

Original Article



Advantages of Distal Subtotal Gastrectomy over Total Gastrectomy in the Quality of Life of Long-Term Gastric Cancer Survivors

Oh Kyoung Kwon ¹, Byunghyuk Yu ¹, Ki Bum Park ¹, Ji Yeon Park ¹,
Seung Soo Lee ², Ho Young Chung ²

¹Gastric Cancer Center, Kyungpook National University Chilgok Hospital, Daegu, Korea

²Department of Surgery, Kyungpook National University Hospital, Daegu, Korea



Received: Nov 29, 2019

Revised: Mar 23, 2020

Accepted: Apr 6, 2020

Correspondence to

Oh Kyoung Kwon

Gastric Cancer Center, Kyungpook National University Chilgok Hospital, 807 Hoguk-ro, Buk-gu, Daegu 41404, Korea.
E-mail: okugisurg@knu.ac.kr


Copyright © 2020. Korean Gastric Cancer Association

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


ORCID iDs

Oh Kyoung Kwon 


<https://orcid.org/0000-0002-3614-8563>

Byunghyuk Yu 


<https://orcid.org/0000-0001-8502-9352>

Ki Bum Park 

<https://orcid.org/0000-0001-5404-5667>

Ji Yeon Park 

<https://orcid.org/0000-0002-6178-7906>

Seung Soo Lee 

<https://orcid.org/0000-0003-4398-6300>

Ho Young Chung 

<https://orcid.org/0000-0001-7264-0865>

ABSTRACT

Purpose: This study evaluated differences and shifting patterns in the health-related quality of life (HRQoL) of 5-year gastric cancer survivors after either a distal subtotal gastrectomy (DSG) or total gastrectomy (TG).

Materials and Methods: We analyzed the prospectively collected HRQoL data of 528 patients who survived 5 years without recurrence using the European Organization for the Research and Treatment of Cancer (EORTC) Core Quality of Life Questionnaire and the EORTC Quality of Life Questionnaire-Stomach module according to the type of surgery. The purpose was to identify the proportion of patients with deteriorating HRQoL and to assess the clinical significance of these changes.

Results: Deteriorating HRQoL was prevalent in both groups, including a large proportion of the DSG group. Decreased overall health status and scores on several function scales were less in the DSG group, while increases on the symptom scales were higher in the TG group. For most of the scales, gaps in HRQoL during the early postoperative period did not merge within the 5 years. Scores on the diarrhea and body image scales revealed “moderate changes” in both groups.

Conclusions: During the 5-year period after surgery, the TG group suffered from inferior HRQoL compared to the DSG group. However, a large proportion of the DSG group also suffered HRQoL deterioration. In general, the TG group experienced more HRQoL decline, with diarrhea and body image being the major concerns for both groups. To improve HRQoL after gastrectomy, patients must be better informed about post-gastrectomy symptoms. These symptoms must be vigorously investigated, and medical interventions should be available parallel to nutritional support. Favorable evidence of function-preserving gastrectomy should be established and disseminated to improve the HRQoL of early gastric cancer patients.

Keywords: Quality of life; Stomach neoplasms; Gastrectomy

Author Contributions

Conceptualization: K.O.K., L.S.S.; Data curation: Y.B., P.K.B.; Formal analysis: K.O.K., P.J.Y.; Investigation: Y.B., L.S.S.; Methodology: K.O.K., P.J.Y., L.S.S.; Resources: K.O.K., C.H.Y.; Supervision: C.H.Y.; Writing - original draft: K.O.K., P.K.B.; Writing - review & editing: K.O.K., P.K.B., C.H.Y.

Conflict of Interest

No potential conflict of interest relevant to this article was reported.

INTRODUCTION

Gastric cancer is one of the leading cancer-related deaths in the world [1]. There are significant regional differences in prevalence, with more than half of all new gastric cancer patients diagnosed in East Asia, including China, Japan, and Korea [1]. Among them, Japan (in the 1960s) and Korea (in 2002) started national screening programs to improve survival rates through early detection. In most countries where national screening programs are not practiced, most newly diagnosed gastric cancer patients are already in advanced stages. The prognosis for patients in advanced stages is poor compared to those who receive initial treatment for early gastric cancer that has an excellent 5-year survival rate of more than 90% [2].

Gastrectomies for gastric cancer are known to negatively impact the patients' health-related quality of life (HRQoL). A radical gastrectomy for gastric cancer results in deprivation of the anatomic and physiologic functions of the stomach, while extended lymph node dissection results in ligation of major vessels and denervation of the stomach. Therefore, excessive body weight loss, malnutrition, and various post-gastrectomy syndromes contribute to deteriorating HRQoL of the patients. For patients with advanced gastric cancer, the importance of HRQoL is often ignored because of the overwhelming concern about recurrence or cancer-related deaths.

In Korea, national gastric cancer screening starts from the age of forty years and is performed biennially thereafter. After implementation of the program, the proportion of T1 gastric cancer patients who were treated by surgery rose to 61% in 2014 from only 30.4% in 1995 [3]. As in Japan, the rate of long-term survival has been increasing rapidly [4]. Therefore, HRQoL has become an important issue for survivors. Published reports related to HRQoL after gastrectomy have become more frequent; however, the majority have been either cross-sectional studies or studies with patient sample sizes that were too small to be truly representative of the general population [5]. Also, the follow-up periods were too short to estimate long-term HRQoL shifts [6].

In most studies, patient HRQoL after a distal subtotal gastrectomy (DSG) was generally better than after a total gastrectomy (TG). It may be essential to identify both the long-term shifting patterns after gastrectomy and the variations in long-term HRQoL caused by the extent of gastric resection (DSG or TG) using a multidirectional approach. A thorough understanding of the comparative HRQoL changes after both types of gastrectomy may enable us to improve HRQoL through medications, emotional support, and further surgical intervention. However, the long-term results with chronological changes that may indicate actual recovery and adaptation after TG are rare.

Therefore, this prospective cohort study was designed to evaluate the differences and shifting patterns of HRQoL for 5-year gastric cancer survivors after DSG and TG. We compared the HRQoL changes after the 2 types of gastrectomy and the proportion of patients with deteriorated HRQoL to estimate the proportion of survivors who suffer from deteriorating symptoms and the accompanying decline of function after surgery.

