

Surgical decisions and quality of life after gastrectomy for gastric cancer: update from Asian studies

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Abstract

Gastric cancer (GC) remains one of the most common and deadly cancers worldwide, especially in Asia. With improvements in long-term survival, the importance of quality of life (QOL) as an outcome measure has been refocused as a consideration of academic interest. This article summarizes the most common GC quality of life metrics and further reviews previous Asian studies and aims to provide an update on the different surgical decisions made related to postgastrectomy QOL. Significant progress has been made in defining and measuring the QOL by multiple quality of life questionnaires. Various surgical factors such as the extent of resection, degree of lymph node dissection, and reconstruction methods are involved in the severity of QOL. Several ongoing trials, especially randomized controlled trials, may improve our understanding of the different surgical decisions made related to postgastrectomy QOL. Reducing resection extent can mitigate postgastrectomy syndromes (PGS) by preserving gastric function and physiology and may translate to better QOL in appropriate GC patients. Patients may benefit from minimally invasive surgery and have better QOL, prospective randomized controlled studies are however still needed.

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Introduction

Gastric cancer (GC) remains the fifth most frequent cancer and fourth in cancer-related deaths^[1]. Surgery still represents the mainstay of curative treatment for GC. With improvements in long-term survival, the importance of quality of life (QOL) as an outcome measure has been refocused as a consideration of academic interest. Some GC patients who have received gastrectomy suffer from distinct, subjective symptoms (such as nausea, reflux, early satiety, and diarrhea). These symptoms are called postgastrectomy syndromes (PGS) which impair the QOL of patients. Various surgical factors, such as the extent of resection, degree of lymph node dissection, and reconstruction methods are involved in the severity of QOL. Thus, a key goal of surgical decision-making is to better achieve good symptomatic control and better QOL. Many kinds of modified gastrectomy (such as gastrectomy preserving the bursa, pylorus, vagal nerve, and omentum) and anastomotic procedures (such as jejunal interposition and jejunal pouch interposition), have been performed from the perspective of patient's QOL^[2].

The prevalence of GC differs among regions worldwide, with more than 50% of cases occurring in Eastern Asia, especially in Japan, South Korea, and China^[3]. Japan and Korea have emerged as leaders in the global efforts to prevent, diagnose, and treat GC, setting an example for Chinese doctors to learn from. Much attention has been paid to the ability of surgery to cure GC in these countries. There are some differences in GC between these countries. More than 80% of patients are diagnosed at an advanced stage in China^[4]. With national programs for GC screening, the rate of diagnosis and treatment of early GC in Japan and Korea is relatively high^[5,6]. Japan, Korea, China, and other Asian countries have been paying attention to the QOL after GC surgery for a long time^[7–9]. Many instruments evaluating the QOL of GC patients have been

developed and more attention to surgical factors has been given to this by these countries^[10,11].

In the last three decades, interest has significantly increased in the creation and validation of QOL questionnaires specific to GC surgery, particularly in Asian nations. Nonetheless, the understanding of the interpretation and practical application of QOL measurements related to GC surgery remains limited^[12]. Incorporation of these results into surgical decisions is frequently underused. In this article, the most common GC QOL metrics are summarized and previous Asian studies further reviewed to provide an update on the different surgical decisions made related to postgastrectomy QOL.

Methods

Literature search

To identify the current status of QOL of GC surgery in Asia, a systematic search was carried out on PUBMED for publications from the past 30 years. Search terms included the MESH terms 'stomach neoplasms', 'surgery', and 'quality of life', and the following free text searches: gastric cancer, stomach cancer, gastric neoplasm, gastric malignancy, stomach malignancy, life quality, and health related quality of life, were made in several combinations. Only English language articles stating the QOL of GC surgery from Asian countries were included in the analysis. The frequency of use of QOL survey metrics was determined by the number of articles obtained through the query. These metrics were categorized into three groups: low-frequency, moderate-frequency, and high-frequency. The low-frequency category included metrics that were mentioned in less than five articles. The moderate-frequency category included metrics mentioned in 5–10 articles. Finally, the high-frequency category included metrics mentioned in more than 10 articles.

Survey metrics

Many instruments have been developed that purport to measure QOL. Assessment of postoperative QOL for GC generally includes several conceptual domains of QOL: systemic symptoms, gastrointestinal symptoms, social and mental health, and overall functioning. This is important in determining the broad health-related implications of GC and postoperative QOL^[13]. Detailed descriptions of QOL assessment instruments for GC surgery are summarized in Table 1.

Gastrointestinal Symptom Rating Scale (GSRS)

The GSRS scale, which was created and validated in Sweden in 1988, is a rating scale used to assess various gastrointestinal symptoms. The GSRS is a specific tool for diseases, comprising of 15 items categorized into five symptom clusters that illustrate reflux, abdominal pain, indigestion, diarrhea, and constipation. The scale of GSRS adopts a Likert-type format with seven points, where 1 indicates the absence of bothersome symptoms and 7 represents highly troublesome symptoms. Studies have provided evidence demonstrating the reliability and validity of the GSRS, while reference values for the general population can be found^[14,26].

Quality of Life Questionnaire(QLQ)-C30 and QLQ-STO22

The European Organization for Research and Treatment of Cancer (EORTC) developed the QLQ-C30 in 1993, a self-administered structured questionnaire comprising 30 items that primarily focused on physical symptoms. It is suitable for self-administration and can be used across various cultural settings. The domains addressed in the questionnaire encompass physical, role, cognitive, emotional, and social functions. Furthermore, it also incorporates symptom domains including fatigue, pain, as well as nausea and vomiting. The questionnaire also assesses global health and QOL and consists of six single items addressing dyspnea, insomnia, appetite loss, constipation, diarrhea, and financial difficulties^[15].

