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Convenience of Adding a Needle Grasper in Single-Incision Laparoscopic Distal Gastrectomy With Billroth I Anastomosis for Clinical Early Gastric Cancer

Jong Won Kim, **Joong-Min Park**, **Kyong-Choun Chi**

Department of Surgery, Chung-Ang University Hospital, Chung-Ang University College of Medicine, Seoul, Korea

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Correspondence to
Kyong-Choun Chi
Department of Surgery, Chung-Ang University Hospital, Chung-Ang University College of Medicine, 102 Heukseok-ro, Dongjak-gu, Seoul 06973, Korea.
Email: kcchi@cau.ac.kr

ORCID iDs
Jong Won Kim
https://orcid.org/0000-0002-9556-7143
Joong-Min Park
https://orcid.org/0000-0002-8582-6391
Kyong-Choun Chi
https://orcid.org/0000-0001-8703-5377

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ABSTRACT

Purpose: To overcome the technical difficulties of single-incision laparoscopic distal gastrectomy (SILDG), needle grasper (Endo Relief^{TM})-assisted SILDG (NASILDG) was developed. Here, we compared the operative convenience and postoperative outcomes between SILDG and NASILDG.
Materials and Methods: A needle grasper was inserted into the right upper abdomen and used in the NASILDG. We retrospectively reviewed patients who underwent D1 + dissection and delta-shaped Billroth I anastomosis with SILDG or NASILDG performed by a single surgeon between September 2015 and August 2018.
Results: The SILDG (male, 50.0%) and NASILDG (male, 60.0%) groups included 10 and 15 patients, respectively. The operative time without combined operation and anastomosis was significantly shorter in the NASILDG group. Early complications and scar characteristics were not significantly different between the two groups.
Conclusions: By adding a needle grasper, SILDG became more convenient without decreasing cosmetic results. NASILDG could be a recommended method to reduce the technical difficulty of SILDG.

Keywords: Gastrectomy; Single incision; Gastric cancer; Needle grasper

INTRODUCTION

Laparoscopic gastrectomy offers several advantages over open gastrectomy. These include reduced postoperative pain, shorter recovery time, shorter hospital stay, and better cosmetic results [1-3]. In addition, laparoscopic gastrectomy is comparable to open gastrectomy in terms of long-term oncological outcomes [4]. Therefore, laparoscopic surgery is an accepted treatment option for clinical stage I gastric cancer [5,6]. In addition, the frequency of laparoscopic gastrectomies is continuously increasing [7].

With the development of instruments and accumulation of experience, laparoscopic surgery is being developed to further reduce incision size and postoperative pain. Currently, single-

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incision laparoscopic surgery (SILS) involves the smallest incision size. However, because of the difficulty of this technique, its adaptation in gastric cancer surgery has been delayed compared to that in other surgical fields [8]. Single-incision laparoscopic distal gastrectomy (SILDG) was first reported in Japan in 2011 and Korea in 2012 [9,10].

However, performing SILDG presents several challenges. First, due to simultaneous insertion of two instruments with the laparoscopic camera through a single incision site, interference between the instruments and the camera is common, which makes tissue handling difficult. Using instruments of different lengths and changing the patient's position can help, but interference and narrow angles between instruments are fundamental limitations of SILS. In addition, gastrectomy for gastric cancer involves complicated procedures, such as lymphadenectomy, which is challenging in the suprapancreatic area because the instruments are inserted from a single incision site at the navel [11]. When approaching its upper border, the pancreas is compressed by instruments that enter through the navel, which may cause damage upon excessive pressure application and may result in a pancreatic fistula in severe cases.

To overcome these problems, a method involving the addition of a needle grasper was devised. A needle grasper is a needlescopic instrument with a diameter of 2–3 mm that can be helpful in laparoscopic surgery because it does not require the creation of a large incision in the abdominal wall [12]. Conventional needle graspers have small jaws and weak shaft strength and grasping force; therefore, they can be used for simple surgeries but not for cancer surgery [13]. However, a specific needle grasper, called Endo Relief™ (Hirata Precisions Co., Chiba, Japan), has a thin shaft measuring 2.4 mm, but its jaws can hold tissue similar to 5-mm graspers. Although thin, the grasper shaft is made of durable material, which results in sufficient force to hold tissues without excessive bending. Therefore, a needle grasper-assisted single-incision laparoscopic distal gastrectomy (NASILDG) using an Endo Relief™ inserted into the right upper abdomen in SILDG was devised.

This study aimed to compare the operative convenience and postoperative outcomes between SILDG and NASILDG.