MATERIALS AND METHODS**Patients**

The present analysis included data from patients who underwent curative gastrectomy for pathologically proven gastric cancer between February 2008 and March 2012 at Kyungpook

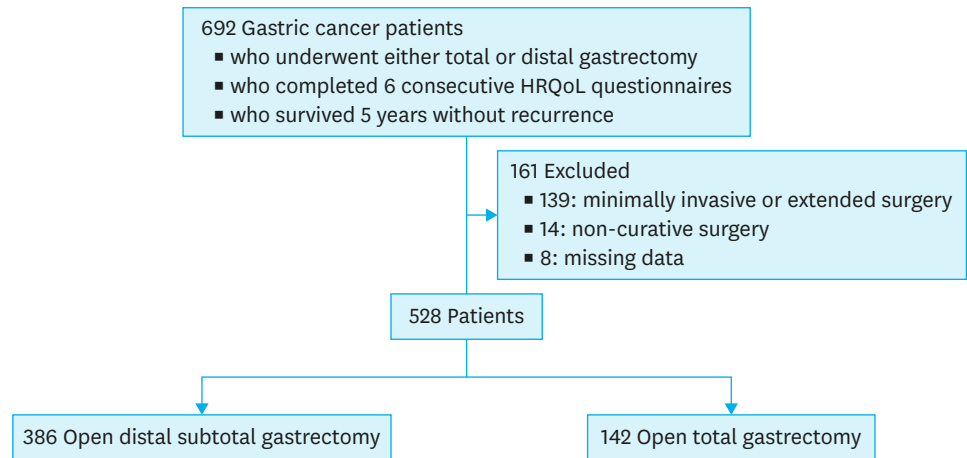


Fig. 1. Diagram of patients enrolled in the study.

National University Hospital and Kyungpook National University Chilgok Hospital. We retrospectively analyzed the prospectively established HRQoL data. Among the 689 patients who had no identified recurrence and had completed all HRQoL questionnaires measured at the preoperative period and at annual regular follow-ups for 5 consecutive years, 161 patients were excluded, of whom 139 patients underwent either minimally invasive or extended surgery, 14 underwent non-curative resection at surgery, and 8 had missing data (Fig. 1). Patients who underwent minimally invasive or extended surgery were excluded from this study because the dissimilar surgical magnitude might have impacted the patients' HRQoL. This study was approved by the respective institutional review boards of the aforementioned hospitals.

Surgery and follow-up

Upper midline incisions were used in both open DSG and TG procedures. In open DSG, the distal two-thirds of the stomach was resected, and an extended lymphadenectomy (D2) was performed. In most of the DSG cases, a Billroth I anastomosis was performed, with the exception of ten cases when a Billroth II anastomosis was chosen as the reconstruction method. In open TG, the whole stomach was resected, D2 was performed, and reconstruction was performed using a Roux-en-Y esophagojejunostomy in all cases.

After discharge, patients visited the outpatient department every 3 months for the first postoperative year and then every six months during the second and third postoperative years. They visited annually in the fourth and fifth postoperative years. In each annual visit, the following were performed: physical examination, chest X-ray, gastroduodenoscopy, an abdomen-pelvis computed tomography scan or ultrasound of the abdomen, tumor markers (CA 19-9, CEA), and additional blood tests for anemia, liver, and renal function analysis.

HRQoL assessment and interpretation

The European Organization for the Research and Treatment of Cancer (EORTC) Core Quality of Life Questionnaire (QLQ-C30) comprises both multi-item and single-item scales, including 5 functional scales, 3 symptom scales, a global health status/QoL scale, and six single items to report other symptoms. The EORTC Quality of Life Questionnaire-Stomach (QLQ-STO22) is a gastric cancer-specific module to assess symptoms associated with gastric cancer treatment. It comprises 5 multi-item and four single-item scales. All completed questionnaires were scored and transformed into a 0–100 scale. Missing values were

processed according to the EORTC QLQ-C30 scoring manual and the EORTC QLQ-STO22 scoring procedure. For overall health status, higher scores represented better HRQoL. For functional scales, high scores represented high or healthy levels of functioning. For symptom scales, high scores represented high levels of symptoms or problems. To measure HRQoL, we used the validated Korean version of the European EORTC QLQ-C30 [7] and QLQ-STO 22 that was checked preoperatively and 5 additional times, once after each regular annual visit. Patients with deteriorating HRQoL were defined as those with decreases in their overall health status and function scale scores and increases in their postoperative symptom scale scores compared to their preoperative scores. All patients completed the questionnaires themselves before interviews with a doctor to exclude the potential influence of the doctor's opinions on the patients' responses. Medical consultations were then conducted based on the completed questionnaires to assess symptoms or difficulties in the daily lives of the patients.

To determine the significance of HRQoL changes from the preoperative scores, we adopted the proposal of Osoba and colleagues [8] that classified the amount of change from 0 to less than 5 as “no change,” 5 to less than 10 as “small change,” 10 to less than 20 as “moderate change,” and more than 20 as “large change.”

Statistical analysis

Based on the possibility of differences in the preoperative HRQoL data, and regardless of statistical significance, we compared the amount of postoperative change (measured score minus preoperative score). A negative score indicated a decrease in the score and a positive score indicated an increase. All data analyses were performed using SPSS 23.0 (IBM Corp, Armonk, NY, USA). The proportions of patients with categorical variables were compared using chi-square tests. Differences in the means of continuous measurements were tested using Student's t-tests. Null hypotheses of no difference were rejected when P-values were less than 0.05.

RESULTS

The characteristics of the patients are presented in **Table 1**. Among the 528 patients enrolled in this study, 386 (73.1%) underwent DSG and 142 (26.9%) patients underwent TG. There were no significant differences between the 2 groups for age, gender, body mass index (BMI), and the degree of obesity according to the National Institutes of Health (NIH) clinical guidelines [9]. Pathological staging was done according to the 7th edition of the American Joint Committee on Cancer (AJCC) cancer staging manual [10]. Patients in the TG group showed significantly advanced stages of cancer. As for adjuvant chemotherapy, among 124 patients with stage II cancer or higher, 75 (60.5%) patients were administered adjuvant chemotherapy. In most cases, adjuvant chemotherapy regimens were either S-1 or S-1 plus a platinum agent. There were no differences in the proportion of patients who received adjuvant chemotherapy. Although the data were not presented in this manuscript, the impact of adjuvant chemotherapy on HRQoL was not significant over the 5-year period of the study.