In 2001, alongside the QLQ-C30, a gastric-cancer specific instrument called QLQ-STO22 was developed^[16]. QLQ-STO22 explores five domains: dysphasia, pain/discomfort, dietary restrictions, upper gastrointestinal symptoms, and specific emotional problems. However, there are a few considerations to be made. Firstly, since 2001,

treatment strategies have significantly evolved, with precision medicine and minimally invasive surgery becoming more prominent. Secondly, the development of the STO22 did not involve specialists and patients from East Asia. Hence, the original version might not adequately address the QOL concerns specific to East Asian patients. As a result, it might not accurately assess the Health-Related Quality of Life of patients currently undergoing treatment. To address this, the EORTC QOL group has collaborated with the EORTC Gastrointestinal Tract Cancer Group and the Japan Clinical Oncology Group (JCOG) to update STO22^[27].

Functional Assessment of Cancer Therapy-General (FACT-G)and FACT-Gastric (FACT-GA)

The measurement instrument FACT-G was created to assess the QOL in cancer patients who are undergoing therapy. It consists of 27 items which are rated on a scale ranging from 0 to 4. The subscales of the instrument encompass physical well-being, social/family well-being, emotional well-being, functional well-being, and overall QOL^[18].

A modified version of FACT-G, known as FACT-GA, was introduced in 2004 specifically for evaluating QOL in patients with GC. The FACT-GA module comprises 19 items focused on GC, which complement the existing 28-item FACT-G core questionnaire. When combined, these two questionnaires result in a total of 47 items. Additionally, the 19-item subscale within FACT-GA (referred to as GCS) explores symptoms related to GC and adverse effects associated with its treatment^[19,20]. To gather information on QOL-related aspects from the past week, FACT-GA items are presented as statements for patients to recall (similar to QLQ-STO22). While QLQ-30 and QLQ-STO22 prioritize functional aspects, FACT-GA places more emphasis on social and emotional issues^[19].

Gastrointestinal Quality of Life Index (GIQLI) scale

First published in 1995, the GIQLI questionnaire underwent development and validation in Germany as a measure of QOL specifically designed for individuals with various gastrointestinal (GI) disorders. Comprising a total of 36 items, this questionnaire delves into diverse aspects such as GI and non-GI symptoms, physical functionality, psychological state, and social well-being. It is important to note that this survey does not differentiate between specific GI ailments and exhibits limited specificity when used with cancer patients. Over

Table 1. Quality of life related to gastric cancer surgery.

Metric	Year	No. of questions	Advantages	Disadvantages	Frequency of use
GSRS ^[14]	1988	15	Specifically developed to address symptoms; Relatively brief	The validity for the GSRS has not been established at the time	Moderate
QLQ-C30 ^[15]	1993	30	The only English questionnaire related to cancer at that time	Combining with QLQ-STO22, too many problems, need a longer time	High
QLQ-STO22 ^[16,17]	2001	22	It focuses on upper gastrointestinal symptoms and is applicable to all aspects of multi-mode gastric cancer treatment	Combining with QLQ-C30, too many problems, need a longer time	High
FACT-G ^[18,19]	1993	28	Covers broader dimensions that are important to quality of life, such as social and emotional factors	Repeated testing is not feasible	Low
FACT-GA ^[19,20]	2011	19	Suitable for repeated testing	Focuses on social and emotional aspects	Low
GIQLI ^[21]	1995	36	Wide applicability, the results can be used to measure the subjective well-being of patients	It is impossible to distinguish specific types of gastrointestinal disease.	Low
DAUGS32 ^[22–24]	2005	32	At that time, it was the only evaluation tool used to evaluate the postoperative quality of life of upper gastrointestinal tumors. This scale could help doctors and their families to choose better surgical methods to reduce the symptoms of postoperative gastrointestinal dysfunction	Not suitable for long postoperative follow-up; pays more attention to symptoms and lack of problems related to postoperative life status and quality	Low
PGSAS-45 ^[10]	2015	45	The only comprehensive questionnaire suitable for evaluating patients after different types of gastrectomy or reconstruction	Too many problems, need a longer time	High
PROMIS ^[25]	2004	> 300	appropriate for patients with a wide variety of chronic diseases and conditions	No specific evaluation for gastric cancer	Low

time, despite its widespread applicability, the GIQLI tool has gradually been supplanted by more cancer-specific indicators among GC patients^[28].

Dysfunction After Upper Gastrointestinal Surgery for Cancer (DAUGS32)

DAUGS32 is a questionnaire developed in 2005 by Japanese scholars. It consists of 32 items and is specifically designed to identify post-operative gastrointestinal dysfunction issues. Unlike other questionnaires like STO-22 and FACT-GA, DAUGS32 solely focuses on gastrointestinal symptoms such as reflux, gastric dumping, digestive difficulties, nausea and vomiting, and lower gastrointestinal symptoms. It does not include a more general cancer QOL questionnaire^[22–24]. The questionnaire has been validated to measure the QOL in patients who have undergone upper gastrointestinal surgery for cancer.

Postgastrectomy Syndrome Assessment Scale (PGSAS-45)

The Japan Postgastrectomy Syndrome Working Party (JPSWP) was established to closely examine the symptoms and lifestyle changes experienced by patients who have undergone gastrectomy. One of the main outcomes of the JPSWP's research is the development of a new questionnaire called the Postgastrectomy Syndrome Assessment Scale (PGSAS)-45. The extensive questionnaire consists of 45 questions, featuring eight questions derived from the 8-Item Short-Form Health Survey (SF-8), 15 questions from the GSRS, and 22 clinically significant questions chosen by the JPSWP. These 22 selected items cover various aspects of postgastrectomy symptoms, dumping syndrome, dietary intake, social activity, and satisfaction with daily life.

The PGSAS-45 questionnaire is particularly useful in evaluating the impact of different types of gastrectomy or reconstructive procedures on the QOL of post-operative patients. It is expected that this questionnaire will be increasingly used in the future. Currently, there have been several studies conducted in Japan using this scale to assess the QOL of patients with early GC^[29–42]. These studies have shown that the main differences in QOL are related to issues such as diet-related distress, esophageal reflux, body mass changes, dietary dissatisfaction, work dissatisfaction, and dissatisfaction with daily life. However, it should be noted that there is a lack of research specifically focusing on the use of the PGSAS-45 questionnaire for evaluating gastrectomized patients with advanced stages of the disease^[42]. Additionally, the questionnaire has only been validated in Asian patients. Therefore, further studies are needed to fully explore its effectiveness and applicability in different patient populations and stages of gastrectomy.