MATERIALS AND METHODS

Between September 2015 and August 2018, we enrolled patients who underwent SILDG or NASILDG performed by the same surgeon (KJW) at Gangnam Severance Hospital and Chung-Ang University Hospital. The surgeon has been working as an upper gastrointestinal surgery staff surgeon since 2010 and has performed approximately 100 open or laparoscopic gastric cancer surgeries per year. For laparoscopic surgery techniques, the surgeon has been verified by participating in the main study by passing surgeon qualification in the KLASS-02 trial [14-16]. SILDG was performed, and after the needle grasper was introduced and became available, NASILDG was performed. SILDG and NASILDG were performed for patients with clinical stage T1N0M0 disease. Therefore, all patients underwent D1 + lymph node dissection, and we included only those who underwent Billroth I dissection for comparison with similar clinical cases. All patients were diagnosed preoperatively with clinical stage T1N0M0 by endoscopic findings, biopsy, and computed tomography, and were not suitable for endoscopic submucosal dissection according to the guidelines of the Japanese Gastric Cancer Association [6]. Billroth I anastomosis was performed in cases where the gastric cancer lesions were located in the lower body or antrum but without invasion of the pylorus.

A total of 7 and 18 patients from Gangnam Severance Hospital and Chung-Ang University Hospital, respectively, were enrolled. There were no exclusion criteria; therefore, all eligible patients were included in this study. SILDG and NASILDG were performed on 10 and 15 patients, respectively.

The medical records of the patients, including their clinical characteristics and surgical parameters such as the operating time and postoperative results, were reviewed retrospectively.

Detailed operative procedures

The extent of lymph node dissection and the approximate method of anastomosis were similar for both SILDG and NASILDG. The approximate surgical procedure that was commonly performed in both surgical methods was as follows: The patient's legs were spread apart with extension using a leg rest. A 10-mm flexible laparoscope was used for the procedure. For liver traction, the esophageal hiatus was sutured, and the suture was withdrawn through the epigastrium. If necessary, the diaphragm could be sutured to the desired position for proper liver retraction. The gastrocolic ligament was excised more than 3 cm from the gastroepiploic arcade. The left gastroepiploic vessels were ligated before the first branch was exited to the greater curvature. The omentum was separated from the greater curvature of the lower body. The right gastroepiploic vein was ligated distal to the branching of the anterior superior pancreaticoduodenal vein. Number 6 LN dissection was performed by ligation of the right gastroepiploic and infrapyloric arteries. We then cleared the lower border of the duodenum to the pylorus and approached and cleared the upper border of the duodenum. A stapler was inserted through the umbilical incision, and the duodenum was incised mediolaterally just below the pylorus. Dissecting along the gastroduodenal artery, we identified the common hepatic artery and the proper hepatic artery, and the right gastric artery was ligated. A suprapancreatic lymph node dissection was performed. The left gastric vein and artery were divided, and the lymph nodes surrounding the common hepatic artery and celiac axis were dissected. The right cardiac lymph nodes were dissected and the lesser curvature was cleared. Using either two 60-mm or 60-mm and 45-mm linear staplers, we incised the stomach from the lesser curvature to the greater curvature at the upper 1/3 level of the stomach. The resected specimen was placed in a plastic bag and withdrawn through an umbilical incision. The remaining stomach and duodenum were anastomosed with three 45-mm linear staplers using the modified delta method [17]. A drainage tube was positioned between the stomach and pancreas, and a small incision was made in the umbilicus next to the main surgical incision at the other end of the drain. Closure was accomplished layer by layer.

In contrast, during SILDG, a 3-cm longitudinal transumbilical incision was made, and a Gloveport[R] (NELIS Co., Bucheon, Korea) was inserted. We used the Gloveport[R] with two 12-mm and 5-mm ports each. The operator stood on the right side of the patient while the scopist stood between the legs of the patient until the right gastroepiploic vessels were divided and the greater curvature was cleared. Thereafter, the operator stood between the patient's legs, whereas the scopist stood on the patient's right side. Left tilting of the bed is sometimes useful when handling the right gastroepiploic vessels. A curved grasper is mainly used as a left-handed instrument to retract the tissue (**Fig. 1**). For the right-handed energy device, which is mainly used for dissection and hemostasis, a longer instrument was used because it can reduce instrument interference by placing the handles in different positions. The incision site was too crowded to allow the assistant to use the instrument for countertraction. A traction suture was used for anastomosis. The remaining stomach and duodenal holes were sutured and pulled through the umbilical incision for traction. This is helpful when proper traction of sutures is applied during stapling. We anastomosed the stomach and duodenal remnants using a 45-mm linear stapler while properly retracting the traction sutures. Stapling was performed twice to close the common entry hole, which was created after stapling of the stomach and duodenal remnants. The middle part of the common entry hole was sutured, and the thread was pulled out of the abdominal wall. The caudal end of the common entry hole was sutured and pulled through the umbilical incision. The first stapling procedure was performed by pulling the threads. The cranial end of the common entry hole was then sutured, and the thread was pulled out of the abdominal wall for final stapling. If the stapler and camera enter through a single incision site, it is very difficult to perform stapling by inserting another grasper through the same incision site and pulling the tissues in the proper direction. Therefore, we had no choice but to use traction sutures for Billroth I anastomosis (**Fig. 2**).

In the case of NASILDG, a 3-cm longitudinal transumbilical incision was created and the same Gloveport[R] was inserted. Additionally, a needle grasper (Endo Relief™) was inserted into the right upper abdomen. The operator and assistant stood on the patient's right and left sides,

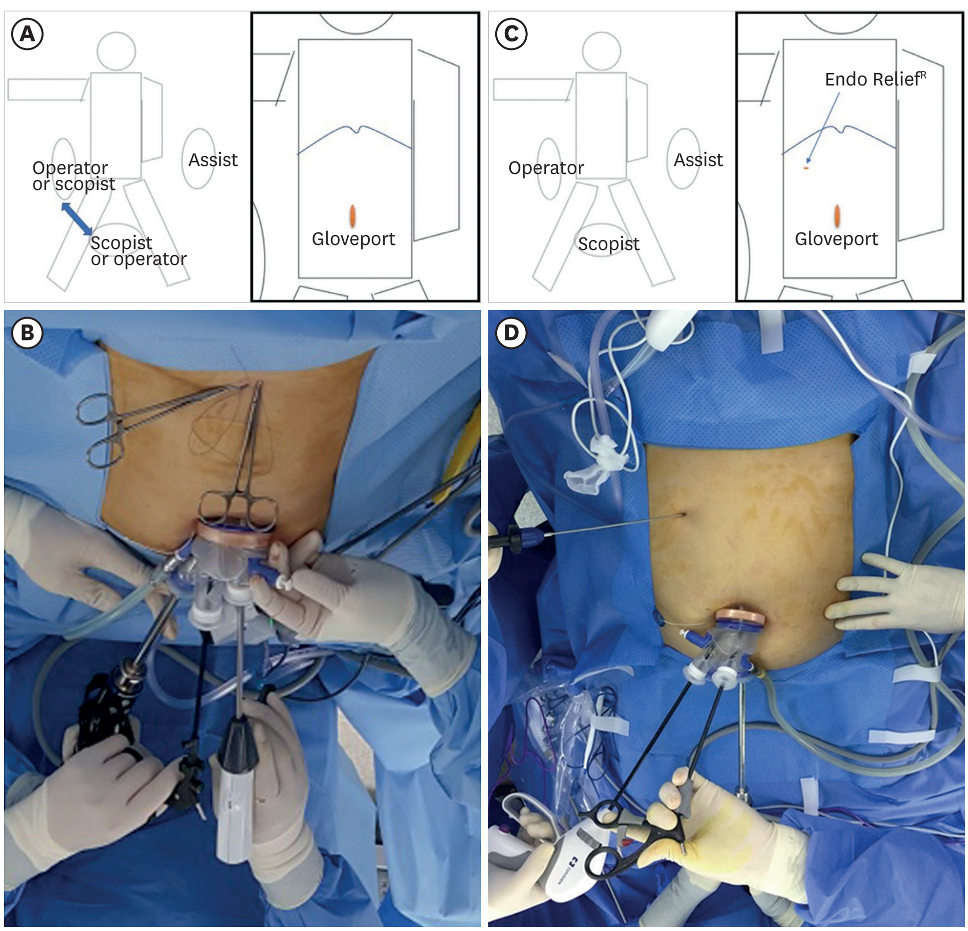

Fig. 1. Patient position, operative field, and trocar site of SILDG and NASILDG. (A) SILDG uses a Gloveport[R] in the umbilicus with an open-leg posture. The operator and scopist change positions as needed. (B) In SILDG, the laparoscopic camera and the operator's two instruments are inserted and operated through the Gloveport[R]. The role of the assistant is minimal. (C) NASILDG uses a Gloveport[R] in the umbilicus and an Endo Relief[R] through a 2.5-mm incision in the right upper abdomen with the open leg posture. The operator stands on the right side of the patient and the scopist stands between the patient's legs. (D) In NASILDG, the laparoscopic camera and operator's right-hand instrument are inserted and operated through Gloveport[R], and the operator handles the Endo Relief[R] with the left hand. The assistant can assist with an instrument inserted through the Gloveport[R].
SILDG = single-incision laparoscopic distal gastrectomy; NASILDG = needle-assisted single-incision laparoscopic distal gastrectomy.

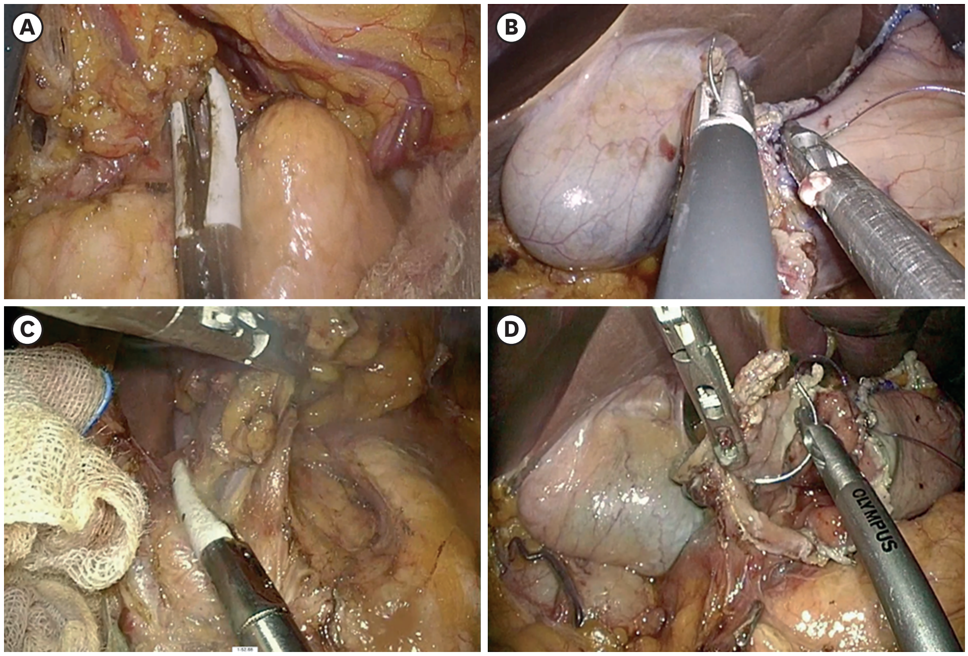

Fig. 2. Intraperitoneal view during operation. (A) The energy device compresses the pancreas during upper border lymph node dissection (SILDG). (B) Gastroduodenostomy suturing during SILDG. The angle between the two instruments was very narrow. (C) The energy device reaches the suprapancreatic area without compressing the pancreas, owing to the assistant's traction of the pancreas (NASILDG). (D) Suturing for gastroduodenostomy during NASILDG. The positions of the two instruments are compatible with conventional multiport laparoscopic surgery. The needle grasper can be used as in any other 5-mm instrument.
SILDG = single-incision laparoscopic distal gastrectomy; NASILDG = needle-assisted single-incision laparoscopic distal gastrectomy.

respectively, whereas the scopist stood between the patient's legs. The operator used a needle grasper with his left hand and an energy device, clip, or stapler with his right hand. The assistant inserted an instrument into the 5-mm Gloveport[R] in the umbilical incision (**Fig. 1**). When performing pancreatic upper border dissection, the assistant surgeon compressed the mesocolon that is connected to the pancreas and pulled it toward the caudal side so that the pancreas was also pulled toward the caudal side (**Fig. 2**). When performing anastomosis, a traction suture was used in the same way, and a similar procedure was followed. However, the number of sutures was reduced because the needle grasper could pull and handle tissues in the proper direction without interference. When performing the first stapling procedure, traction sutures could not be applied to the duodenum. However, during final stapling, proper traction was possible using a needle grasper without suturing the cranial end of the common entry hole. The wound into which the needle grasper was inserted did not need to be sutured after surgery and almost disappears over time (**Fig. 3**).

Data collection and variables for comparison

The patients' clinical characteristics, including sex, age, body mass index (BMI), American Society of Anesthesiologists (ASA) classification, and pathological status of cancer, were evaluated by reviewing their medical records. Operative parameters, including operation time, combined resection, estimated blood loss, hemoglobin change, and hematocrit change, were reviewed. In addition, postoperative outcomes, length of hospital stay, and complications were reviewed. Postoperative complications were classified according to the Clavien–Dindo classification [18].

