophagus and proximal jejunum using a 45-mm linear stapler. The entry hole was closed with a 45-mm linear stapler or robot-sewn continuous suture. All anastomoses were performed without the aid of an assistant or placement of stay sutures.

**Results:** Among the 40 patients, there were no conversions to open, laparoscopic, or conventional 5-port robotic surgery. The median operation time and blood loss were 254 min and 50 mL, respectively. The median number of retrieved lymph nodes was 40.5. The median time to first flatus, soft diet intake, and length of hospital stay were 3, 5, and 7 days, respectively. Three (7.5%) major complications, including two anastomosis-related complications and a case of small bowel obstruction, were treated with an endoscopic procedure and re-operation, respectively. No mortality occurred during the study period.

**Conclusions:** Intracorporeal esophagojejunostomy during reduced-port gastrectomy can be safely performed and is feasible with acceptable surgical outcomes.

**Keywords:** Roux-en-Y anastomosis; Stomach cancer; Robot surgery

Minah Cho <https://orcid.org/0000-0003-3011-5813>Yoo Min Kim <https://orcid.org/0000-0002-5176-804X>Hyoung-Il Kim <https://orcid.org/0000-0002-6134-4523>Woo Jin Hyung <https://orcid.org/0000-0002-8593-9214>

### Funding

This study was supported by a faculty research grant from Yonsei University College of Medicine (6-2019-0053), and the funding source was not involved in the study and or its execution.

### Author Contributions

Conceptualization: S.T., K.H.I., H.W.J.; Data curation: S.J.H., L.S.; Formal analysis: C.S., C.M.; Writing - original draft: C.S., S.T.; Writing - review & editing: S.T.

### Conflict of Interest

Drs. Seohee Choi, Taeil Son, Jeong Ho Song, Sejin Lee, Minah Cho, Yoo Min Kim, and Hyoung-Il Kim have no conflicts of interest or financial ties to disclose.

Dr. Woo Jin Hyung received research grants from Medtronic and GC Pharma. This funding source had no role in the design of this study and its execution, in the analyses and interpretation of the data, or in the decision to submit results.

## INTRODUCTION

In recent years, minimally invasive surgery for gastric cancer has been widely adopted, particularly in East Asia. According to several studies, laparoscopic distal gastrectomy for early gastric cancer is technically feasible and as safe as open distal gastrectomy [1,2]. Currently, large-scale multicenter studies have reported comparable long-term outcomes between laparoscopic and open distal gastrectomy [3,4].

As laparoscopic techniques continue to develop, experienced surgeons have successfully performed reduced-port laparoscopic gastrectomy for gastric cancer to reduce postoperative pain and improve cosmetic outcomes [5,6]. However, technical difficulties related to image instability, suboptimal movement of the energy device, and instrument collision within a limited space have hindered the widespread use of reduced-port laparoscopic gastrectomy. Some surgeons have tried to overcome these technical limitations by introducing robotic surgical systems, such as Single-Site® [7,8]. We previously reported the conduction of reduced-port totally robotic distal gastrectomy using the Single-Site and an additional 2 ports for gastric cancer [9,10].

Total or proximal gastrectomy using reduced-port surgery for upper gastric cancer is still rarely performed. This is partly because of the technical difficulty in performing lymph node (LN) dissection around the splenic vessels and splenic hilum, due to the presence of complex vascular structures. Additionally, intracorporeal esophagojejunostomy, which has not yet been proven as safe, is considerably challenging with limited access. A few studies have reported the safety of reduced- or single-port laparoscopic total gastrectomy [11-14]; however, there have been no studies on the use of reduced-port robotic gastrectomy for proximal gastric cancer. Herein, we demonstrated a safe and feasible intracorporeal esophagojejunostomy technique to facilitate reduced-port totally robotic total or proximal gastrectomy using the current da Vinci surgical system.