Korean Quality of Life in Stomach Cancer Patients Study Group (KOQUSS-40)

The KOREAN QUALITY of life in Stomach cancer patients Study group (KOQUSS) was formed in January 2016 with the goal of developing a method to assess the QOL of GC patients who have undergone gastrectomy. In 2020, a questionnaire called KOQUSS-40 was released, which was based on methods used for EORTC QLQ-C30 and QLQ-STO22^[11]. The KOQUSS-40 comprises 40 questions categorized into 11 distinct domains. These questions particularly address symptoms experienced after gastrectomy, such as difficulty digesting food, trouble swallowing, acid reflux, dumping syndrome, alterations in bowel habits, constipation, psychological concerns, and anxieties related to cancer. It is important to note that the validity and applicability of the questionnaire have only been assessed in Korean patients with stage I GC who have successfully recovered from surgery. Patients who have undergone chemoradiotherapy and have different symptoms are not included in the questionnaire.

Patient Reported Outcomes Measurement Information System (PROMIS)

The National Institutes of Health (NIH) developed the PROMIS program in 2004. This program consists of a standardized collection of patient-reported outcomes (PROs), which encompass physical, mental, and social aspects of health. With its extensive catalog of over 300 items, most of which employ five-option response scales, ranging from 1 (not at all) to 5 (very much)^[25], PROMIS has gained significant recognition as a valuable tool for assessing the well-being of patients diagnosed with GI cancers^[43]. By utilizing PROMIS, healthcare professionals can gauge the extent of health impairment caused by the underlying disease before surgical intervention, monitor the degree of post-operative recovery, and determine the duration required for full recuperation^[44,45].

Resection approach

Extent of resection

Adequate surgical resection with adequate lymphadenectomy is the only potentially curative method in GC treatments. Pre-operative evaluation identifying clinical stage, location, size, and histological type affects the strategy regarding the extent of resection. Meanwhile, the postoperative QOL should be under consideration before surgeons determine the surgical decision. Reducing resection extent can theoretically mitigate PGS by preserving gastric function and physiology and may translate to better QOL in appropriate GC patients. [Table 2](#) shows recent studies that assessed the relationship between the extent of gastrectomy and QOL in Asia.

TG vs PG in proximal gastric cancer

The incidence of proximal gastric cancer (PGC), especially proximal early GC has been increasing worldwide^[53]. Total gastrectomy (TG) has been used as a standard operation in advanced GC for cancers of the upper one-third of the stomach. However, for early proximal GC, proximal gastrectomy (PG), as a functional preservation surgery, was at one point a popular form of resection to obtain better postoperative QOL^[54–56]. Esophagogastrostomy anastomosis was recommended for large residual stomach volume, while jejunal pouch anastomosis was recommended for small residual stomach volume, which can improve postoperative QOL of PG patients^[32,57]. Most studies concerning PG and QOL were from Japan. A Japanese nationwide multi-institutional study found that PG had fewer symptoms of diarrhea and vomiting, less weight loss, and no additional meals were required, which could reduce the incidence of postoperative PGS^[33]. However, reflux esophagitis and anastomotic stenosis are still reported in PG^[49,58].

PPG vs DG in middle-third gastric cancer

Pylorus-preserving gastrectomy (PPG) was initially devised for resection of gastric ulcers and recently applied to middle-third early GC patients to maintain pyloric function and improve QOL. Several studies from Japan and China showed that PPG can provide better QOL than DG, with less incidence of diarrhea and vomiting, less body weight loss, and no need for supplementary feeding^[36,37,52]. In a retrospective trial, it was recommended to retain sufficient proximal residual stomach to allow patients to achieve higher postoperative QOL when PPG was performed^[35].

Open vs minimally invasive surgery

During the period of minimally invasive surgical techniques, both laparoscopic-assisted gastrectomy and totally laparoscopic gastrectomy have been emphasized due to their anticipated minimal invasiveness and comparable oncological results when contrasted with traditional open gastrectomy. The Korean Laparoendoscopic

Table 2. Extent of resection.

First author	Year	Country	Design	N	Groups	Superior group	Metric	Symptom advantage
Nakamura ^[23]	2011	Japan	Retrospective	165	DG; TG; PPG	DG	DAUGS32	De-glutition disturbances, pain, total DAUGS32 score
Tomikawa ^[46]	2012	Japan	Retrospective	21	PPG; DG	PPG	GSRS	Body weight loss, improved anemia
Takiguchi ^[33]	2015	Japan	Retrospective	586	TG; PG	PG	PGSAS-45	Weight loss, necessity for additional meals, diarrhea, dumping
Lee ^[47]	2016	Korea	Match	178	STG; TG	STG	EORTC-C30 STO22	Social functioning, nausea, vomiting, eating restrictions, taste
Kim ^[48]	2016	Korea	RCT	163	VPG; CG	VPG	EORTC-STO22	Diarrhea, appetite loss
Nishigori ^[49]	2017	Japan	Retrospective	62	PG; TG	PG	PGSAS-45	Reflux, body weight loss, diarrhea, dissatisfaction with symptoms
Takahashi ^[41]	2017	Japan	Retrospective	868	TG; DG	DG	PGSAS-45	Body weight loss, esophageal reflux, meal-related distress, dissatisfaction with meals, necessity for additional meals, dissatisfaction with daily life
Hosoda ^[37]	2017	Japan	Cross-sectional	112	PPG; DG	PPG	PGSAS-45	Dumping, diarrhea, dissatisfaction with meals, dissatisfaction with work
Park ^[50]	2018	Korea	Retrospective	80	PG; TG	ND	EORTC-C30 STO22	ND
Eom ^[51]	2019	Korea	Retrospective	296	PPG; DG	DG	EORTC-C30 STO22	Delayed gastric emptying, reflux, pain
Huang ^[52]	2020	China	Retrospective	91	PPG; DG	PPG	EORTC-C30 STO22	Emotional functioning, insomnia, appetite loss, reflux, taste problem

STG, subtotal gastrectomy; VPG, vagus nerve preserving distal gastrectomy; CG, conventional distal gastrectomy; ND, no difference; RCT, randomized controlled trial; GSRS, Gastrointestinal Symptom Rating Scale; EORTC, European Organization for Research and Treatment of Cancer; DAUGS32, the 32-item study of the Dysfunction after Upper Gastrointestinal Surgery for Cancer.