After processing the missing items according to the EORTC QLQ-C30 scoring manual that suggested less than 2% of patient data would be missing, we found the actual rate of missing values in this study was 1.55%, excluding the hair loss scale. Therefore, the collected data satisfied the criteria set forth in the EORTC QLQ-C30.

Table 1. Characteristics of patients

Characteristics	All (n=528)	DSG (n=386)	TG (n=142)	P-value
Age (yr)	56.1 ± 10.8	56.8 ± 10.5	57.4 ± 10.5	0.547
<65 (young)	381 (72.2)	279 (72.3)	102 (71.8)	0.919
≥65 (old)	147 (27.8)	107 (27.7)	40 (28.2)	
Sex				0.066
Female	190 (36.0)	148 (38.3)	42 (29.6)	
Male	338 (64.0)	238 (61.7)	100 (70.4)	
BMI				0.161
Underweight (<18.5kg/m ²)	13 (2.5)	7 (1.8)	6 (4.2)	
Normal weight (18.5–24.9 kg/m ²)	341 (64.6)	246 (63.7)	95 (66.9)	
Overweight (25.0–29.9 kg/m ²)	161 (30.5)	125 (32.4)	36 (25.4)	
Obese (≥30 kg/m ²)	13 (2.5)	8 (2.1)	5 (3.5)	
Pathological stage (AJCC 7th edition)				<0.001
IA	333 (63.1)	264 (68.4)	69 (48.6)	
IB	74 (14.0)	45 (11.7)	29 (20.4)	
IIA	51 (9.7)	37 (9.6)	14 (9.9)	
IIB	31 (5.9)	22 (5.7)	9 (6.3)	
IIIA	17 (3.2)	10 (2.6)	7 (4.9)	
IIIB	13 (2.5)	5 (1.3)	8 (5.6)	
IIIC	9 (1.7)	3 (0.8)	6 (4.2)	
Adjuvant chemotherapy				0.962
Yes	75 (14.2)	55 (14.2)	20 (14.1)	
No	453 (85.8)	331 (85.8)	122 (85.9)	

Values are presented as mean±standard deviation or number of patients (%).

DSG = distal subtotal gastrectomy; TG = total gastrectomy; BMI = body mass index; AJCC = American Joint Committee on Cancer.

There were no significant differences in the preoperative EORTC QLQ-C30 and QLQ-STO22 scores between the DSG and TG groups. Despite this finding, we compared the score changes at each measurement with the preoperative scores to evaluate the post-surgery changes over 5 years.

The HRQoL shift patterns between the 2 groups over 5 postoperative years were roughly classified into 3 patterns according to each scale. In the first pattern, there were no significant differences between the 2 groups over 5 postoperative years (**Fig. 2**). In the second pattern, there was a significant gap between the groups that increased over time (**Fig. 3**). In the third pattern, there was a significant difference at the first postoperative year, and this difference lasted throughout the remainder of the 5 postoperative years (**Fig. 4**).

Fig. 2 reveals the changes over time in the scales that did not show significant differences between the groups for 5 years after surgery and the percentage of patients with deteriorating HRQoL during that period. In cognitive functioning, there was a rapid and ongoing decline from the first postoperative year through the remainder of the 5 years in both groups. The proportion of patients with declining cognitive functioning showed a slight increase over the 5 years. There were no significant differences in social functioning, general pain, dyspnea, insomnia, financial difficulties, and dry mouth episodes between the groups over the 5 years. Both groups had significantly elevated scores on the diarrhea scale over 5 years.

Fig. 3 illustrates the changes in scales in which the difference between the 2 groups increased over 5 postoperative years and the percentage of patients with deteriorating HRQoL after surgery.

For overall health status, the scores gradually increased with time after an operation. Although there were no statistical significances, the magnitude of increase was higher in the DSG group. The proportion of patients who reported having deteriorating overall health