## MATERIALS AND METHODS

### Patients

We retrospectively reviewed the data of patients with gastric cancer who underwent reduced-port totally robotic total, completion total, or proximal gastrectomy with intracorporeal esophagojejunostomy between August 2016 and March 2020. All patients were diagnosed with gastric adenocarcinoma located in the upper part of the stomach or the remnant stomach. Indications for total gastrectomy included patients who had early gastric cancer but were ineligible for endoscopic submucosal dissection, or patients who had advanced cancer without definite serosal exposure based on the preoperative evaluation. Indications for proximal gastrectomy included a diagnosis of early gastric cancer located in the upper part of the stomach, without evidence of LN metastasis. If minimally invasive surgery was applicable, patients were provided with a detailed description of each procedure, including a reduced-port robotic or conventional 5-port laparoscopic gastrectomy. Patients could then choose one of the two operative methods. All patients provided written informed consent for the procedure they elected to undergo. The work described here was carried out in accordance with the Code of Ethics of the World Medical Association (Declaration of Helsinki) for experiments involving humans. This study was approved by the Institutional Review Board of Severance Hospital, Yonsei University College of Medicine (4-2020-0011).

### Port placement during reduced-port totally robotic gastrectomy

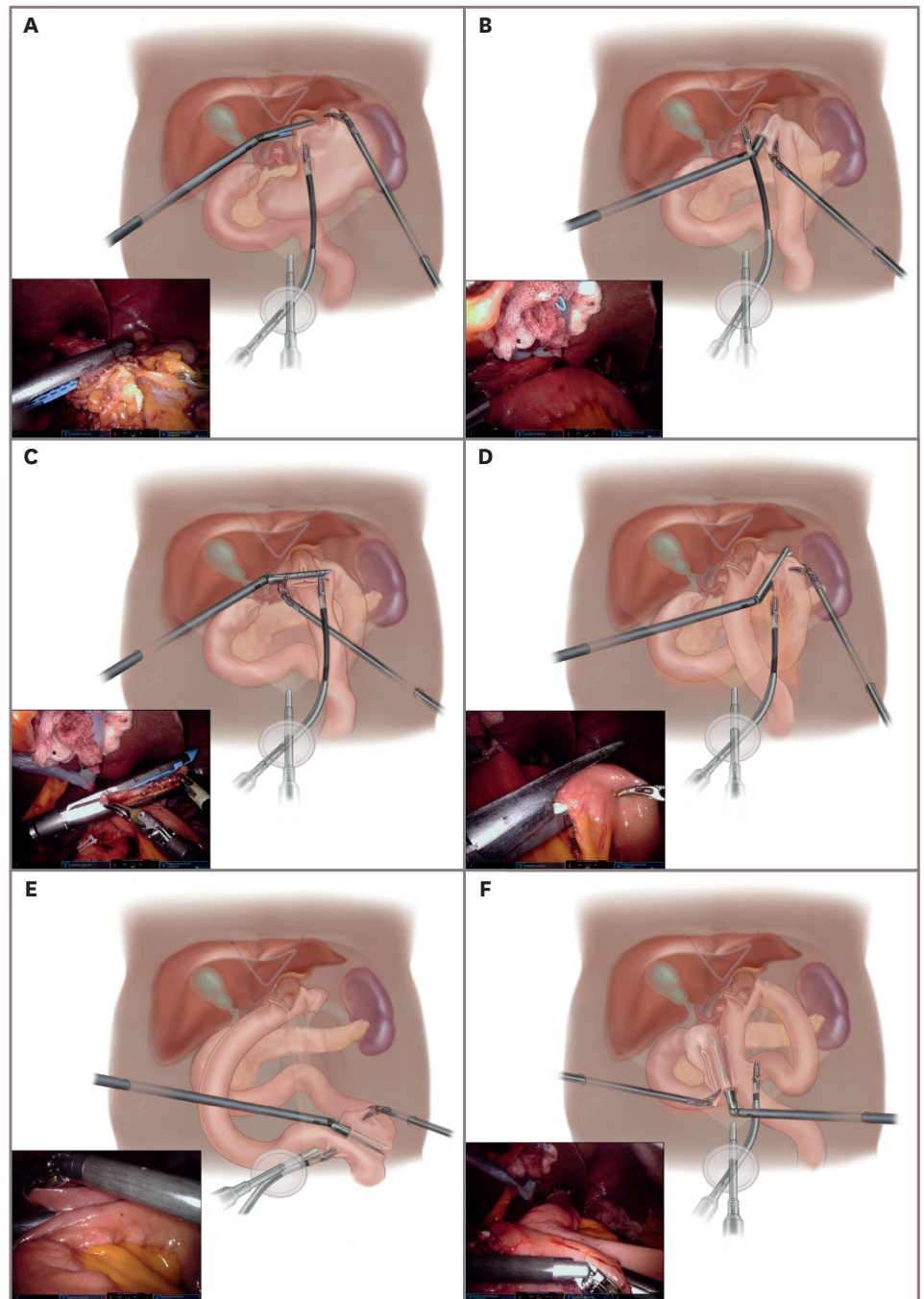
Details on the procedure for reduced-port robotic gastrectomy at our institution have been previously published [9,10]. The port placements for total or proximal gastrectomy are similar to those for reduced-port robotic distal gastrectomy. The reduced-port approach used a Single-Site® (Intuitive Surgical, Sunnyvale, CA, USA) below the umbilicus and two additional ports for rigid instruments on both sides of the abdomen. An infra-umbilical 25 mm vertical incision was made, and a Single-Site® was inserted. An 8.5-mm camera port, a 10-mm assistant port, and a 5-mm curved cannula for semi-rigid Cadieere forceps (Intuitive Surgical) was inserted via the Single-Site®. An 8-mm cannula was placed on the right upper abdomen for ultrasonic shears (Harmonic®, Ethicon Endo-surgery, Cincinnati, OH, USA), with another 8-mm cannula on the left lower abdomen for Maryland bipolar forceps (Intuitive Surgical). The two ports were placed in a port-in-port fashion via 12-mm laparoscopic balloon ports (Kii Balloon Blunt Tip System, Applied Medical, Rancho Santa Margarita, CA, USA), which were used to access the endolinear stapler during anastomosis.