To evaluate the convenience of the operation, operation time, anastomosis time, estimated blood loss, and complication rate were evaluated. As for the operation time, the total

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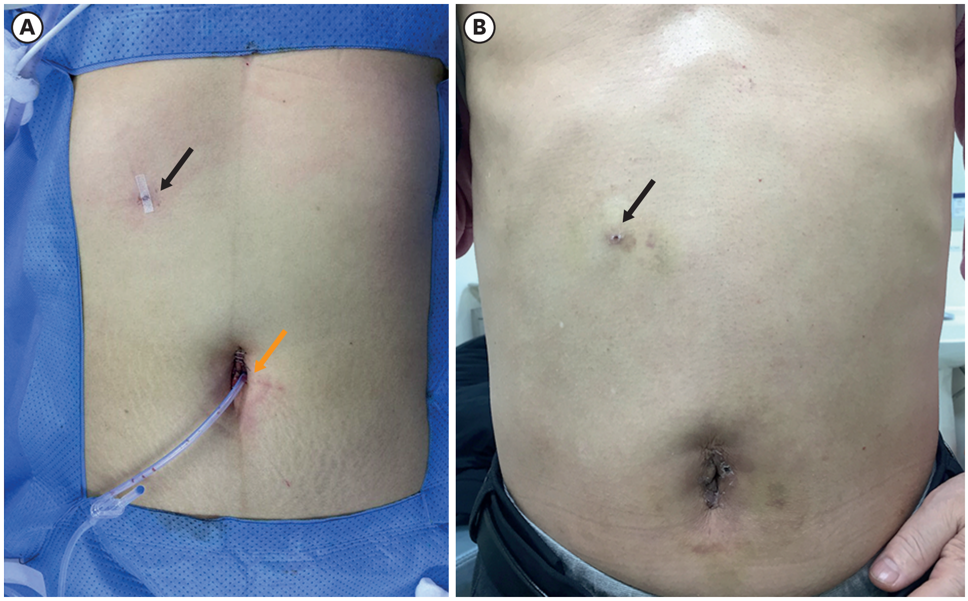

Fig. 3. Postoperative wound and scar of needle-assisted single-incision laparoscopic distal gastrectomy. (A) Immediate post-operative wounds. The Endo Relief[R] insertion site (black arrow) does not require suture. The drain is inserted into the umbilicus through a separate incision next to the main surgical incision. (B) Three weeks after surgery. The scar at the Endo Relief[R] insertion site is small. Except for the Endo Relief[R] insertion site, the scars are similar to those of single-incision laparoscopic distal gastrectomy.

operation time and, in the case that underwent combined operation, the operation time excluding the combined operation were also analyzed through a video review of the operation. Combined operation meant that other surgeries unrelated to gastric cancer were performed with that for the gastric cancer. The combined operations performed in this study included cholecystectomy and lipoma excision.

To distinguish the anastomosis time from the operation time, we reviewed the recorded video of the operation. However, the anastomosis time was not determined in one patient because no video of the operation was available. We also measured the combined operation time using the operation video in cases with a combined operation.

To evaluate scarring, telephone interviews were conducted using a modified version of the Patient and Observer Scar Assessment Scale [19]. We asked six questions grouped as follows: two questions on scar symptoms (pain and itching), three questions on the differences observed in normal skin (color, thickness, and irregularity of the scar), and one question on the overall opinion regarding the scar compared to normal skin. Scar symptoms were scaled from 0 ("no, not at all") to 10 ("yes, very much"). The differences observed in normal skin were scaled from 0 ("no, as normal skin") to 10 ("yes, very different"). The overall opinion regarding the scar compared to normal skin was scaled from 0 ("as normal skin") to 10 ("very different").

This retrospective study was reviewed and approved by the Institutional Review Board (IRB) of Chung-Ang University Hospital (IRB No. 1810-009-16212). All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and the Helsinki Declaration of 1964 and later versions.

We analyzed the distribution of each variable between the two groups using the Mann–Whitney U test for continuous variables and χ^2 test for categorical variables. Some variables

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required a nonparametric test such as Fisher's exact test. All statistical analyses were performed using SPSS (version 23.0; IBM Corp., Armonk, NY, USA). Statistical significance was set at P<0.05.

RESULTS

No differences in sex, BMI, tumor depth, T or N stage, number of retrieved lymph nodes, or number of metastatic lymph nodes were observed between the SILDG and NASILDG groups. The patients in the NASILDG group were significantly older than those in the SILDG group (67.9±10.9 years vs. 54.6±11.2 years, P=0.007). The ASA classification of patients was significantly higher in the NASILDG group than in the SILDG group (P=0.005). The participants in both the SILDG and NASILDG groups were clinically diagnosed with T1N0 disease, but pathologically after surgery, there was one T3 patient in the SILDG group and one N1 patient in each group (**Table 1**).

None of the patients underwent conversion to open gastrectomy or multiport laparoscopic gastrectomy, and D1 + lymph node dissection and intracorporeal Billroth I anastomosis were performed.