Long-Term HRQoL after Gastrectomy

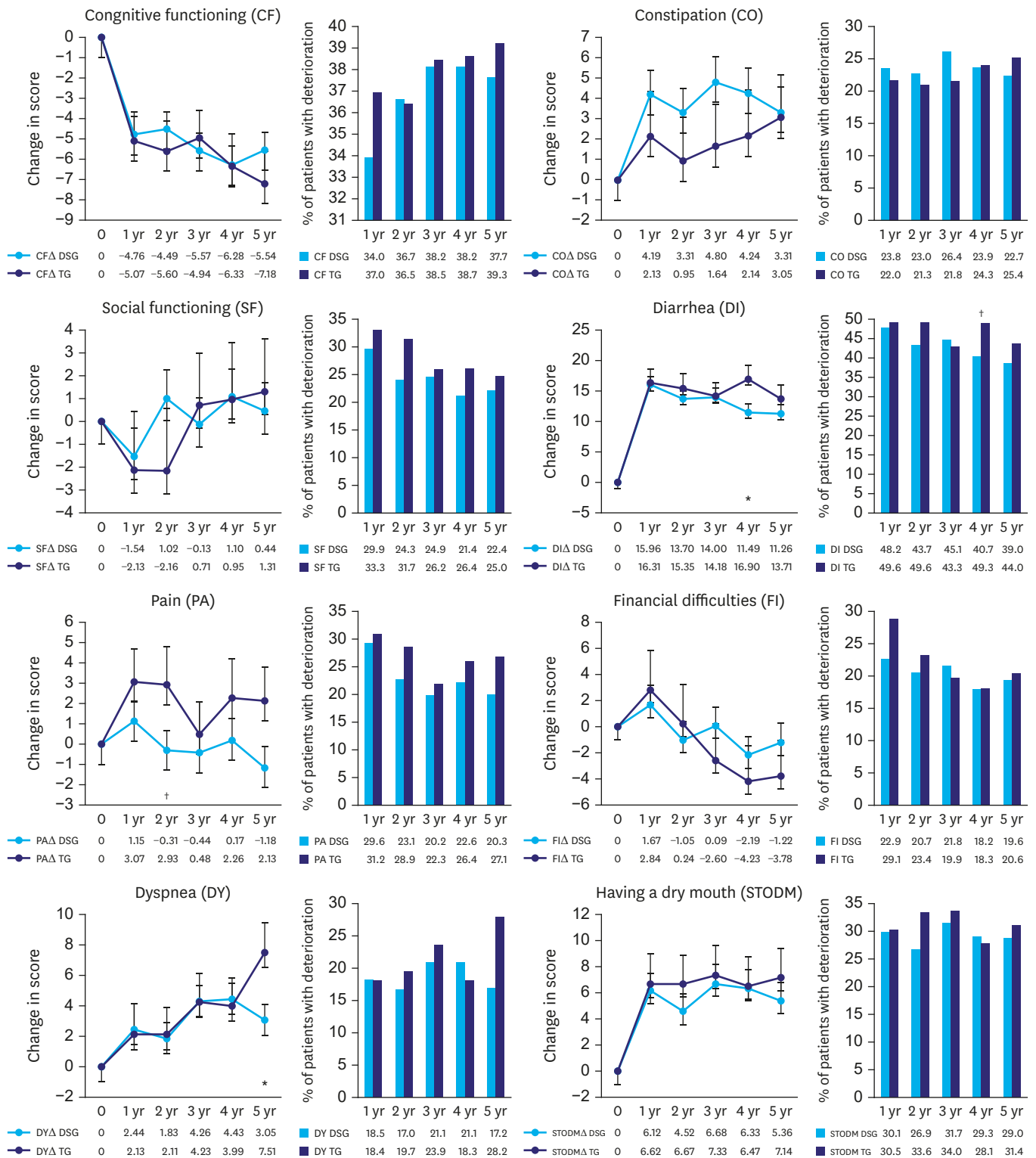


Fig. 2. Chronological changes of mean score and proportion of patients with deterioration from the preoperative state, in which, the scale showed the gap between groups had no statistical significance for 5 years. DSG = distal subtotal gastrectomy; TG = total gastrectomy. *P-value of <0.05, †P-values of >0.05 and <0.10.

(continued to the next page)

Long-Term HRQoL after Gastrectomy

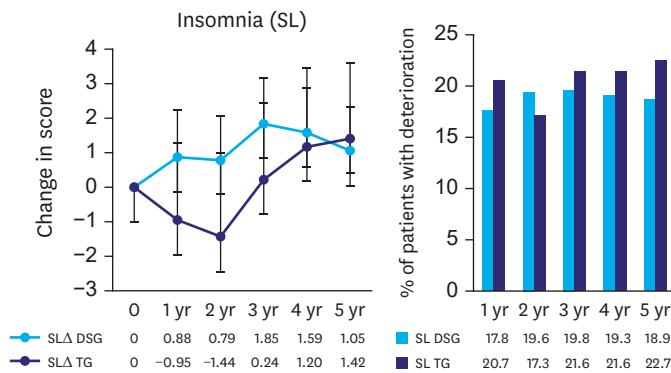


Fig. 2. (Continued) Chronological changes of mean score and proportion of patients with deterioration from the preoperative state, in which, the scale showed the gap between groups had no statistical significance for 5 years. DSG = distal subtotal gastrectomy; TG = total gastrectomy. *P-value of <0.05, †P-values of ≥0.05 and <0.10.

status decreased slightly, but the gaps between the 2 groups were significant at both the 3- and 5-year postoperative intervals. On the role functioning scale, the DSG group showed less decline in scores while the TG group showed a more rapid decline in the first postoperative year, a small increase for the next 2 years, followed by another decline. The gap between the 2 groups seemed to increase from the 3-year point post-surgery. Regarding the proportion of patients exhibiting deterioration, the DSG group showed a gradual decrease from 38.8% to 30.1% while the TG group showed an increase from 42.8% to 46.4% after the fifth

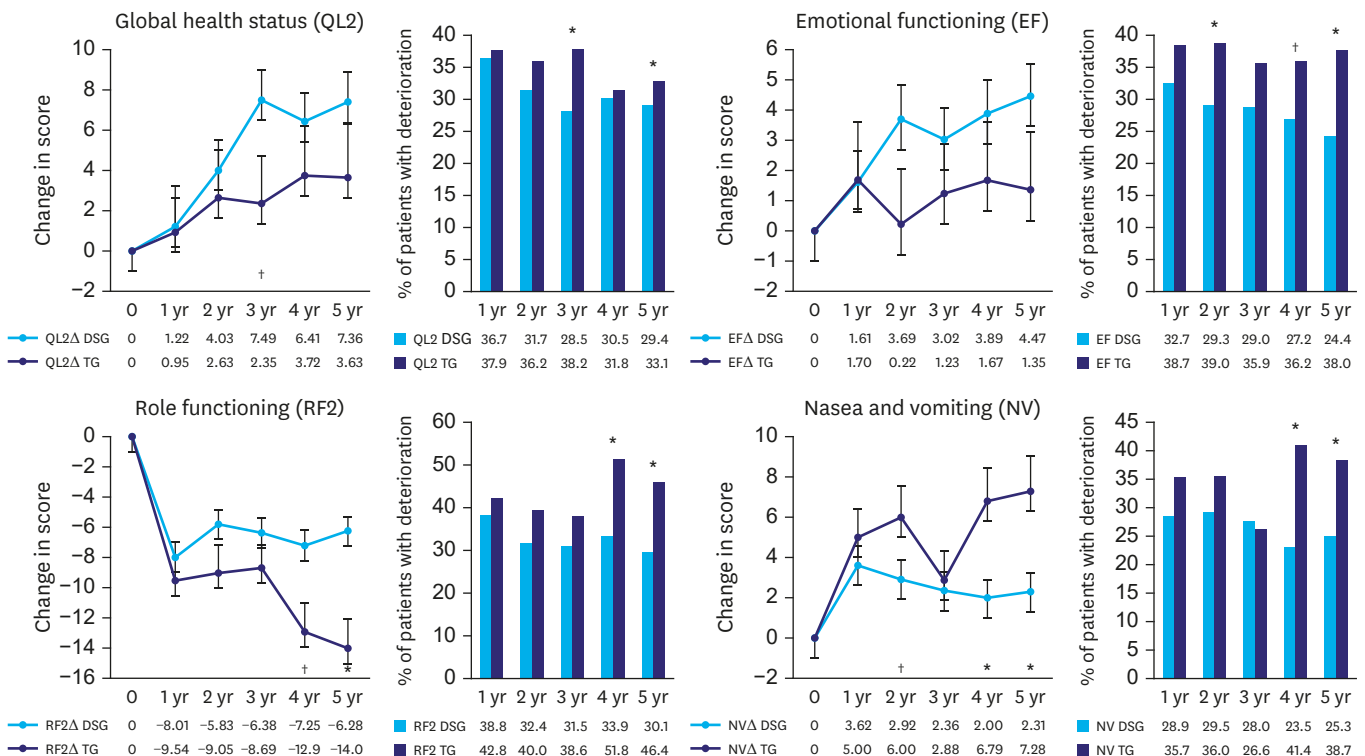


Fig. 3. Chronological changes of mean score and proportion of patients with deterioration from the preoperative state, in which, the scale showed the gap between groups increased with time for 5 years. DSG = distal subtotal gastrectomy; TG = total gastrectomy. *P-value of <0.05, †P-values of ≥ 0.05 and <0.10.

Long-Term HRQoL after Gastrectomy

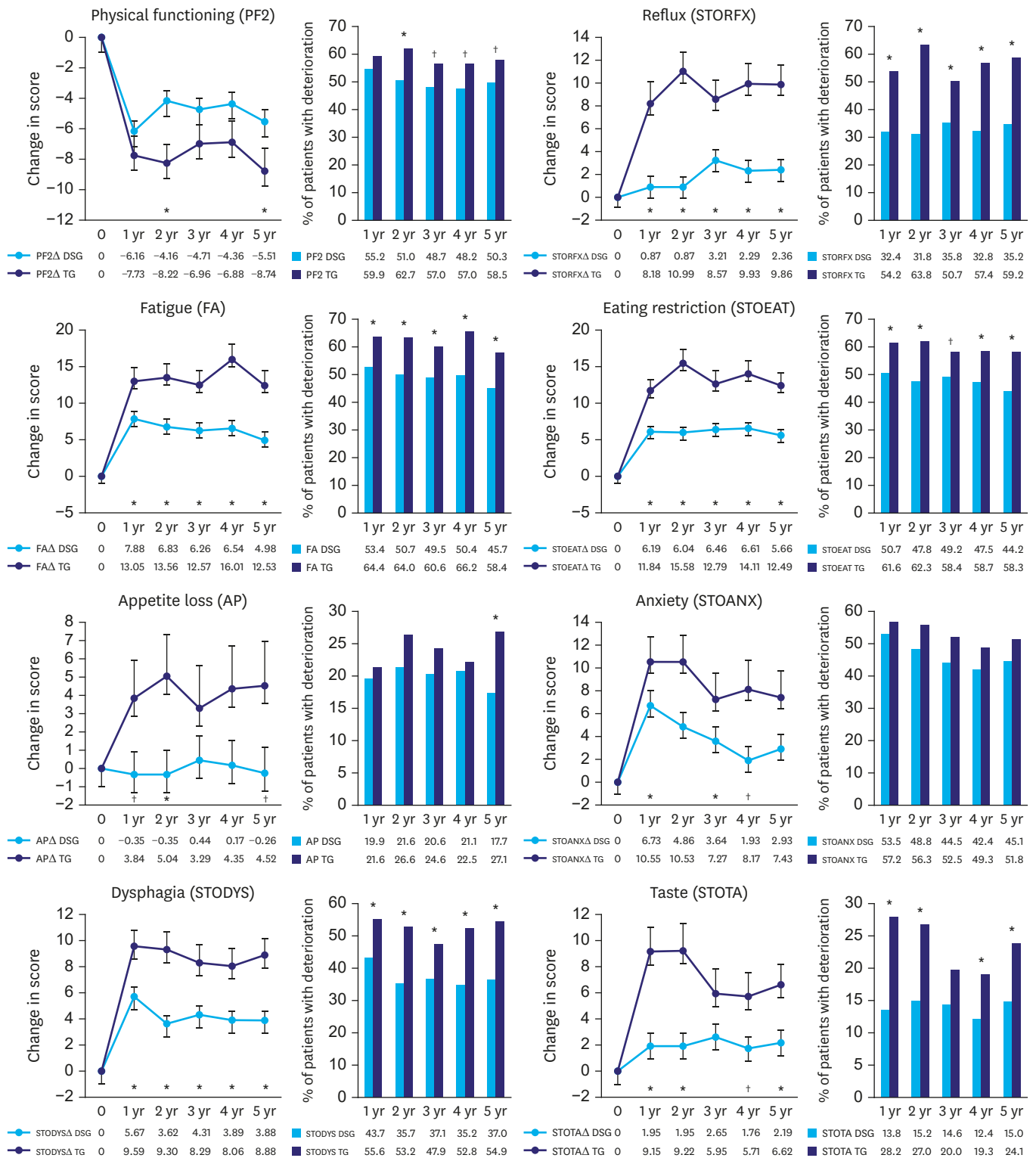


Fig. 4. Chronological changes of mean score and proportion of patients with deterioration from the preoperative state, in which, the scale showed the gap between groups has a significant difference for 5 years.

DSG = distal subtotal gastrectomy; TG = total gastrectomy.

*P-value of <0.05, †P-values of ≥0.05 and <0.10.

(continued to the next page)

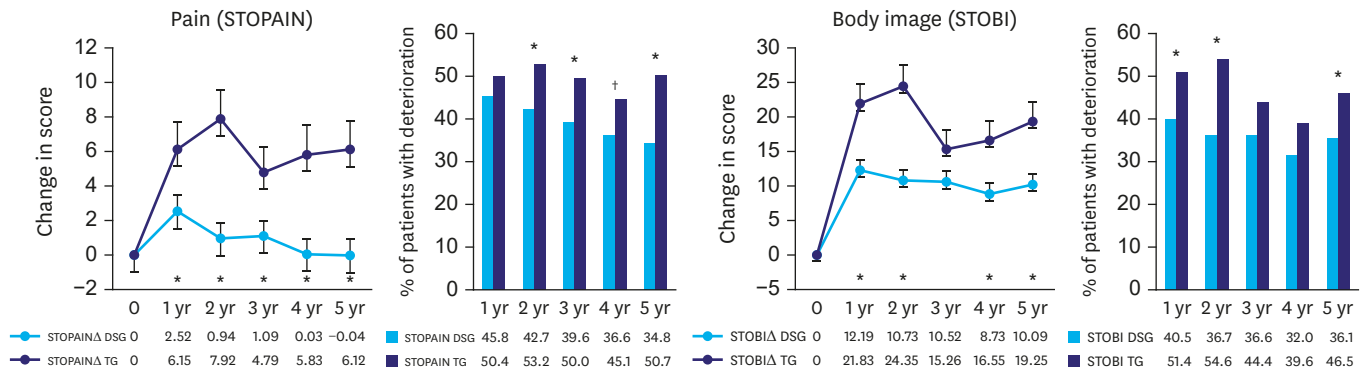


Fig. 4. (Continued) Chronological changes of mean score and proportion of patients with deterioration from the preoperative state, in which, the scale showed the gap between groups has a significant difference for 5 years. DSG = distal subtotal gastrectomy; TG = total gastrectomy. *P-value of <0.05, †P-values of ≥0.05 and <0.10.

postoperative year. On the emotional functioning scale, both groups showed elevated levels of emotional functioning compared to their preoperative status, and the increment was larger in the DSG group. The TG group had a significantly larger proportion of patients exhibiting deterioration on the 3- and 5-year assessments compared to the DSG group. On the nausea/vomiting scale, the gap between the groups increased; the TG group reported a significantly higher level after 4 and 5 postoperative years. A similar finding was seen in the proportion of patients with deterioration.

Fig. 4 shows the changes in the scales on which significant differences between the 2 groups persisted for 5 postoperative years and the percentage of patients exhibiting deterioration after surgery. On the physical functioning scale, there was a rapid decline after the first postoperative year in both groups. In the DSG group, the initial decreased level of physical function was maintained thereafter. However, in the TG group, there was a more pronounced decline at the 1 year mark, and the score decreased again after 5 years. The gap in the physical functioning scores between groups had statistical significance at 2 and 5 postoperative years, and the 2 groups did not merge over the 5 years. The proportion of patients with declining physical functioning was higher in the TG group over the 5 years. On the symptom scales, including fatigue, dysphagia, pain, reflux, and eating restriction, the TG group showed significantly higher scores throughout the 5 years, and significantly more patients suffered deteriorating conditions compared to their preoperative states. Similar findings were noted for appetite loss, anxiety, problems with taste, and body image.

Table 2 shows the determination of clinical significance of the postoperative HRQoL changes at 5 yearly intervals. Both groups in common showed “no change” in emotional functioning, social functioning, general pain, insomnia, appetite loss, constipation, and financial difficulties, a “small increase” in dry mouth, a “small decrease” in physical functioning and cognitive functioning, and a “moderate increase” in diarrhea and body image. For the scales of nausea and vomiting, dyspnea, dysphagia, stomach area pain, reflux, anxiety, and problems with taste, the DSG group showed “no change” while the TG group showed a “small increase.” For the scales of role functioning, fatigue, and eating restriction, the DSG group showed a “small decrease” in role functioning and “no change” or a “small increase” on the other symptom scales; however, the TG group showed a “moderate decrease” in role functioning and a “moderate increase” on the aforementioned symptom scales. Regarding overall health status, the DSG group showed a “small increase” while the TG group showed “no change.”

Table 2. Determination of the significance of the changes in the HRQoL over 5 postoperative years

Scale	Groups	Change	Significance
QL2	DSG	+7.36	↑
	TG	+3.63	=
PF2	DSG	-5.51	↓
	TG	-8.84	↓
RF2	DSG	-6.28	↓
	TG	-14.05	↓↓
CF	DSG	-5.57	↓
	TG	-7.18	↓
FA	DSG	+4.98	=
	TG	+12.5	↑↑
NV	DSG	+2.37	=
	TG	+7.28	↑
DI	DSG	+11.26	↑↑
	TG	+13.71	↑↑
STODYS	DSG	+3.88	=
	TG	+8.88	↑
STOPAIN	DSG	-0.04	=
	TG	+6.12	↑
STORFX	DSG	+2.26	=
	TG	+9.86	↑
STOEAT	DSG	+5.66	↑
	TG	+12.49	↑↑
STOANX	DSG	+2.93	=
	TG	+7.43	↑
STODM	DSG	+5.36	↑
	TG	+7.14	↑
STOTA	DSG	+2.19	=
	TG	+6.62	↑
STOBI	DSG	+10.09	↑↑
	TG	+19.25	↑↑

'=' signifies no change (0-5); '↑' or '↓' signify small changes (5-10); '↑↑' or '↓↓' signify moderate changes (10-20). Words written in bold type indicate scales showing moderate changes.

HRQoL = health-related quality of life; DSG = distal subtotal gastrectomy; TG = total gastrectomy.

DISCUSSION

Some authors have previously reported that long-term survivors after TG generally do as well as the normal population control groups in their studies using SF-36 and 15D questionnaires [11]. Others insisted that there were no differences in overall patient QoL after TG or DSG except for diminished results on the eating restriction and dysphagia scales [12]. However, the DSG group in this study showed either larger increases or less decreases than the TG group in overall health status and on most of the function scales. For most of the symptom scales of the EORTC QLQ-C30, no significant differences existed between the groups except for significantly elevated scores on the fatigue and nausea/vomiting scales in the TG group. Contrarily, there were significant differences between the groups on most of the symptom scales of the QLQ-STO22 with the exception of dry mouth and hair loss. Therefore, this study aligned with similar results from previous reports that showed declining HRQoL after TG [13-16]. In a study showing a serial comparison of HRQoL after DSG and TG over 2 years, the authors classified deviant QoL patterns into 3 types: 1) with consistent gaps throughout, 2) without significant differences, and 3) with a brief QoL gap followed by rapid convergence [14]. In the present study, we found similar patterns with the first 2 types but did not find a brief QoL gap followed by rapid convergence. Instead, in some scales—including role functioning, emotional functioning, and the nausea/vomiting scales—the gap seemed to increase after 2 or 3 postoperative years. Fortunately, a study that compared HRQoL of

patients after TG who survived 5 years with HRQoL of patients after TG who survived more than 5 years reported improved HRQoL for patients who had survived beyond 5 years [17].

One study revealed that most of the patients after DSG experienced fair to good HRQoL [18]. Although the patient grouping was different, our study showed that a large proportion of patients had declining HRQoL after DSG based on any of several factors—including diarrhea (39%), dysphagia (37%), stomach area pain (34.8%), reflux (35.2%), eating restriction (44.2%), anxiety (45.1%), and body image (36.1%)—compared to their preoperative state. Therefore, this suggests that the HRQoL of patients after DSG in this study was not very good but they still experienced less decline than TG patients.

Aside from the HRQoL differences between the groups, it is also important to determine the clinical significance of these post-surgery changes. We used the classification suggested by Osoba and colleagues [8], one of the most frequently used tools for the determination of the clinical significance of HRQoL changes. On most HRQoL scales, except for diarrhea and body image, the DSG group showed “no change” or a “small change” (increase or decrease). In the TG group, the magnitude of change was larger than that of DSG, including an identified moderate decrease on the role function scale and moderate increases on the fatigue, diarrhea, eating restriction, and body image scales. It is clear that diarrhea and body image are common major concerns for patients after both DSG and TG, and patients after TG have more significant HRQoL deterioration.

Diarrhea is one of the most common symptoms of post-gastrectomy maldigestion syndrome that is also characterized by flatulence, weight loss, and fatty stools. Possible effects of maldigestion syndrome are reduced food intake, small-bowel bacterial overgrowth, rapid small-bowel transit, and exocrine pancreatic enzyme insufficiency [19]. Although the body weight loss data were not presented in this study, weight loss was found to be significantly higher in the TG group compared to the DSG group [20]. Therefore, body image dissatisfaction seemed more attributable to postoperative body weight loss rather than the presence of an operative wound scar because all of the patients who underwent open surgery had similar scars.

The presence of a larger magnitude of change on the QLQ-STO22 symptom scales in the TG group seemed to be influenced by the absence of a remnant stomach. The presence of a remnant stomach and the esophagogastric junction after DSG usually enables accommodation of food, smooth transfer of food from the esophagus into the stomach, and the prevention of reflux to the esophagus. On the contrary, patients after TG have an anastomotic ring at the distal part of the esophagus that may cause difficulties when swallowing, eating restrictions, and reflux.

There have been many trials to improve patients' HRQoL after gastrectomy by function-preserving gastrectomy and/or by education.

Regarding function-preserving gastrectomy for early gastric cancer, in a nationwide Japanese study, pylorus-preserving gastrectomy achieved better outcomes on the diarrhea and dumping subscales as well as the frequency of additional meals [21]. Proximal gastrectomy (PG) was not widely performed because of higher incidences of postoperative complications, such as anastomotic stricture and reflux esophagitis [22]. Recent modifications of reconstruction in PG—including jejunal interposition, double-tract reconstruction, and

valvuloplasty esophagojejunostomy—have been shown to reduce complications like reflux and to improve HRQoL after TG [23-25]. For advanced gastric cancer patients, modified surgery to reduce the extent of lymph node dissection or to leave more of the remnant stomach is not permitted as a general practice [26,27]. Therefore, frequent reassessment of patients' symptoms and medical interventions with nutritional support are important to prevent HRQoL deterioration after surgery in these cases.

One study has shown that extensive nutritional training has improved the immediate postoperative nutritional status of gastrectomy patients as well as their self-efficacy and meal satisfaction, thereby suggesting a promising role of nutritional education for post-surgery patients [28]. The HRQoL of patients with decreased BMI after TG was significantly worse than that of patients with maintained or increased BMI [29]. Therefore, nutritional support and training should be integrated into postoperative follow-up programs as well as comprehensive medical interventions.

Quality of life depends on subjective evaluations that reflect the ratio between expectations and the present status of an individual. An overly optimistic and thus erroneous expectation of surgery might result in postoperative disappointment that may in turn lead to further deterioration of the patient's HRQoL [30]. Before surgery, patients with gastric cancer should be thoroughly informed of the expected postoperative symptoms and all potential decreases in systemic functions. After surgery, patients must be trained how to cope with postoperative symptoms through self-management and medical interventions together with the provision of information and guidance regarding nutrition and exercise.

We acknowledge the following limitations: 1) this retrospective study could not be free from selection bias based on the significant difference in the pathological stages of the 2 groups; 2) the DSG group was 2.5 times larger than the TG group; 3) this study did not consider any administered measures to improve the patients' HRQoL; and 4) preoperative HRQoL cannot represent premorbid HRQoL. Despite these limitations, we believe that this study provides important information regarding long-term serial shifts in HRQoL after 2 types of gastrectomy based on a large sample of patients.

To conclude, a significant number of patients after either TG or DSG for gastric cancer exhibited deteriorated HRQoL compared to their preoperative states, and the diminished HRQoL for patients after TG was worse after 5 years. Therefore, one recommendation is to favor DSG over TG when oncological principles are strictly observed. Further investigations should follow, particularly those related to function-preserving gastrectomy, nutritional support and education, and education for self-management to improve postoperative HRQoL after gastrectomy, especially after TG.

REFERENCES

1. Torre LA, Bray F, Siegel RL, Ferlay J, Lortet-Tieulent J, Jemal A. Global cancer statistics, 2012. *CA Cancer J Clin* 2015;65:87-108.
[PUBMED](#) | [CROSSREF](#)
2. Kim YW, Yoon HM, Yun YH, Nam BH, Eom BW, Baik YH, et al. Long-term outcomes of laparoscopy-assisted distal gastrectomy for early gastric cancer: result of a randomized controlled trial (COACT 0301). *Surg Endosc* 2013;27:4267-4276.
[PUBMED](#) | [CROSSREF](#)

3. Information Committee of Korean Gastric Cancer Association. Korean Gastric Cancer Association nationwide survey on gastric cancer in 2014. *J Gastric Cancer* 2016;16:131-140.
[PUBMED](#) | [CROSSREF](#)
4. Maruyama K, Katai H. Surgical treatment of gastric cancer in Japan, trend from standardization to individualization. *Chirurgia (Bucur)* 2014;109:722-730.
[PUBMED](#)
5. Hosoda K, Yamashita K, Sakuramoto S, Katada N, Moriya H, Mieno H, et al. Postoperative quality of life after laparoscopy-assisted pylorus-preserving gastrectomy compared with laparoscopy-assisted distal gastrectomy: a cross-sectional postal questionnaire survey. *Am J Surg* 2017;213:763-770.
[PUBMED](#) | [CROSSREF](#)
6. Climent M, Munarriz M, Blazeby JM, Dorcaratto D, Ramón JM, Carrera MJ, et al. Weight loss and quality of life in patients surviving 2 years after gastric cancer resection. *Eur J Surg Oncol* 2017;43:1337-1343.
[PUBMED](#) | [CROSSREF](#)
7. Yun YH, Park YS, Lee ES, Bang SM, Heo DS, Park SY, et al. Validation of the Korean version of the EORTC QLQ-C30. *Qual Life Res* 2004;13:863-868.
[PUBMED](#) | [CROSSREF](#)
8. Osoba D, Rodrigues G, Myles J, Zee B, Pater J. Interpreting the significance of changes in health-related quality-of-life scores. *J Clin Oncol* 1998;16:139-144.
[PUBMED](#) | [CROSSREF](#)
9. National Institutes of Health. Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults--the evidence report. *Obes Res* 1998;6 Suppl 2:51S-209S.
[PUBMED](#) | [CROSSREF](#)
10. Washington K. 7th edition of the AJCC cancer staging manual: stomach. *Ann Surg Oncol* 2010;17:3077-3079.
[PUBMED](#) | [CROSSREF](#)
11. Tyrväinen T, Sand J, Sintonen H, Nordback I. Quality of life in the long-term survivors after total gastrectomy for gastric carcinoma. *J Surg Oncol* 2008;97:121-124.
[PUBMED](#) | [CROSSREF](#)
12. Goh YM, Gillespie C, Couper G, Paterson-Brown S. Quality of life after total and subtotal gastrectomy for gastric carcinoma. *Surgeon* 2015;13:267-270.
[PUBMED](#) | [CROSSREF](#)
13. Wu CW, Chiou JM, Ko FS, Lo SS, Chen JH, Lui WY, et al. Quality of life after curative gastrectomy for gastric cancer in a randomised controlled trial. *Br J Cancer* 2008;98:54-59.
[PUBMED](#) | [CROSSREF](#)
14. Park S, Chung HY, Lee SS, Kwon O, Yu W. Serial comparisons of quality of life after distal subtotal or total gastrectomy: what are the rational approaches for quality of life management? *J Gastric Cancer* 2014;14:32-38.
[PUBMED](#) | [CROSSREF](#)
15. Kobayashi D, Kodera Y, Fujiwara M, Koike M, Nakayama G, Nakao A. Assessment of quality of life after gastrectomy using EORTC QLQ-C30 and STO22. *World J Surg* 2011;35:357-364.
[PUBMED](#) | [CROSSREF](#)
16. Takahashi M, Terashima M, Kawahira H, Nagai E, Uenosono Y, Kinami S, et al. Quality of life after total vs distal gastrectomy with Roux-en-Y reconstruction: use of the Postgastrectomy Syndrome Assessment Scale-45. *World J Gastroenterol* 2017;23:2068-2076.
[PUBMED](#) | [CROSSREF](#)
17. Lee SS, Chung HY, Kwon OK, Yu W. Quality of life in cancer survivors 5 years or more after total gastrectomy: a case-control study. *Int J Surg* 2014;12:700-705.
[PUBMED](#) | [CROSSREF](#)
18. Park KB, Lee SS, Kwon OK, Chung HY, Yu W. Chronological changes in quality of life after distal gastrectomy for gastric cancer. *J Gastric Cancer* 2017;17:110-119.
[PUBMED](#) | [CROSSREF](#)
19. Antonini F, Crippa S, Falconi M, Macarri G, Pezzilli R. Pancreatic enzyme replacement therapy after gastric resection: an update. *Dig Liver Dis* 2018;50:1-5.
[PUBMED](#) | [CROSSREF](#)
20. Kiyama T, Mizutani T, Okuda T, Fujita I, Tokunaga A, Tajiri T, et al. Postoperative changes in body composition after gastrectomy. *J Gastrointest Surg* 2005;9:313-319.
[PUBMED](#) | [CROSSREF](#)
21. Fujita J, Takahashi M, Urushihara T, Tanabe K, Kodera Y, Yumiba T, et al. 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* 2016;19:302-311.
[PUBMED](#) | [CROSSREF](#)

22. An JY, Youn HG, Choi MG, Noh JH, Sohn TS, Kim S. The difficult choice between total and proximal gastrectomy in proximal early gastric cancer. *Am J Surg* 2008;196:587-591.
[PUBMED](#) | [CROSSREF](#)
23. Ohashi M, Morita S, Fukagawa T, Oda I, Kushima R, Katai H. Functional advantages of proximal gastrectomy with jejunal interposition over total gastrectomy with Roux-en-Y esophagojejunostomy for early gastric cancer. *World J Surg* 2015;39:2726-2733.
[PUBMED](#) | [CROSSREF](#)
24. Li S, Gu L, Shen Z, Mao D, Khadaroo PA, Su H. A meta-analysis of comparison of proximal gastrectomy with double-tract reconstruction and total gastrectomy for proximal early gastric cancer. *BMC Surg* 2019;19:117.
[PUBMED](#) | [CROSSREF](#)
25. Hayami M, Hiki N, Nunobe S, Mine S, Ohashi M, Kumagai K, et al. Clinical outcomes and evaluation of laparoscopic proximal gastrectomy with double-flap technique for early gastric cancer in the upper third of the stomach. *Ann Surg Oncol* 2017;24:1635-1642.
[PUBMED](#) | [CROSSREF](#)
26. Japanese Gastric Cancer Association. Japanese gastric cancer treatment guidelines 2014 (ver. 4). *Gastric Cancer* 2017;20:1-19.
[PUBMED](#) | [CROSSREF](#)
27. Guideline Committee of the Korean Gastric Cancer Association (KGCA), Development Working Group & Review Panel. Korean practice guideline for gastric cancer 2018: an evidence-based, multi-disciplinary approach. *J Gastric Cancer* 2019;19:1-48.
[PUBMED](#) | [CROSSREF](#)
28. Lee HO, Han SR, