

Single incision gastrectomy for gastric cancer

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Abstract: Based on rapid development of laparoscopic techniques and instruments, single-incision laparoscopic surgery (SILS) is expected to be the next step of “more” minimally invasive surgery. A few institutions gradually started to report their experience of single incision gastrectomy (SIG) for gastric cancer, but it is still difficult to accept that SIG can be performed as a popular procedure because of its technical difficulty. For wide adoption of SIG, the simplicity, safety and reproducibility of not only lymph node dissection but also reconstruction should be evaluated compared to a conventional procedure. With a thorough understanding of unique characteristics of SILS, single incision distal gastrectomy (SIDG) for early gastric cancer performed by laparoscopic surgeons with advanced technique is expected to have promising potential about excellent cosmesis, comparable morbidity and mortality in carefully selected patients. For appropriate adoption and steady progress of this state-of-the art surgery, scientific evaluation with healthy critics is necessary with new generation of SILS instrument platform.

Keywords: Single-incision laparoscopic surgery (SILS); gastric cancer; single incision distal gastrectomy (SIDG); minimally invasive surgery

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Introduction for single-incision laparoscopic surgery (SILS)

Laparoscopic gastrectomy has been known to have several advantages, including less postoperative pain, better cosmesis, less inflammatory reaction, rapid recovery of bowel function, and fast recovery compared to conventional open surgery (1). For early gastric cancer, laparoscopic gastrectomy and lymph node dissection is considered safe and comparable procedure in terms of postoperative outcome even in large scale randomized clinical trial, and also expected to show promising long-term survival outcome (2-4). Technically, laparoscopic gastrectomy may be feasible and gradually standardized even for advanced gastric cancer (5).

Owing to rapid development of laparoscopic instruments and techniques, SILS could be expected to be the next step of “more” minimally invasive surgery and also becoming an academic issue recently (*Figure 1*).

The first adoption of SILS starts from the early 1990's (6). However, it took long time for this novel approach using single umbilical incision to be generalized because of technical difficulties with unstandardized surgical procedures and limitation of laparoscopic instruments. Especially, SILS has typical disadvantage including the lack of “triangulation” among instruments and camera scope, and extremely narrow range of motion around a single port, which may lead to collision among each instrument, uncomfortable or limited surgical view, unnecessarily larger umbilical incision and lack of assistance.

In terms of general surgery including appendectomy or cholecystectomy, recent several studies have reported that SILS is feasible and has similar surgical outcome without increasing significant complication (7-10). In terms of malignancy of digestive tract, SILS has been eagerly investigated in colorectal cancer and showed comparable outcome in a few studies including randomized clinical trial

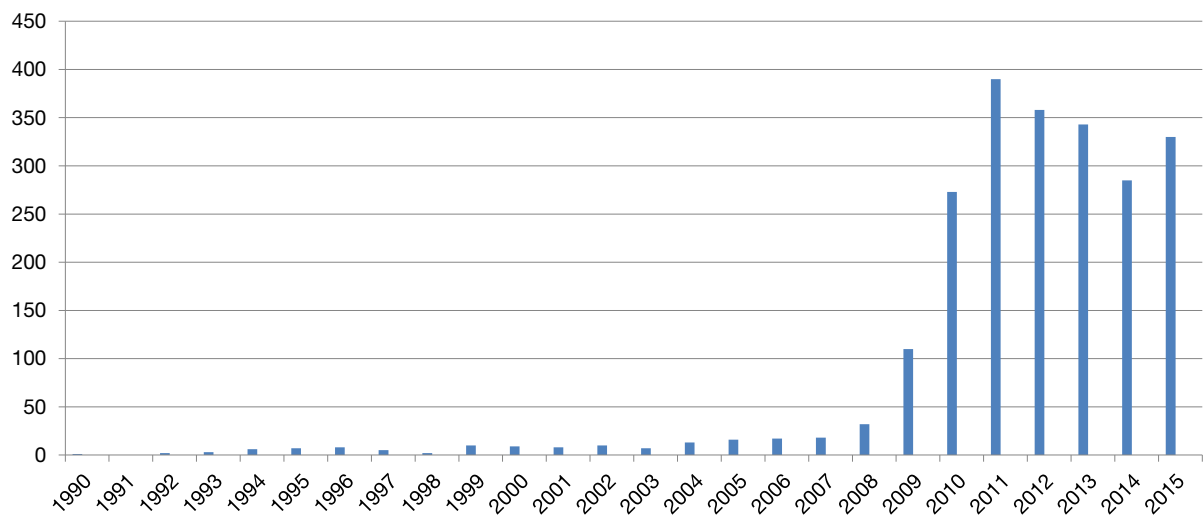


Figure 1 Time trends of the number of searched reports using keyword of “single incision laparoscopic” from 1990 to 2015 using PubMed as of January, 2016.

or matched retrospective study, even though the number of sample size was limited (11-14).