There were four combined operations, all of which were performed in the NASILDG group. The operation time was significantly shorter in the NASILDG group than in the SILDG group (138.3±25.0 min vs. 176.4±25.3 min P=0.002). The operation time without a combined operation was also significantly shorter in the NASILDG group than in the SILDG group. The anastomosis time was shorter in the NASILDG group than in the SILDG group (14.7±4.3 min vs. 28.0±6.1 min, P<0.001). Estimated intraoperative blood loss was greater in the NASILDG group than in the SILDG group. However, the immediate postoperative hemoglobin change or postoperative day 1 hemoglobin change, as well as the hematocrit change, was not significantly different between the two groups. The postoperative complication rate, which was classified according to the Clavien–Dindo classification, was not significantly different

Table 1. Clinicopathologic characteristics

Variables	SILDG (n=10)	NASILDG (n=15)	P-value
Sex			0.697*
Female	5 (50.0)	6 (40.0)	
Male	5 (50.0)	9 (60.0)	
Age (yr)	54.6±11.2 (37–76)	67.9±10.9 (52–84)	0.007†
ASA			0.005‡
1	4 (40.0)	0 (0.0)	
2	6 (60.0)	11 (73.3)	
3	0 (0.0)	4 (26.7)	
BMI (kg/m^2)	22.6±1.6 (19.9–26.6)	24.8±4.3 (18.5–33.2)	0.216†
T-stage			0.414‡
T1a	7 (70.0)	11 (73.3)	
T1b	2 (20.0)	4 (26.7)	
T3	1 (10.0)	0 (0.0)	
N-stage			1.000*
N0	9 (90.0)	14 (93.3)	
N1	1 (10.0)	1 (6.7)	
No. of retrieved LN	37.7±13.1 (13–60)	36.0±12.9 (19–63)	0.892†

Values are presented as number (%) or mean ± SD (min–max).SILDG = single-incision laparoscopic distal gastrectomy; NASILDG = needle-assisted single-incision laparoscopic distal gastrectomy; ASA = American Society of Anesthesiology; BMI = body mass index; LN = lymph node.
*Fisher's exact test; †Mann–Whitney U-test; ‡linear-by-linear association.

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Table 2. Operative and short-term postoperative outcome

Variables	SILDG (n=10)	NASILDG (n=15)	P-value
CoOP			0.357*
Cholecystectomy	0 (0.0)	3 (20.0)	
Lipoma excision	0 (0.0)	1 (6.7)	
None	10 (100)	11 (73.3)	
OP time (min)	176.4±25.3 (135, 206)	138.3±25.0 (105, 185)	0.002†
OP time without CoOP (min)	176.4±25.3 (135, 206)	134.1±20.2 (105, 165)	<0.001†
Anastomosis time (min)	28.0±6.1 (20, 39)‡	14.7±4.3 (9, 23)	<0.001†
PostOP hospital stay (days)	9.9±12.1 (4, 44)	8.5±5.9 (6, 28)	0.849†
Estimated blood loss (mL)	33.0±33.3 (0, 100)	75.3±47.2 (10, 200)	0.014†
Hb change POD1 (g/dL)	−1.2±0.6 (−1.9, 0)	−0.4±1.0 (−1.8, 1.7)	0.062†
HCT change POD1 (%)	−3.3±1.8 (−5.9, 0.2)	−1.4±3.6 (−5.5, 9.3)	0.091†
C-D classification			0.445§
0	7 (70.0)	12 (80.0)	
II	2 (20.0)∥	3 (20.0)¶	
IIIa	1 (10.0)**	0 (0.0)	

Values are presented as number (%) or mean ± SD (min–max).
SILDG = single-incision laparoscopic distal gastrectomy; NASILDG = needle-assisted single-incision laparoscopic distal gastrectomy; OP = operation; CoOP = combined operation; PostOP = postoperative; Hb = hemoglobin; POD1 = postoperative day 1; HCT = hematocrit; C-D = Clavien-Dindo.
*Fisher's exact test; †Mann–Whitney U-test; ‡n=9 because one operation video was lost; §Linear-by-linear association; ∥Wound complication; ¶Wound complication, delayed gastric emptying, urinary retention; **Pancreatic fistula.

between the two groups. However, a pancreatic fistula developed in one patient in the SILDG group. The duration of postoperative hospital stay was not significantly different between the two groups (**Table 2**).