Gastrointestinal Surgery Study (KLASS) group, Japan Clinical Oncology Group, and the Chinese Laparoscopic Gastrointestinal Surgery Study (CLASS) group performed separately or jointly launched several randomized trials assessing QOL of minimally invasive gastrectomy, such as JCOG0912, KLASS-01, CLASS-08 (NCT04351321), and CKLASS-01. However, to date most QOL outcomes have not been reported.

In various postgastrectomy symptoms, such as fatigue, pain, dietary restrictions, dysphagia, reflux, and body image, laparoscopic-assisted distal gastrectomy (LADG) usually demonstrates superior performance compared to open distal gastrectomy in nonrandomized studies^[59–62]. Multiple retrospective studies indicated that the laparoscopic approach, when performed independently, outperformed the approach that involved laparoscopic assistance in terms of QOL. A Korean prospective randomized study could not find significant differences in QOL scores at 2 weeks and 3 months after surgery between laparoscopic distal gastrectomy (TLDG) and LADG, incorporating QLQ-C30 STO22^[63]. However, a recent study from China showed that LADG generally outperforms

TLDG in body image^[64]. To explore the total laparoscopic approach in patient's QOL, KLASS designed a multicentre prospective study (KLASS07 trial)^[65]. In a propensity-score matched analysis from Korea, total laparoscopic total gastrectomy resulted in improved quality of life regarding dysphagia, pain, eating, and odynophagia compared to laparoscopic-assisted total gastrectomy (LATG) for patients^[66]. Compared with the LATG group, elderly patients aged ≥ 70 years had lower nausea and vomiting scores and higher satisfaction with their body image^[64]. Table 3 shows recent studies that assessed laparoscopic gastrectomy compared with open surgery.

Reconstruction

Pouch reconstruction

To prevent PGS, various procedures for total gastrectomy have been introduced. These procedures bear minimal dissimilarities. Based on their fundamental features, they can be categorized as reconstruction methods with or without pouch construction, and reconstruction methods with or without preservation of the

Table 3. Minimally invasive vs open approach.

First author	Year	Country	Design	N	Groups	Superior group	Metric	Symptom advantage
Kim ^[67]	2008	Korea	RCT	164	LADG; ODG	LADG (> 3 months and < 1 year)	EORTC-C30 STO22	Physical, role, emotional, social; Fatigue, pain, appetite loss, sleep disturbance, dysphasia, Gastroesophageal reflux, dietary restriction, anxiety, dry mouth, body image
Kobayashi ^[59]	2011	Japan	Retrospective	98	LADG; ODG	LADG	EORTC-C30 STO22	Physical functioning (12 months postoperatively), fatigue, dyspnea, dysphagia
Lee ^[62]	2012	Korea	Retrospective	80	LADG; ODSG	ODSG	EORTC-C30 STO22	Role, cognitive, fatigue, eating restriction, anxiety
Liu ^[61]	2012	China	Retrospective	74	LADG; ODG	LADG	EORTC-C30 STO22	Role, cognitive, emotional, social, constipation, reflux, body image
Lee ^[68]	2012	Korea	RCT	159	LAG; OG	LAG	GIQLI	Physical, symptom
Kim ^[69]	2013	Korea	RCT	164	LADG; ODG	ND (> 1 year)	EORTC-C30 STO22	Dysphagia lower in LADG; Dyspnea lower in ODG
Misawa ^[60]	2015	Japan	Prospective	145	LAG; OG	LAG	EORTC-C30 STO22	Role, emotional, cognitive, social, pain, fatigue, eating restriction, anxiety, taste problems
Tanaka ^[70]	2024	Japan	Prospective	59	LAG; OG	PGSAS	EORTC-C30 STO22	dissatisfaction at working score

LADG, laparoscopically assisted distal gastrectomy; OG, open gastrectomy; LAG, laparoscopy-assisted distal gastrectomy; ODG, open distal gastrectomy; ODSG, open distal subtotal gastrectomy; ND, no difference; RCT, randomized controlled trial; GSRS, Gastrointestinal Symptom Rating Scale; EORTC, European Organization for Research and Treatment of Cancer; DAUGS32, the 32-item study of the Dysfunction after Upper Gastrointestinal Surgery for Cancer; PGSAS, Postgastrectomy Syndrome Assessment Scale

duodenal passage^[71]. The Japanese Gastric Cancer Association's 6th edition of the guideline recommends several effective techniques for restoring the digestive system, including Roux-en-Y esophagojejunostomy, jejunal interposition, and the newly introduced double-tract method. However, it should be noted that the functional advantages of pouch reconstruction are yet to be determined^[72]. Creating a gastric substitute pouch that can simulate the reservoir function could reduce the rate of dumping symptoms. Recent meta-analysis revealed pouch-based methods markedly reduced the risk of dumping syndrome, esophagitis, heartburn, and food intake disturbance and nutritional outcomes^[73–75]. Recently a Japanese multi-institutional cross-sectional study investigated the usefulness of jejunal pouch creation using PGSAS-45. Three pouch-creation procedures: total gastrectomy with jejunal pouch interposition (TGJPR), total gastrectomy with Roux-en-Y oral pouch (TGJPI), and total gastrectomy with Roux-en-Y aboral pouch (TGJPY) were analyzed. Patients with TGJPR and TGJPI reported a significantly higher QOL compared to those in the TGJPY group. Additionally, utilizing an oral pouch during TG may enhance postoperative QOL and alleviate the symptoms associated with PGS^[76].

Reconstruction for distal gastrectomy

Radical distal gastrectomy is the main therapeutic approach for tumors located in the distal part of the stomach. After this surgical procedure, four principal reconstruction choices can be considered: Billroth-I (BI), Billroth-II (BII), Roux-en-Y (RY), and uncut Roux-en-Y (URY). These alternatives provide different approaches to reconstructing the gastrointestinal tract. BI, which is frequently used, is simple and can provide a physiological route for food digestion and absorption. In advanced-stage patients, the volume of residual stomach is sometimes small, and BI reconstruction may lead to tension during anastomosis, BII and RY are more commonly adopted. BII is a less complex procedure compared to RY gastrojejunostomy, although it is frequently linked to bile reflux and the development of gastritis caused by reflux. RY is used for the prevention of alkaline reflux gastritis, esophagitis, and dumping syndrome through a complex anastomosis. The URY is a modified technique based on the BII operation with Braun anastomosis to reduce gastric residue and decrease reflux.

Several retrospective studies have compared BI against RY reconstruction, and each method has its advantages. It was reported that BI had less body weight reduction, and RY had a lower incidence of residual gastritis and esophageal reflux symptoms^[29,77–82]. An optimal technique for digestive tract reconstruction has not yet been established. When BI was performed, the Kocher maneuver may increase meal-related discomfort and diminish the quality of ingestion and impart a negative effect on QOL^[30]. When RY was performed, the size of the residual stomach, and the length and route of the Roux limb significantly affects the QOL^[31]. RCT trials revealed that RY and BII are comparable in terms of postoperative QOL and nutritional status^[68,83]. It was indicated that URY has the potential to decrease occurrences of gastric stasis, gastritis, and bile reflux, while also enhancing the postoperative quality of life for patients based on a study involving 200 Chinese patients^[84]. A multicenter phase III study with a larger population from China is ongoing comparing QOL as a secondary outcome between BII and URY^[85].

Conclusions

Over the past 30 years, there has been growing interest in developing and the validation of QOL questionnaires suitable for GC surgery, especially in Asian countries. Reducing resection extent can mitigate PGS by preserving gastric function and physiology and may

translate to better QOL in appropriate GC patients. Patients may benefit from minimally invasive surgery and have better QOL, however prospective randomized controlled studies are still needed.

Ethical statements

Not applicable.

Author contributions

The authors confirm contribution to the paper as follows: study conception and design: Zhang S, Jiang X; draft manuscript preparation: Xu J, Yan D, Hu R; literature collection and review, analysis and interpretation of results: Xu J, Yan D, Zhang S, Jiang X. All authors revised and contributed to the interpretation of the findings and accepted the final article.

Data availability

Data sharing not applicable to this article as no datasets were generated or analyzed during the current study.

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Conflict of interest

The authors declare that they have no conflict of interest.

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References

1. Sung H, Ferlay J, Siegel RL, Laversanne M, Soerjomataram I, et al. 2021. Global cancer statistics 2020: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA: a Cancer Journal for Clinicians* 71:209–49
2. Hu Y, Zaydfudim VM. 2020. Quality of life after curative resection for gastric cancer: survey metrics and implications of surgical technique. *The Journal of Surgical Research* 251:168–79
3. GBD 2017 Stomach Cancer Collaborators. 2020. The global, regional, and national burden of stomach cancer in 195 countries, 1990–2017: a systematic analysis for the Global Burden of Disease study 2017. *The Lancet Gastroenterology & Hepatology* 5:42–54
4. Zong L, Abe M, Seto Y, Ji J. 2016. The challenge of screening for early gastric cancer in China. *Lancet* 388:2606
5. Hatta W, Gotoda T, Koike T, Masamune A. 2020. History and future perspectives in Japanese guidelines for endoscopic resection of early gastric cancer. *Digestive Endoscopy* 32:180–90
6. Suh YS, Lee J, Woo H, Shin D, Kong SH, et al. 2020. National cancer screening program for gastric cancer in Korea: Nationwide treatment benefit and cost. *Cancer* 126:1929–39
7. Sasako M. 2020. Progress in the treatment of gastric cancer in Japan over the last 50 years. *Annals of Gastroenterological Surgery* 4:21–29
8. Ahn S, Jung H, Kim S, Shin SJ, Park CG, et al. 2017. Quality of life among Korean gastrointestinal cancer survivors. *European Journal of Oncology Nursing* 30:15–21
9. Tian J, Chen JS. 2005. Nutritional status and quality of life of the gastric cancer patients in Changle County of China. *World Journal of Gastroenterology* 11:1582–86