### Total gastrectomy

We adopted the overlap method for intracorporeal esophagojejunostomy during minimally invasive surgery, as described by Inaba et al. [15]. After the abdominal esophagus was fully mobilized, it was partially transected to make an aperture for the entry of an articulating 45-mm linear stapler (anvil side) via the 12-mm port on the right side of the abdomen. The esophageal stump was completely transected using an ultrasound device or endo scissors, leaving a small entry hole (**Fig. 1A**). The proximal jejunum, which is a tension-free area for anastomosis, was brought to the transected esophagus. Subsequently, the posterolateral side of the esophagus and the antimesenteric side of the jejunum, 20 cm below the Treitz ligament, were anastomosed intracorporeally using the overlap method [15], with a 45-mm linear stapler through the right-sided abdominal port (**Fig. 1B**). The common entry hole was usually closed using the same linear stapler; however, we occasionally performed a robot-sewn technique using a running, continuous, barbed absorbable suture when the entry hole was large or the level of the anastomosis was too high to adequately apply the linear stapler (**Fig. 1C**) (**Supplementary Video 1**). The retrocolic route is used in obese patients depending on the tension in the mesentery. The biliary limb of the jejunal loop was intracorporeally transected 2–3 cm proximal to the esophagojejunal anastomosis, without mesenteric division using a 45-mm linear stapler via a 12-mm port on the right side of the abdomen (**Fig. 1D**). At the Roux-limb, 45 cm below the esophagojejunostomy, a side-to-side jejunojejunostomy was created using a 45-mm linear stapler through the right-sided abdominal port, and the entry holes were closed using a 45-mm linear stapler (**Fig. 1E**). In our institute, an assistant surgeon standing beside the patient's side is needed to control the endolinear stapler during the procedure with a laparoscopic endolinear stapler. However, it is noteworthy that recently, a robot-controlled stapler for robotic surgical systems (ENDOWRIST Stapler, Intuitive Surgical) has been used to enable intracorporeal anastomosis by the surgeon on the console. The Peterson's and mesenteric defects were closed during the procedure using a 3-0 nonabsorbable v-loc suture.

### Proximal gastrectomy with double-tract reconstruction

The stomach was transected above the gastric angle using two or three linear staplers through the left-sided abdominal port. Esophagojejunostomy was performed in the same manner as described above using a 45-mm linear stapler. The gastrojejunostomy was created with a 45-mm linear stapler 15 cm below the esophagojejunostomy through the left-sided abdominal port, and then the entry hole was closed using a 45-mm linear stapler (**Fig. 1F**). A



**Fig. 1.** Steps of intracorporeal anastomosis, including esophagojejunostomy during reduced-port totally robotic total or proximal gastrectomy. During anastomosis, 8-mm rigid Maryland forceps and 5-mm semi-rigid Cadieere forceps inserted through the curved cannula in the Single-Site® are used in coordination with each other to retract the intestines.

(A) The esophagus is partially transected from the right lateral side of the esophagus. An entry hole for esophagojejunostomy was made at the left lateral side of the esophageal stump. (B) The lateral wall of the esophageal stump and jejunum are approximated with a 45-mm robotic or laparoscopic endolinear stapler through the right cannula. (C) The common entry hole was closed using a 45-mm endolinear stapler. If the entry hole is too large, it is closed with a 3-0 barbed suture using the robot-sewn technique. (D) The biliopancreatic limbs of the jejunum were transected with a 45-mm stapler through the right cannula. (E) Side-to-side jejunojunction was created 45 cm below the esophagojejunostomy with a 45-mm stapler, and the entry hole was closed with another 45-mm stapler. (F) In the case of proximal gastrectomy with double-tract reconstruction, a gastrojejunostomy was created using a 45-mm stapler through the left cannula.

side-to-side jejunojunctionostomy was designed with a 45-mm linear stapler 20 cm below the gastrojejunostomy through the right-sided abdominal port [16].

**Measurement of short-term operative outcomes**

Short-term operative outcomes, including operation time, estimated blood loss, operation type, extent of LN dissection, pathologic stage, and number of metastatic/retrieved LNs were assessed. Readmission was assessed 30 days postoperatively. Postoperative in-hospital complications and complications requiring readmission were stratified using the Clavien-Dindo classification [17].

**RESULTS**

During the study period, intracorporeal esophagojejunostomy following reduced-port robotic total or proximal gastrectomy was performed in 40 consecutive patients. The patient characteristics are shown in **Table 1**. Twenty-one patients (52.5%) were men. The median age and body mass indices were 58 years (range, 35–82 years) and 22.8 kg/m<sup>2</sup> (range, 18–29 kg/m<sup>2</sup>), respectively. Clinical early cancer (cT1) was present in 30 (75%) patients and advanced cancer (cT2 or higher) in 10 (25%) patients. Clinically suspected LN involvement was noted in 6 (17.5%) patients. The operative outcomes are summarized in **Table 2**. The median operation time was 254 min (range, 185–432 min), and the estimated blood loss was 50 mL (range, 20–900 mL). Nineteen patients underwent total gastrectomy, 19 underwent proximal gastrectomy, and 2 underwent complete gastrectomy. The median number of retrieved LNs was 40.5 (range, 12–98). D2 LN dissection was performed in 11 patients (27.5%). The median postoperative hospital stay was 7 days (range, 5–35 days). All robotic gastrectomies were successfully completed without conversion to open or laparoscopic surgery and without any additional port insertion. Anastomosis-related complications were observed in 2 patients. The patient was discharged on POD 6 after proximal gastrectomy and was re-admitted 14 days after discharge. The patient developed esophagojejunostomy leakage, which was treated with endoscopic stent insertion. Another patient developed esophagojejunostomy site

**Table 1.** Preoperative patient characteristics (n=40)

Variables	Values
Age (yr)	58 (35–82)
Sex	
Male	21 (52.5)
Female	19 (47.5)
Body mass index (kg/m <sup>2</sup> )	22.8 (18–29)
ASA class	
1	11 (27.5)
2	23 (57.5)
3	6 (15)
Previous abdominal surgery	15 (37.5)
Depth of invasion, clinical	
cT1	30 (75)
cT2	6 (15)
cT3	3 (7.5)
cT4a	1 (2.5)
Lymph node metastasis, clinical	
cN0	33 (82.5)
cN+	6 (17.5)

All data are shown as the median and range or number (%).  
 ASA = American Society of Anesthesiologists.



**Table 2.** Operative and pathologic outcomes (n=40)

Variables	Values
Operative time (min)	254 (185–432)
Estimated blood loss (mL)	50 (20–900)
Transfusion	1 (2.5)
Operation type	
Total gastrectomy	19 (47.5)
Proximal gastrectomy	19 (47.5)
Completion total gastrectomy	2 (5)
Extent of lymph node dissection	
D1+	29 (72.5)
D2	11 (27.5)
Conversion to conventional robotic or open surgery	0
Combined operation*	3 (7.5)
Pathological stage, AJCC 8 <sup>th</sup> edition	
I	30 (75)
II	6 (15)
III	3 (7.5)
Number of metastatic lymph nodes	0 (0–32)
Number of retrieved lymph nodes	40.5 (12–98)
Resumption of soft diet, POD	5 (4–32)
Hospital stay, POD	7 (5–35)
Grade >3 complications <sup>†</sup>	3 (7.5)
Anastomosis-related complications	2 (5.0)

All data are shown as the median and range or number (%).