Single incision distal gastrectomy (SIDG)

For gastric cancer, SIDG with lymph node dissection was firstly reported in 2011 (15). Nowadays a few institutions gradually started to report their experience, but it is still difficult to accept that SIDG can be performed as more popular procedure (*Table 1*).

Gastric cancer surgeries consist of three major parts including lymph node dissection, gastrectomy, and reconstruction. Compared to other surgeries in gastrointestinal tract, there are more complicated guidelines for lymph node dissection around major nominated vessels and various ways of laparoscopic reconstruction in laparoscopic gastric cancer surgery which are continuously investigated and modified (26-28). To evaluate feasibility of SIDG for gastric cancer, we should consider these troublesome characteristics and its adequate solution in advance.

Prerequisites

Usually SILS requires at least 2.5 or 3 cm sized umbilical incision which is significantly much larger incision than conventional laparoscopic surgery. Therefore, many surgeons concerned that single wound complication including incisional hernia. However, resected stomach, several stations of lymph nodes and omentum consists of

bulky specimen compared to relatively small appendix or gallbladder, or uniformly tubular structure of colon or rectum. To retrieve that bulky specimen without squeezing, current multiport laparoscopic gastric cancer surgery usually requires at least 2.5–3 cm sized incision, which means single incision laparoscopic gastric surgery does not require any extension of periumbilical wound and only omits other multi ports. Therefore, it may be more favorable situation for gastric surgery to adopt SILS compared to other intestinal surgeries. According to previous studies, there are several prerequisites to adopt SIDG as of now.

Firstly, in case of conventional rigid 30-degree laparoscope, energy device and camera scope almost always parallel to the surgical “point of interest” and very close between each other, which may lead to frequent collision and hinder the safe surgical view. To avoid this collision among grasper, energy device, stapler and camera system, the tip (camera) of the laparoscope should be located as much as far from other devices. Therefore, flexible laparoscope seems to be a nearly mandatory instrument. During the SILS, frequent movement of camera scope is more limited compared to conventional multiport laparoscopic surgery because of collision of instruments. Recently developed 3D scope system could be useful in terms of superior task efficiency because it can show more effective perspective and depth of field to operator, which means the decreased number of “air-catching” and less position change of camera scope (29-31). Secondly, the length and shape of instrument can be chosen depending

Table 1 Previous historical reports of single incision distal gastrectomy for gastric cancer

Year	Publication	Author	Country	Pure or additional	Anastomosis	n	Analysis
2015	<i>J Gastric Cancer</i> (16)	Suh <i>et al.</i>	Korea	Pure	11 for Billroth I (uDelta); 5 for Roux-en Y	16	Comparative study (Billroth I vs. Roux-en Y)
2015	<i>Surg Endosc</i> (17)	Kim <i>et al.</i>	Korea	Pure	Billroth I	48	Comparative study (vs. 46 reduced ports)
2014	<i>J Am Coll Surg</i> (18)	Ahn <i>et al.</i>	Korea	Pure	42 for Roux-en Y; 8 for Billroth I	50	Comparative study (vs. 50 multiports laparoscopic distal gastrectomy)
2014	<i>J Am Coll Surg</i> (19)	Ahn <i>et al.</i>	Korea	Pure	Roux-en Y	22	Single arm, feasibility
2014	<i>J Gastrointest Surg</i> (20)	Omori <i>et al.</i>	Japan	With assistance	Billroth I, linear (intact)	45	Single arm, feasibility
2014	<i>Ann Surg Treat Res</i> (21)	Ahn <i>et al.</i>	Korea	Pure	Roux-en Y	14	Single arm, D2 LND with mid pancreas mobilization
2013	<i>J Laparoendosc Adv Surg Tech A</i> (22)	Kong <i>et al.</i>	China	Pure	Billroth II	4	Case report with D2 LND
2012	<i>Surg Laparosc Endosc Percutan Tech</i> (23)	Park <i>et al.</i>	Korea	2 mm additional	Billroth I (delta anastomosis)	2	Case report with D1 + β LND
2012	<i>Surg Endosc</i> (24)	Omori <i>et al.</i>	Japan	2 mm additional	Billroth I (efficient purse string)	20	Single arm, feasibility
2011	<i>Surg Innov</i> (25)	Ozdemir <i>et al.</i>	UK	Pure	Billroth II	1	Case report with D1 + α LND
2011	<i>Surg Endosc</i> (15)	Omori <i>et al.</i>	Japan	2 mm additional	1 for Roux-en Y and 6 for Billroth I; (efficient purse string)	7	Single arm, feasibility

LND indicates lymphadenectomy.

on the situation. “Collision” is always problematic issue not only inside the peritoneal cavity but also outside the port in SILS. If possible, longer devices including energy device are much more useful to avoid collision among devices outside the port, because instruments longer than 40 cm makes wider gap between two hands of operator compared to conventional instruments. During the SILS, conventional linear grasper sometimes cannot effectively reach small lymph nodes around suprapancreatic area due to collision of energy device or protruded pancreas body with low lying umbilicus. For such cases, bending graspers are occasionally helpful to perform meticulous dissection of those lymph nodes. However, operator should be competent to perform “cross-handed manipulation” of instruments which is sometimes obviously required and also offers more various way of approach under limited surgical field. Lastly, operator should accustom himself to surgical procedure with minimal assistant, especially making good surgical field. To make good surgical field without any special assistant, frequent position change and subsequent

traction using gravity should be utilized, and skillful usage of one left-handed grasper is important to make critical surgical field. However, obese patients who have much visceral fat are still not be a recommendable indication for SIDG because huge amount fat including possible metastatic lymph nodes is big hurdle to make clear surgical field without effective assistance.

Lymphadenectomy

For early gastric cancer located in lower one-third of the stomach, D1 or D1+ lymph node dissection is required according the Japanese gastric cancer treatment guideline (26). One of the most important stations is station #6 around right gastroepiploic vessels. Because the root of right gastroepiploic vessels is slightly right side from the midline, the approach to the station #6 is usually performed using left side approach which is preferred by some Japanese surgeons (32,33). Using the gravity with right side upward position, dissection of station #6 including soft tissue at

the anterior surface of pancreas head can be performed safely. However, regarding the dissection of suprapancreatic lymph nodes, the neck and body of pancreas is sometimes significantly protruded, which make it difficult to approach the lymph nodes behind that pancreas using a straight energy based device from down the umbilicus. Especially, station #11p is troublesome area for complete dissection if the proximal part of splenic artery is tortuous. In our early experience, one patient was readmitted after discharge because of splenic artery pseudoaneurysm, and underwent reoperation with intensive care. This type of unique complication that might result from thermal damage by the various energy device was already reported even in a previous large scale study of laparoscopic distal gastrectomy with lymph node dissection (34,35). In particular, during SIDG, use of an energy-based device should be minded with much more caution because there is no effective assistance to avoid possible thermal injury to adjacent tissues, including major vessels. Because dissection of #11p is not mandatory for complete dissection in distal third early gastric cancer, strict indication for early gastric cancer and rather incomplete, safe exploration around station #11p with careful usage of energy device might be more safe approach to adopt SIDG for gastric cancer as of now (26). As an alternative, mid-pancreas mobilization, somewhat aggressive mobilization for early gastric cancer, was recently introduced for complete dissection of #11p LN (21).

Reconstruction

For the generalization of a new procedure such as SIDG, the simplicity, safety and reproducibility of not only lymph node dissection but also reconstruction should be evaluated compared to a conventional procedure (17). Regarding reconstruction, to consider procedure generalization, gastroduodenostomy or gastrojejunostomy should be equivocally evaluated after SIDG. Compared to Billroth II or Roux-en Y anastomosis using gastrojejunostomy, Billroth I anastomosis using gastroduodenostomy has been known to offer such advantages as more simple, less anatomical change after anastomosis, more physiological food passage and a lower incidence of internal hernia or adhesion and is consequently the most common anastomosis technique after distal gastrectomy in Korea and Japan, even in expert groups (33,36).

Compared to gastroduodenostomy, gastrojejunostomy can be relatively simple procedure, and most of studies on the initial experience with SIDG preferred BII or Roux-en Y reconstruction using gastrojejunostomy (19,22,25). In

laparoscopic surgery, gastroduodenostomy has been usually considered as a more difficult technique because of the limitation of the intracorporeal approach with a circular stapler as well as the narrow working space around the duodenal stump. One of the well-established intracorporeal gastroduodenostomy, Delta-shaped anastomosis still requires advanced assistance because that assistant usually manipulates remnant stomach as well as staplers for reconstruction itself (37-39). In addition, it is more difficult to expect such advanced-assistance dependent procedure in SIDG, and one more small assistance grasper is likely to result in more collision because it makes narrow port space more crowded. Therefore, there have been limited number of original experience or modification of Billroth I anastomosis after SIDG, and reproducibility of gastroduodenostomy in pure SIDG still seems to be doubtful (20,23,24). We reported our novel technique for gastroduodenostomy, “unaided delta-shaped anastomosis”, without any additional port or intracorporeal assistance for pure SIDG, and also hope this technique will contribute to reproducible establishment of gastroduodenostomy in SIDG after validation (17).

Outcome and understanding

Regarding the outcomes of SIDG for gastric cancer, there have been only a few comparative studies (16-18). Two studies comparing SIDG and multi (three or more) port totally laparoscopic distal gastrectomy (TLDG) reported similar operation time and comparable complication rate (16,18). Regarding the oncologic outcome, the numbers of retrieved lymph nodes were similar between SIDG and TLDG in both studies. Interestingly these two studies showed similar operation time of SIDG (144.5 ± 35.4 and 135.3 ± 18.8 minutes) compared to TLDG (140.3 ± 36.3 and 132.8 ± 27.0 minutes). However previous report of large scale randomized clinical trial performed by a “master class” group reported mean operation time of LADG as 184.7 ± 55.0 minutes, which is much longer than that of SIDG studies (2,40). Considering standard deviation of 55.0 minutes, only limited population with shortest operation time in that trial may have similar operation time to SIDG studies. Therefore, recent limited reports of SIDG may have been understood as those results could be achieved only after the limited surgeons who have advanced skill for laparoscopic surgery carefully selected “surgeon-friendly” patients, and not be easily generalized for laparoscopic surgeons with insufficient

experience as of now. In addition, even though previous studies of SIDG reported comparable morbidity and absence of open/multiport conversion, low competency for unexpected intraoperative accident in pure single port surgery still cannot be ignored. Single incision gastrectomy (SIG) usually requires least number of personnel, only one scopist and scrub nurse, in operating theatre. This procedure might receive any attention as “economically-efficient” surgery for a while (41,42). However, low competency for intraoperative accidents including critical bleeding in SIDG is inevitable which is similar or more serious situation to that in transition period from open surgery to early laparoscopic surgery. In addition, considering the first step of standardization of surgical procedures are education and consensus, this dramatic advances in laparoscopic surgery has a tendency to longer distance trainees from the patient and especially assistant has none or least participatory role in SIG, which may result in much steeper learning curve for laparoscopic surgery in the future (43,44).

To evaluate outcome of surgical procedure, the measurement of quality of life (QOL) is one of the most important issues, which will guide us from the comfort of previous medicine into a world that is less concrete and less controllable, but more human (45,46). However, the objective and reproducible evaluation of QOL is not easy, especially in minimally invasive surgery or simple basic surgical procedure. Recently, for cholecystectomy, double-blinded RCT evaluating QOL between single-port cholecystectomy and conventional laparoscopic cholecystectomy was firstly reported (10). Using previously validated cosmesis and body image scores, and short form 36 health survey questionnaire SF-36, this study reported the statistical advantage of cosmesis and body image, higher QOL regarding emotional wellbeing, physical pain, physical health and mental health after postoperative 1 year, and less postoperative pain in single port cholecystectomy (47-49). However, quality of life in SIDG compared to TLGDG was not comprehensively evaluated until now. Only regarding postoperative pain, previous two studies reported inconsistent results and difference of VAS score is less than 1 point in even significant result (16,18). In the future, scientific evaluation of QOL will guide us to more reasonable assessment of outcome of this state-of-the-art procedure.

Single incision total gastrectomy

The case report of pure single incision total gastrectomy

for proximal early gastric cancer was firstly reported in 2014 (50). Collision of each instrument is expected to be more serious and making good surgical field also more difficult, however authors reported similar operation outcome compared to conventional multiport laparoscopic total gastrectomy. Obviously total gastrectomy has been known as a surgical technique with more significant morbidity and mortality compared to distal gastrectomy. Because this report is the only study based on single institution’s early experience as of now, hasty adoption with distorted attraction to new technique should be postponed if it were not for enough experience of SIDG or other pure SILS.

Conclusions

As of now, SILS is one of the closest approaches to the ideal concept of “scarless” surgery. With a thorough understanding of unique characteristics of SILS, SIDG for gastric cancer performed by laparoscopic surgeons with advanced technique is expected to have promising positive potential about excellent cosmesis, comparable morbidity and mortality in carefully selected patients. For appropriate adoption and steady progress of this state-of-the-art surgery, scientific evaluation with healthy critics is necessary with new generation of SILS instrument platform. Lastly, we have to keep in mind that the long term outcome of a large scale randomized clinical trial comparing “conventional” multiport laparoscopic distal gastrectomy and open distal gastrectomy for early gastric cancer is still waiting for us before SIDG (2).

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Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

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