10. Nakada K, Ikeda M, Takahashi M, Kinami S, Yoshida M, et al. 2015. Characteristics and clinical relevance of postgastrectomy syndrome assessment scale (PGSAS)-45: newly developed integrated questionnaires for assessment of living status and quality of life in postgastrectomy patients. *Gastric Cancer* 18:147–58
11. Eom BW, Lee J, Lee IS, Son YG, Ryu KW, et al. 2021. Development and validation of a symptom-focused quality of life questionnaire (KOQUSS-40) for gastric cancer patients after gastrectomy. *Cancer Research and Treatment* 53:763–72
12. McNair AG, Blazeby JM. 2009. Health-related quality-of-life assessment in GI cancer randomized trials: improving the impact on clinical practice. *Expert Review of Pharmacoeconomics & Outcomes Research* 9:559–67
13. Kaptein AA, Morita S, Sakamoto J. 2005. Quality of life in gastric cancer. *World Journal of Gastroenterology* 11:3189–96
14. Svedlund J, Sjödin I, Dotevall G. 1988. GSRS—a clinical rating scale for gastrointestinal symptoms in patients with irritable bowel syndrome and peptic ulcer disease. *Digestive Diseases and Sciences* 33:129–34
15. Aaronson NK, Ahmedzai S, Bergman B, Bullinger M, Cull A, et al. 1993. The European Organization for Research and Treatment of Cancer QLQ-C30: a quality-of-life instrument for use in international clinical trials in oncology. *Journal of the National Cancer Institute* 85:365–76
16. Vickery CW, Blazeby JM, Conroy T, Arraras J, Sezer O, et al. 2001. Development of an EORTC disease-specific quality of life module for use in patients with gastric cancer. *European Journal of Cancer* 37:966–71
17. Blazeby JM, Conroy T, Bottomley A, Vickery C, Arraras J, et al. 2004. Clinical and psychometric validation of a questionnaire module, the EORTC QLQ-STO 22, to assess quality of life in patients with gastric cancer. *European Journal of Cancer* 40:2260–68
18. Cella DF, Tulsky DS, Gray G, Sarafian B, Linn E, et al. 1993. The functional assessment of cancer therapy scale: development and validation of the general measure. *Journal of Clinical Oncology* 11:570–79
19. Woo A, Fu T, Popovic M, Chow E, Cella D, et al. 2016. Comparison of the EORTC STO-22 and the FACT-Ga quality of life questionnaires for patients with gastric cancer. *Annals of Palliative Medicine* 5:13–21
20. Garland SN, Pelletier G, Lawe A, Biagioni BJ, Easaw J, et al. 2011. Prospective evaluation of the reliability, validity, and minimally important difference of the functional assessment of cancer therapy-gastric (FACT-Ga) quality-of-life instrument. *Cancer* 117:1302–12
21. Eypasch E, Williams JL, Wood-Dauphinee S, Ure BM, Schmulding C, et al. 1995. Gastrointestinal Quality of Life Index: development, validation and application of a new instrument. *British Journal of Surgery* 82:216–22
22. Nakamura M, Kido Y, Yano M, Hosoya Y. 2005. Reliability and validity of a new scale to assess postoperative dysfunction after resection of upper gastrointestinal carcinoma. *Surgery Today* 35:535–42
23. Nakamura M, Hosoya Y, Yano M, Doki Y, Miyashiro I, et al. 2011. Extent of gastric resection impacts patient quality of life: the Dysfunction After Upper Gastrointestinal Surgery for Cancer (DAUGS32) scoring system. *Annals of Surgical Oncology* 18:314–20
24. Nakamura M, Kido Y, Egawa T. 2008. Development of a 32-item scale to assess postoperative dysfunction after upper gastrointestinal cancer resection. *Journal of Clinical Nursing* 17:1440–49
25. Cella D, Riley W, Stone A, Rothrock N, Reeve B, et al. 2010. The Patient-Reported Outcomes Measurement Information System (PROMIS) developed and tested its first wave of adult self-reported health outcome item banks: 2005–2008. *Journal of Clinical Epidemiology* 63:1179–94
26. Sun QH, Wang HY, Sun SD, Zhang X, Zhang H. 2019. Beneficial effect of probiotics supplements in reflux esophagitis treated with esomeprazole: A randomized controlled trial. *World Journal of Gastroenterology* 25:2110–21
27. Terada M, Sodergren S, Singer S, Yoshikawa T, Terashima M, et al. 2020. P-81 phase I-II of the update of the EORTC quality of life gastric module QLQ-STO22. *Annals of Oncology* 31:S116
28. Cleeland CS, Mendoza TR, Wang XS, Chou C, Harle MT, et al. 2000. Assessing symptom distress in cancer patients: the M.D. Anderson Symptom Inventory. *Cancer* 89:1634–46
29. Terashima M, Tanabe K, Yoshida M, Kawahira H, Inada T, et al. 2014. Postgastrectomy Syndrome Assessment Scale (PGSAS)-45 and changes in body weight are useful tools for evaluation of reconstruction methods following distal gastrectomy. *Annals of Surgical Oncology* 21:370–78