AJCC = American Joint Committee on Cancer; POD = postoperative day.

\*Combined operation: splenectomy, appendectomy, and cholecystectomy. <sup>†</sup>Clavien-Dindo classification.

stenosis that required endoscopic dilatation during hospitalization, after which the patient was discharged on postoperative day (POD) 29. The other patient who underwent completion total gastrectomy developed an intestinal obstruction that required additional surgery (laparoscopic segmental resection of the small bowel), after which the patient was discharged on POD 35. No mortality occurred during the study period.

## DISCUSSION

In this report, we describe a novel intracorporeal anastomosis technique for esophagojejunostomy during reduced-port totally robotic gastrectomy. The major in-hospital complication rate during the study period was 7.5%, which is comparable with that reported in previous studies on conventional minimally invasive gastrectomy [18]. The observed operative outcomes, including operation time, hospital stay, and estimated blood loss, were acceptable. We did not encounter any cases of conversion to open or laparoscopic procedures or a requirement for additional port insertion. We found that intracorporeal esophagojejunostomy was technically feasible and safe to perform during reduced-port robotic gastrectomy.

Intracorporeal esophagojejunostomy is regarded as a technically demanding procedure during laparoscopic total or proximal gastrectomy. An international cross-sectional survey on the surgical treatment of gastric cancer revealed that minimally invasive surgery was the preferred method for distal gastrectomy in cases of early gastric cancer in Asia (82% for distal gastrectomy and 64% for total gastrectomy for early gastric cancer) [19]. Minimally invasive surgery was favored by 49% of international gastric surgeons for early gastric cancer, but only by 6% of surgeons for advanced gastric cancer regarding total gastrectomy. This presumably

reflects the technical difficulties in performing total gastrectomy for proximal gastric cancer. Furthermore, differences in the type and incidence of complications between laparoscopic total and distal gastrectomy can arise from difficulties in performing intracorporeal esophagojejunostomy and cause anastomosis-related complications such as leakage, bleeding, and stenosis [18,20]. The incidence of anastomosis-related complications after laparoscopic distal gastrectomy was 1.6% in the Korean Laparoendoscopic Gastrointestinal Surgery Study Group (KLASS)-01 trial [21] and 3.2% in the KLASS-03 trial for laparoscopic total gastrectomy [18]. Thus, safe esophagojejunostomy is crucial to reduce complications related to the procedure associated with higher morbidity and mortality, as well as a worse prognosis.

Reduced-port laparoscopic total gastrectomy is rarely performed due to difficulties in performing intracorporeal esophagojejunostomy using conventional devices and techniques. Because of the risk of collision between the surgeon and the assistants, reduced-port laparoscopic total gastrectomy would require special equipment, such as an articulating instrument or scope holder [14]. Previously published studies on laparoscopic reduced-port and conventional total gastrectomy are shown in **Supplementary Table 1**. Several retrospective studies comparing surgical outcomes with those of conventional 5-port surgery have reported the feasibility and safety of reduced-port total gastrectomy [12,13], and demonstrated that the number of retrieved LNs and blood loss did not differ between the two groups. However, the limitations of these studies were that they included only early gastric cancer patients and that reduced-port gastrectomy was more commonly performed in less obese or female patients. In addition, Kim et al. [22] reported that postoperative anastomosis-related complications were more common in reduced-port laparoscopic total gastrectomy than in conventional laparoscopic total gastrectomy (6/34 patients vs. 0/23 patients,  $P=0.020$ ), although overall complications were comparable. Surgeons with extensive experience in laparoscopic gastrectomy stated that a prolonged learning period was essential to gain expertise in performing a secure intracorporeal anastomosis during reduced-port gastrectomy [22,23].