Fig. 4 shows the operation time in the order of cases. Through video review, the total operating time, excluding the time for the combined operation and the time spent on anastomosis to connect the stomach and duodenum, was displayed in the order of the cases performed. The total operation time was stably short after using NASILDG, and the anastomosis time was significantly shorter with NASILDG than with SILDG. In the first case

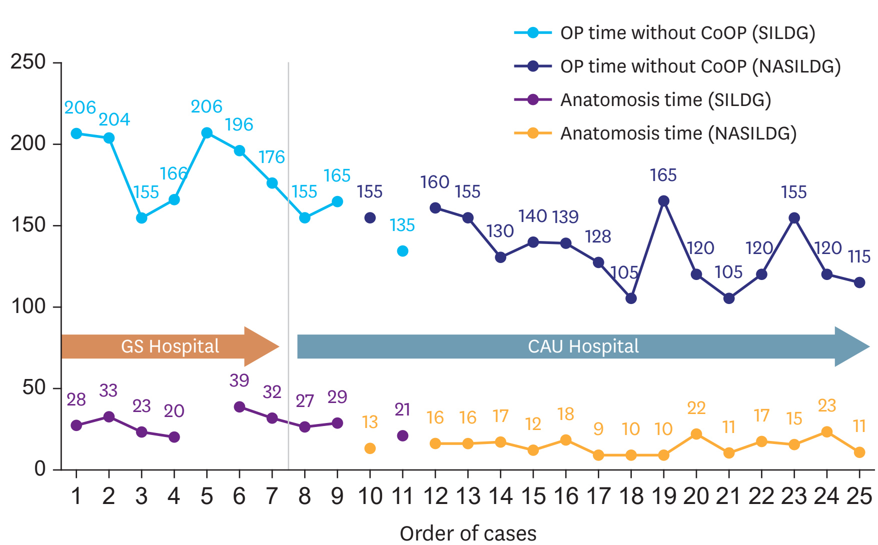

Fig. 4. Change of operation time and anastomosis time according to order of cases. Operation time is presented in minutes and OP time without CoOP is the total operation time including anastomosis time without combined operation.
OP = operation; CoOP = combined operation; SILDG = single-incision laparoscopic distal gastrectomy; NASILDG = needle-assisted single-incision laparoscopic distal gastrectomy; GS Hospital = Gangnam Severance Hospital; CAU Hospital = Chung-Ang University Hospital.

Table 3. Complaint of scar

Variables	SILDG (n=8)	NASILDG (n=14)	P-value
Duration from OP (mon)	26.0±6.7 (15.6–33.9)	8.3±3.4 (1.9–14.1)	<0.001
Pain Has the scar been painful for the past few weeks?	0.0±0.0 (0–0)	0.2±0.6 (0–2)	0.616
Itching Has the scar been itching the past few weeks?	0.0±0.0 (0–0)	0.0±0.0 (0–0)	1.000
Color change Is the scar color different from the color of your normal skin at present?	1.1±1.8 (0–5)	0.7±2.7 (0–10)	0.297
Thickness Is the thickness of the scar different from your normal skin at present?	0.0±0.0 (0–0)	0.3±0.6 (0–2)	0.441
Irregularity Is the scar more irregular than your normal skin at present?	0.6±1.8 (0–5)	0.0±0.0 (0–0)	0.664
Overall opinion What is your overall opinion of the scar compared to normal skin?	1.3±1.8 (0–5)	0.1±0.5 (0–2)	0.110

SILDG = single-incision laparoscopic distal gastrectomy; NASILDG = needle-assisted single-incision laparoscopic distal gastrectomy; OP = operation.
P-value from Mann–Whitney U-test.
Scale: 0 to 10.

of NASILDG, the anastomosis time clearly decreased in the subsequent cases. Compared with the last case of SILDG, the first case of NASILDG had a longer overall operation time but shorter anastomosis time, despite the last case of SILDG performed after NASILDG.

There was no significant difference between the two groups in all parameters in the evaluation of scars checked by phone; however, there was a significant difference in the time of conducting the telephone interview. Interviews were conducted after an average of 26 months in the SILDG group and 8.3 months in the NASILDG group ($P<0.001$) (**Table 3**).

DISCUSSION

This study demonstrates that NASILDG is not cosmetically inferior to SILDG, which is cosmetically the best precursor at present, and has excellent ergonomics, as shown by the significantly shorter surgical time and duration of anastomosis, which is a complicated process. There have been no comparative studies of NASILG and SILG, and the present study suggests that NASILDG should be preferred over SILDG for stable patient outcomes because it has a similar cosmetic result and is more convenient to perform.

SILDG was first reported in Japan in 2011 and Korea in 2012 [9,10]. Since then, it has been performed to achieve cosmesis and lessen the invasiveness of laparoscopic procedures. However, SILDG has been implemented in only a few institutions and has not been widely adopted [20]. SILDG procedures have some limitations, including instrument interference and difficulty in visualizing the operative field [21]. Additionally, SILG for early gastric cancer was found to have a longer operative time than conventional multiport laparoscopic gastrectomy [9,22]. Lymphadenectomy for the treatment of suprapancreatic lesions using the single-incision laparoscopic method is technically demanding owing to the narrow angle between the dissection plane and instrument axis. We initially experienced the abovementioned difficulties with SILDG, but considering the excellent cosmetic advantages and reduced wound pain, we considered the difficulties as tolerable and bound to resolve after the learning curve period. However, as we gradually gained experience, the greatest challenge was that the pancreas was excessively compressed during the lymph node dissection at the upper border. In the case of a patient with a bulging pancreas on the ventral

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side, while the navel was located considerably below, the instruments inserted into the umbilical incision would unavoidably compress the pancreas to reach and dissect its upper border lymph nodes, which may theoretically damage the pancreas (**Fig. 2**, Multimedia 1). Therefore, an advanced needle grasper was used. If one needle grasper is added to the SILDG, one of the operator's instruments can be removed from the umbilical wound to accommodate the assistant's instrument without significant interference. The assistant's device can then pull the pancreas toward the dorsal and caudal sides to prevent excessive compression of the pancreas when performing lymph node dissection on its upper border (**Fig. 2**, Multimedia 1). In this study, no complications occurred in patients in the NASILDG group compared with those in the SILDG group (pancreatic fistula) (**Table 2**).

The advanced needle grasper also has a thin shaft, but unlike the existing needle grasper, its jaw is similar to that of a conventional 5-mm grasper, which allows adequate tissue handling and manipulation. It is very useful, but has some weaknesses compared to the conventional 5-mm grasper: the gripping force is weaker and the shaft bends well; therefore, it may feel weak when grabbing and pulling the tissue. In addition, in patients with a thick abdominal wall, the needle grasper itself may not function because of the resistance of the abdominal wall. In these cases, a 3-mm trocar can be used for better operation. Moreover, it is difficult to replace the grasper during surgery.

In SILDG, collisions and interference occur between instruments. However, many problems with SILDG have been resolved in NASILDG. Thus, the operation time was significantly shorter in the NASILDG group. Although the reduction in the operation time may be attributed to the learning curve of the surgeon, we believe that NASILDG is more responsible for this, as evidenced by the significant reduction in the anastomosis time in the first case and the maintenance of a shorter anastomosis time since the first case (**Fig. 4**). Anastomosis is one of the most difficult procedures in SILDG, as the application of the stapler is challenging because of the narrow angle among the instruments that go through the umbilical incision. Hence, stapling has been performed while applying traction using sutures; however, suturing itself using a single-incision laparoscopic method is not easy [21]. By adding a needle grasper, the number of sutures required for adequate traction can be reduced, and suturing is less difficult because there is less interference among the instruments. Thus, anastomosis time, which is a particularly complex process, can be dramatically reduced. The overall operation time was significantly reduced by the addition of an assistant, non-use of other tools for tissue traction in the abdominal cavity, and less interference among instruments during the entire process.

There was no difference in the subjective evaluation of scars performed through telephone interviews between the two groups. No studies have compared scarring between SILG and NASILG. A previous study compared SILG with conventional multiport laparoscopic gastrectomy (CLG) and found that SILG was superior to CLG [23]. However, in this study, the cosmetic results of SILG and NASILG were comparable, and there was no difference between the two groups. In fact, the needle grasper incision was very small and did not require stitching, which became almost invisible over time; thus, there was very little possibility of a cosmetic difference [24]. Because the study was conducted retrospectively, there was a significant difference between the two groups in terms of the period from surgery to scar evaluation. However, since the evaluation was performed at least 1.9 months after the surgery, it was considered that the wound healing process was completed, so the difference in time interval was not considered to be significant (**Table 3**). Even if there was an effect, it should be noted that the NASILDG group was at a disadvantage as they had a shorter evaluation period.

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Estimated intraoperative blood loss was greater in the NASILDG group than in the SILDG group. This is because there was a difference in the method of estimating blood loss for each institute as the operator changed institutes (**Fig. 4**). Therefore, we compared the changes in hemoglobin and hematocrit levels before and after surgery and on the first day after surgery. Although not statistically significant, the hemoglobin and hematocrit in the SILDG group showed a greater decrease (**Table 2**). However, it cannot be said that actual bleeding is higher in NASILDG.

This study was a retrospective case review. As the operator changed institutes in the middle of the study period, the analysis and evaluation of the variables were based on the differences in each institution, and the change in the surgical teams must have had some effect. Moreover, it is difficult to completely rule out the effects of the learning curve. Furthermore, to discuss the advantages of NASILDG, we inevitably compared it with SILDG, but concrete evidence cannot be provided because of the small number of cases.

In conclusion, NASILDG may not be inferior to SILDG in terms of cosmetic results; however, its operative convenience is better than that of SILDG. Therefore, NASILDG can be recommended as a method to reduce the technical difficulty of SILDG for patients with early gastric cancer.

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