30. Misawa K, Terashima M, Uenosono Y, Ota S, Hata H, et al. 2015. Evaluation of postgastrectomy symptoms after distal gastrectomy with Billroth-I reconstruction using the Postgastrectomy Syndrome Assessment Scale-45 (PGSAS-45). *Gastric Cancer* 18:675–81
31. Kawahira H, Kodera Y, Hiki N, Takahashi M, Itoh S, et al. 2015. Optimal Roux-en-Y reconstruction after distal gastrectomy for early gastric cancer as assessed using the newly developed PGSAS-45 scale. *Surgery Today* 45:1307–16
32. Inada T, Yoshida M, Ikeda M, Yumiba T, Matsumoto H, et al. 2014. Evaluation of QOL after proximal gastrectomy using a newly developed assessment scale (PGSAS-45). *World Journal of Surgery* 38:3152–62
33. Takiguchi N, Takahashi M, Ikeda M, Inagawa S, Ueda S, et al. 2015. Long-term quality-of-life comparison of total gastrectomy and proximal gastrectomy by postgastrectomy syndrome assessment scale (PGSAS-45): a nationwide multi-institutional study. *Gastric Cancer* 18:407–16
34. Coffey H, Chanopinsiri V, Ly B, Nguyen D. 2020. Comparing 10 kVp and 15% rules in extremity radiography. *Radiologic Technology* 91:516–24
35. Namikawa T, Hiki N, Kinami S, Okabe H, Urushihara T, et al. 2015. Factors that minimize postgastrectomy symptoms following pylorus-preserving gastrectomy: assessment using a newly developed scale (PGSAS-45). *Gastric Cancer* 18:397–406
36. Fujita J, Takahashi M, Urushihara T, Tanabe K, Kodera Y, et al. 2016. Assessment of postoperative quality of life following pylorus-preserving gastrectomy and Billroth-I distal gastrectomy in gastric cancer patients: results of the nationwide postgastrectomy syndrome assessment study. *Gastric Cancer* 19:302–11
37. Hosoda K, Yamashita K, Sakuramoto S, Katada N, Moriya H, et al. 2017. Postoperative quality of life after laparoscopy-assisted pylorus-preserving gastrectomy compared With laparoscopy-assisted distal gastrectomy: A cross-sectional postal questionnaire survey. *American Journal of Surgery* 213:763–70
38. Tanizawa Y, Tanabe K, Kawahira H, Fujita J, Takiguchi N, et al. 2016. Specific features of dumping syndrome after various types of gastrectomy as assessed by a newly developed integrated questionnaire, the PGSAS-45. *Digestive Surgery* 33:94–103
39. Nakada K, Takahashi M, Ikeda M, Kinami S, Yoshida M, et al. 2016. Factors affecting the quality of life of patients after gastrectomy as assessed using the newly developed PGSAS-45 scale: A nationwide multi-institutional study. *World Journal of Gastroenterology* 22:8978–90
40. Tanabe K, Takahashi M, Urushihara T, Nakamura Y, Yamada M, et al. 2017. Predictive factors for body weight loss and its impact on quality of life following gastrectomy. *World Journal of Gastroenterology* 23:4823–30
41. Takahashi M, Terashima M, Kawahira H, Nagai E, Uenosono Y, et al. 2017. Quality of life after total vs distal gastrectomy with Roux-en-Y reconstruction: Use of the Postgastrectomy Syndrome Assessment Scale-45. *World Journal of Gastroenterology* 23:2068–76
42. Nakada K, Kawashima Y, Kinami S, Fukushima R, Yabusaki H, et al. 2021. Comparison of effects of six main gastrectomy procedures on patients' quality of life assessed by Postgastrectomy Syndrome Assessment Scale-45. *World Journal of Gastrointestinal Surgery* 13:461–75
43. Tao J, Zheng Y, Huang Q, Pu F, Shen Q, et al. 2023. Patient-reported outcomes measurement information system in patients with gastrointestinal cancer: a scoping review. *Supportive Care in Cancer* 31:567
44. Jones RS, Stukenborg GJ. 2017. Patient-Reported Outcomes Measurement Information System (PROMIS) Use in Surgical Care: A Scoping Study. *Journal of the American College of Surgeons* 22: 245–254e1
45. Kaurah P, Talhouk A, MacMillan A, Lewis I, Chelcun-Schreiber K, et al. 2019. Hereditary diffuse gastric cancer: cancer risk and the personal cost of preventive surgery. *Familial Cancer* 18:429–38
46. Tomikawa M, Korenaga D, Akahoshi T, Kohshi K, Sugimachi K, et al. 2012. Quality of life after laparoscopy-assisted pylorus-preserving gastrectomy: an evaluation using a questionnaire mailed to the patients. *Surgery Today* 42:625–32
47. Lee SS, Chung HY, Kwon OK, Yu W. 2016. Long-term quality of life after distal subtotal and total gastrectomy: symptom- and behavior-oriented consequences. *Annals of Surgery* 263:738–44
48. Kim SM, Cho J, Kang D, Oh SJ, Kim AR, et al. 2016. A randomized controlled trial of vagus nerve-preserving distal gastrectomy versus conventional distal gastrectomy for postoperative quality of life in early stage gastric cancer patients. *Annals of Surgery* 263:1079–84

49. Nishigori T, Okabe H, Tsunoda S, Shinohara H, Obama K, et al. 2017. Superiority of laparoscopic proximal gastrectomy with hand-sewn esophagogastrostomy over total gastrectomy in improving postoperative body weight loss and quality of life. *Surgical Endoscopy* 31:3664–72.
50. Park JY, Park KB, Kwon OK, Yu W. 2018. Comparison of laparoscopic proximal gastrectomy with double-tract reconstruction and laparoscopic total gastrectomy in terms of nutritional status or quality of life in early gastric cancer patients. *European Journal of Surgical Oncology* 44:1963–70.
51. Eom BW, Park B, Yoon HM, Ryu KW, Kim YW. 2019. Laparoscopy-assisted pylorus-preserving gastrectomy for early gastric cancer: a retrospective study of long-term functional outcomes and quality of life. *World Journal of Gastroenterology* 25:5494–504.
52. Huang C, Yu F, Zhao G, Xia X. 2020. Postoperative quality of life after laparoscopy-assisted pylorus-preserving gastrectomy compared with laparoscopy-assisted distal gastrectomy for early gastric cancer. *Journal of Gastroenterology and Hepatology* 35:1712–19.
53. Ahn HS, Lee HJ, Yoo MW, Jeong SH, Park DJ, et al. 2011. Changes in clinicopathological features and survival after gastrectomy for gastric cancer over a 20-year period. *British Journal of Surgery* 98:255–60.
54. Hiki N, Nunobe S, Kubota T, Jiang X. 2013. Function-preserving gastrectomy for early gastric cancer. *Annals of Surgical Oncology* 20:2683–92.
55. Katai H. 2006. Function-preserving surgery for gastric cancer. *International Journal of Clinical Oncology* 11:357–66.
56. Nunobe S, Hiki N. 2017. Function-preserving surgery for gastric cancer: current status and future perspectives. *Translational Gastroenterology and Hepatology* 2:77.
57. Yabusaki H, Kodera Y, Fukushima N, Hiki N, Kinami S, et al. 2020. Comparison of postoperative quality of life among three different reconstruction methods after proximal gastrectomy: insights from the PGSAS study. *World Journal of Surgery* 44:3433–40.
58. Pu YW, Gong W, Wu YY, Chen Q, He TF, et al. 2013. Proximal gastrectomy versus total gastrectomy for proximal gastric carcinoma. A meta-analysis on postoperative complications, 5-year survival, and recurrence rate. *Saudi Medical Journal* 34:1223–28.
59. Kobayashi D, Kodera Y, Fujiwara M, Koike M, Nakayama G, Nakao A. 2011. Assessment of quality of life after gastrectomy using EORTC QLQ-C30 and STO22. *World Journal of Surgery* 35:357–64.
60. Misawa K, Fujiwara M, Ando M, Ito S, Mochizuki Y, et al. 2015. Long-term quality of life after laparoscopic distal gastrectomy for early gastric cancer: results of a prospective multi-institutional comparative trial. *Gastric Cancer* 18:417–25.
61. Liu J, Yang K, Chen XZ, Dai B, Zhang B, et al. 2012. Quality of life following laparoscopy-assisted distal gastrectomy for gastric cancer. *Hepato-gastroenterology* 59:2207–12.
62. Lee SS, Ryu SW, Kim IH, Sohn SS. 2012. Quality of life beyond the early postoperative period after laparoscopy-assisted distal gastrectomy: the level of patient expectation as the essence of quality of life. *Gastric Cancer* 15:299–304.
63. Woo J, Lee JH, Shim KN, Jung HK, Lee HM, et al. 2015. Does the Difference of Invasiveness between Totally Laparoscopic Distal Gastrectomy and Laparoscopy-Assisted Distal Gastrectomy Lead to a Difference in Early Surgical Outcomes? A prospective randomized trial. *Annals of Surgical Oncology* 22:1836–43.
64. Zhao RY, Li HH, Zhang KC, Cui H, Deng H, et al. 2022. Comparison of short-term efficacy between totally laparoscopic gastrectomy and laparoscopic assisted gastrectomy for elderly patients with gastric cancer. *World Journal of Gastrointestinal Surgery* 14:950–62.
65. Jin HE, Kim MS, Lee CM, Park JH, Choi CI, et al. 2019. Meta-analysis and systematic review on laparoscopy-assisted distal gastrectomy (LADG) and totally laparoscopic distal gastrectomy (TLDG) for gastric cancer: preliminary study for a multicenter prospective KLASO7 trial. *European Journal of Surgical Oncology* 45:2231–40.
66. Park SH, Suh YS, Kim TH, Choi YH, Choi JH, et al. 2021. Postoperative morbidity and quality of life between totally laparoscopic total gastrectomy and laparoscopy-assisted total gastrectomy: a propensity-score matched analysis. *BMC Cancer* 21:1016.
67. Kim YW, Baik YH, Yun YH, Nam BH, Kim DH, et al. 2008. Improved quality of life outcomes after laparoscopy-assisted distal gastrectomy for early gastric cancer: results of a prospective randomized clinical trial. *Annals of Surgery* 248:721–27.
68. Lee MS, Ahn SH, Lee JH, Park DJ, Lee HJ, et al. 2012. What is the best reconstruction method after distal gastrectomy for gastric cancer? *Surgical Endoscopy* 26:1539–47.
69. Kim YW, Yoon HM, Yun YH, Nam BH, Eom BW, et al. 2013. Long-term outcomes of laparoscopy-assisted distal gastrectomy for early gastric cancer: result of a randomized controlled trial (COACT 0301). *Surgical Endoscopy* 27:4267–76.
70. Tanaka C, Kanda M, Misawa K, Mochizuki Y, Hattori M, et al. 2024. Long-term quality of life after open and laparoscopic total gastrectomy for stage I gastric cancer: a prospective multi-institutional study (CCOG1504). *Annals of Gastroenterological Surgery* 8(6):999–1007.
71. Chin AC, Espat NJ. 2003. Total gastrectomy: options for the restoration of gastrointestinal continuity. *The Lancet Oncology* 4:271–76.
72. Japanese Gastric Cancer A. 2023. Japanese Gastric Cancer Treatment Guidelines 2021 (6th edition). *Gastric Cancer* 26:1–25.
73. Syn NL, Wee I, Shabbir A, Kim G, So JBY. 2019. Pouch versus no pouch following total gastrectomy: meta-analysis of randomized and non-randomized studies. *Annals of Surgery* 269:1041–53.
74. Gertler R, Rosenberg R, Feith M, Schuster T, Friess H. 2009. Pouch vs no pouch following total gastrectomy: meta-analysis and systematic review. *The American Journal of Gastroenterology* 104:2838–51.
75. Zong L, Chen P, Chen Y, Shi G. 2011. Pouch Roux-en-Y vs No Pouch Roux-en-Y following total gastrectomy: a meta-analysis based on 12 studies. *Journal of Biomedical Research* 25:90–99.
76. Tsuji T, Isobe T, Seto Y, Tanaka C, Kojima K, et al. 2022. Effects of creating a jejunal pouch on postoperative quality of life after total gastrectomy: A cross-sectional study. *Annals of Gastroenterological Surgery* 6:63–74.
77. Du N, Chen M, Shen Z, Li S, Chen P, et al. 2020. Comparison of quality of life and nutritional status of between Roux-en-Y and Billroth-I reconstruction after distal gastrectomy: a systematic review and meta-analysis. *Nutrition and Cancer* 72:849–57.
78. Komatsu S, Ichikawa D, Kubota T, Okamoto K, Shiozaki A, et al. 2015. Clinical outcomes and quality of life according to types of reconstruction following laparoscopy-assisted distal gastrectomy for gastric cancer. *Surgical Laparoscopy, Endoscopy & Percutaneous Techniques* 25:69–73.
79. Nakamura M, Nakamori M, Ojima T, Iwahashi M, Horiuchi T, et al. 2016. Randomized clinical trial comparing long-term quality of life for Billroth I versus Roux-en-Y reconstruction after distal gastrectomy for gastric cancer. *British Journal of Surgery* 103:337–47.
80. Nunobe S, Okaro A, Sasako M, Saka M, Fukagawa T, et al. 2007. Billroth I versus Roux-en-Y reconstructions: a quality-of-life survey at 5 years. *International Journal of Clinical Oncology* 12:433–39.
81. Toyomasu Y, Ogata K, Suzuki M, Yanoma T, Kimura A, et al. 2018. Comparison of the physiological effect of Billroth-I and Roux-en-Y reconstruction following laparoscopic distal gastrectomy. *Surgical Laparoscopy, Endoscopy & Percutaneous Techniques* 28:328–33.
82. Yang K, Zhang WH, Liu K, Chen XZ, Zhou ZG, et al. 2017. Comparison of quality of life between Billroth-capital I, Ukrainian and Roux-en-Y anastomosis after distal gastrectomy for gastric cancer: a randomized controlled trial. *Scientific Reports* 7:11245.
83. So JB, Rao J, Wong AS, Chan YH, Pang NQ, et al. 2018. Roux-en-Y or Billroth II reconstruction after radical distal gastrectomy for gastric cancer: a multicenter randomized controlled trial. *Annals of Surgery* 267:236–42.
84. Ye XS, Lin X, Liu JJ, Shi Y, Qian F, et al. 2022. Comparison of clinical efficacy and quality of life between uncut Roux-en-Y and Billroth II with Braun anastomosis in laparoscopic distal gastrectomy for gastric cancer. *Chinese Journal of Gastrointestinal Surgery* 25:166–72 (In Chinese).
85. Chen S, Chen DW, Chen XJ, Lin YJ, Xiang J, et al. 2019. Postoperative complications and nutritional status between uncut Roux-en-Y anastomosis and Billroth II anastomosis after D2 distal gastrectomy: a study protocol for a multicenter randomized controlled trial. *Trials* 20:428.



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