To overcome the difficulties of reduced-port laparoscopic total gastrectomy, we used a robotic surgical system that could provide a technically superior operative environment, such as tremor filtration and articulated function of wristed instruments. In addition, the robotic system helped surgeons dissect LNs around the splenic vessels and splenic hilum, which are difficult to reach with current laparoscopic instruments and camera systems [24]. We previously reported the short-term outcomes of reduced-port robotic distal gastrectomy and demonstrated the feasibility and safety of the procedure. As in the previous study, reduced-port robotic gastrectomy in this study was designed to utilize the same rigid instruments as those used in conventional robotic gastrectomy [25]. This procedure involved the use of five ports through three incisions, in contrast to conventional 5-port robotic gastrectomy, but was able to be used in similar operative procedures and achieved acceptable surgical outcomes. In conventional robotic gastrectomy, adequate retraction in the required direction can be achieved using Maryland and Cadere forceps through both side ports of the abdomen. In reduced-port robotic gastrectomy, the staplers were inserted in the same direction as in conventional robotic gastrectomy, and adequate retraction was obtained using the flexible semi-rigid Cadere forceps through the Single-Site and Maryland forceps through the left-sided abdominal port, leading to fewer intra- and extra-abdominal collisions. Consequently, operations in all cases could be performed without stay sutures or additional retraction by bedside assistant surgeons. A bedside assistant surgeon who had sufficient training and experience in intracorporeal anastomosis participated in using the laparoscopic endoliner

stapler. However, using this technique, the robotic stapler could allow surgeons to perform secure intracorporeal anastomosis without the help of a skilled assistant surgeon. Moreover, the robotic system facilitated easier hand-sewn suturing for the closure of the entry hole or reinforcement of the anastomosis line, especially when the entry hole was too large or the level of the anastomosis was too high to adequately apply the stapler.

In this study, we did not observe any intraoperative robotic procedure-related complications. Grade III or higher complications related to esophagojejunostomy occurred in a patient who developed esophagojejunostomy site stenosis during the early days of our experience with the technique. The patient was a 64-year-old woman who underwent reduced-port total gastrectomy and was found to have proximal margin involvement by frozen section during the operation and thus underwent additional esophageal resection. However, during esophagojejunostomy, one fork of the linear stapler (anvil side) was inserted into the submucosal layer of the esophagus, creating a false lumen in the submucosal plane of the esophagus. The operation was completed without the recognition of the false lumen. On postoperative day 3, the patient experienced nausea and vomiting, and abdominal computed tomography demonstrated partial obstruction at the site of the anastomosis. After confirmation of esophageal stenosis, endoscopic dilatation was performed on postoperative day 7. The patient was discharged on postoperative day 29 without any other complications.

This is the first description of an intracorporeal esophagojejunostomy in reduced-port robotic gastrectomy for proximal gastric cancer. Moreover, in this study, we found that D2 LN dissection and intracorporeal anastomosis including esophagojejunostomy, gastrojejunostomy, and jejunojunctionostomy, which are regarded as highly challenging procedures when using a reduced-port technique, could be successfully performed. However, this study has some limitations. First, our results were based on a retrospective analysis of the initial experience at a single high-volume institution. Second, we could not compare reduced-port totally robotic gastrectomy with other procedures, such as reduced-port laparoscopic or conventional robotic gastrectomy. Third, we did not assess patient benefits, including postoperative pain, recovery, surgical stress, cosmetic effects, and quality of life. Further studies regarding the safety and patient benefits of reduced-port intracorporeal esophagojejunostomy compared to those of other procedures should be conducted.

In conclusion, we have described a technique for intracorporeal esophagojejunostomy during reduced-port totally robotic gastrectomy, and discussed its short-term outcomes. Intracorporeal esophagojejunostomy during reduced-port totally robotic gastrectomy is feasible and safe. Moreover, it shows acceptable surgical outcomes, including in the number of retrieved LNs, blood loss, and operation time. We believe that this novel technique using the current robotic system could facilitate the use of reduced-port gastrectomy for proximal gastric cancer.

## ACKNOWLEDGMENTS

We would like to thank Editage ([www.editage.co.kr](http://www.editage.co.kr)) for English language editing.



## SUPPLEMENTARY MATERIALS

### Supplementary Table 1

Previously published studies of laparoscopic reduced-port and conventional total gastrectomy

[Click here to view](#)

### Supplementary Video 1

Representative view of intracorporeal esophagojejunostomy using endoliner staplers during reduced-port totally robotic total gastrectomy.

[Click here to view](#)

## REFERENCES

1. Inaki N, Etoh T, Ohyama T, Uchiyama K, Katada N, Koeda K, et al. A multi-institutional, prospective, phase II feasibility study of laparoscopy-assisted distal gastrectomy with D2 lymph node dissection for locally advanced gastric cancer (JLSSG0901). *World J Surg* 2015;39:2734-2741.  
[PUBMED](#) | [CROSSREF](#)
2. Kim W, Kim HH, Han SU, Kim MC, Hyung WJ, Ryu SW, et al. Decreased morbidity of laparoscopic distal gastrectomy compared with open distal gastrectomy for stage I gastric cancer: short-term outcomes from a multicenter randomized controlled trial (KLASS-01). *Ann Surg* 2016;263:28-35.  
[PUBMED](#) | [CROSSREF](#)
3. Park DJ, Han SU, Hyung WJ, Kim MC, Kim W, Ryu SY, et al. Long-term outcomes after laparoscopy-assisted gastrectomy for advanced gastric cancer: a large-scale multicenter retrospective study. *Surg Endosc* 2012;26:1548-1553.  
[PUBMED](#) | [CROSSREF](#)
4. Kim HH, Han SU, Kim MC, Hyung WJ, Kim W, Lee HJ, et al. Long-term results of laparoscopic gastrectomy for gastric cancer: a large-scale case-control and case-matched Korean multicenter study. *J Clin Oncol* 2014;32:627-633.  
[PUBMED](#) | [CROSSREF](#)
5. Kang SH, Cho YS, Min SH, Park YS, Ahn SH, Park DJ, et al. Early experience and learning curve of solo single-incision distal gastrectomy for gastric cancer: a review of consecutive 100 cases. *Surg Endosc* 2019;33:3412-3418.  
[PUBMED](#) | [CROSSREF](#)
6. Kim SM, Ha MH, Seo JE, Kim JE, Choi MG, Sohn TS, et al. Comparison of single-port and reduced-port totally laparoscopic distal gastrectomy for patients with early gastric cancer. *Surg Endosc* 2016;30:3950-3957.  
[PUBMED](#) | [CROSSREF](#)
7. Lee S, Kim JK, Kim YN, Jang DS, Kim YM, Son T, et al. Safety and feasibility of reduced-port robotic distal gastrectomy for gastric cancer: a phase I/II clinical trial. *Surg Endosc* 2017;31:4002-4009.  
[PUBMED](#) | [CROSSREF](#)
8. Kim YY, Lee Y, Lee CM, Park S. Lymphadenectomy using two instrument arms during robotic surgery for gastric cancer: a strategy to facilitate reduced-port robotic gastrectomy. *Asian J Surg* 2020;43:459-466.  
[PUBMED](#) | [CROSSREF](#)
9. Seo WJ, Son T, Roh CK, Cho M, Kim HI, Hyung WJ. Reduced-port totally robotic distal subtotal gastrectomy with lymph node dissection for gastric cancer: a modified technique using Single-Site® and two additional ports. *Surg Endosc* 2018;32:3713-3719.  
[PUBMED](#) | [CROSSREF](#)
10. Lee JH, Son T, Kim J, Seo WJ, Rho CK, Cho M, et al. Intracorporeal delta-shaped gastroduodenostomy in reduced-port robotic distal subtotal gastrectomy: technical aspects and short-term outcomes. *Surg Endosc* 2018;32:4344-4350.  
[PUBMED](#) | [CROSSREF](#)
11. Kunisaki C, Miyamoto H, Sato S, Tanaka Y, Sato K, Izumisawa Y, et al. Surgical outcomes of reduced-port laparoscopic gastrectomy versus conventional laparoscopic gastrectomy for gastric cancer: a propensity-matched retrospective cohort study. *Ann Surg Oncol* 2018;25:3604-3612.  
[PUBMED](#) | [CROSSREF](#)

12. Kunisaki C, Makino H, Kimura J, Takagawa R, Ota M, Kosaka T, et al. Application of reduced-port laparoscopic total gastrectomy in gastric cancer preserving the pancreas and spleen. *Gastric Cancer* 2015;18:868-875.  
[PUBMED](#) | [CROSSREF](#)
13. Kawamura H, Tanioka T, Kuji M, Tahara M, Takahashi M. The initial experience of dual port laparoscopy-assisted total gastrectomy as a reduced port surgery for total gastrectomy. *Gastric Cancer* 2013;16:602-608.  
[PUBMED](#) | [CROSSREF](#)
14. Ahn SH, Son SY, Jung DH, Park YS, Shin DJ, Park DJ, et al. Solo intracorporeal esophagojejunostomy reconstruction using a laparoscopic scope holder in single-port laparoscopic total gastrectomy for early gastric cancer. *J Gastric Cancer* 2015;15:132-138.  
[PUBMED](#) | [CROSSREF](#)
15. Inaba K, Satoh S, Ishida Y, Taniguchi K, Isogaki J, Kanaya S, et al. Overlap method: novel intracorporeal esophagojejunostomy after laparoscopic total gastrectomy. *J Am Coll Surg* 2010;211:e25-e29.  
[PUBMED](#) | [CROSSREF](#)
16. Cho M, Son T, Kim HI, Noh SH, Choi S, Seo WJ, et al. Similar hematologic and nutritional outcomes after proximal gastrectomy with double-tract reconstruction in comparison to total gastrectomy for early upper gastric cancer. *Surg Endosc* 2019;33:1757-1768.  
[PUBMED](#) | [CROSSREF](#)
17. Dindo D, Demartines N, Clavien PA. Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. *Ann Surg* 2004;240:205-213.  
[PUBMED](#) | [CROSSREF](#)
18. Hyung WJ, Yang HK, Han SU, Lee YJ, Park JM, Kim JJ, et al. A feasibility study of laparoscopic total gastrectomy for clinical stage I gastric cancer: a prospective multi-center phase II clinical trial, KCLASS 03. *Gastric Cancer* 2019;22:214-222.  
[PUBMED](#) | [CROSSREF](#)
19. Brenkman HJ, Haverkamp L, Ruurda JP, van Hillegersberg R. Worldwide practice in gastric cancer surgery. *World J Gastroenterol* 2016;22:4041-4048.  
[PUBMED](#) | [CROSSREF](#)
20. Katai H, Mizusawa J, Katayama H, Kunisaki C, Sakuramoto S, Inaki N, et al. Single-arm confirmatory trial of laparoscopy-assisted total or proximal gastrectomy with nodal dissection for clinical stage I gastric cancer: Japan Clinical Oncology Group study JCOG1401. *Gastric Cancer* 2019;22:999-1008.  
[PUBMED](#) | [CROSSREF](#)
21. Kim HH, Han SU, Kim MC, Kim W, Lee HJ, Ryu SW, et al. Effect of laparoscopic distal gastrectomy vs open distal gastrectomy on long-term survival among patients with stage I gastric cancer: the KCLASS-01 randomized clinical trial. *JAMA Oncol* 2019;5:506-513.  
[PUBMED](#) | [CROSSREF](#)
22. Kim HB, Kim SM, Ha MH, Seo JE, Choi MG, Sohn TS, et al. Comparison of reduced port totally laparoscopic-assisted total gastrectomy (Duet TLTG) and conventional laparoscopic-assisted total gastrectomy. *Surg Laparosc Endosc Percutan Tech* 2016;26:e132-e136.  
[PUBMED](#) | [CROSSREF](#)
23. Kunisaki C, Makino H, Yamaguchi N, Izumisawa Y, Miyamoto H, Sato K, et al. Surgical advantages of reduced-port laparoscopic gastrectomy in gastric cancer. *Surg Endosc* 2016;30:5520-5528.  
[PUBMED](#) | [CROSSREF](#)
24. Son T, Lee JH, Kim YM, Kim HI, Noh SH, Hyung WJ. Robotic spleen-preserving total gastrectomy for gastric cancer: comparison with conventional laparoscopic procedure. *Surg Endosc* 2014;28:2606-2615.  
[PUBMED](#) | [CROSSREF](#)
25. Song J, Oh SJ, Kang WH, Hyung WJ, Choi SH, Noh SH. Robot-assisted gastrectomy with lymph node dissection for gastric cancer: lessons learned from an initial 100 consecutive procedures. *Ann Surg* 2009;249:927-932.  
[PUBMED](#) | [CROSSREF](#)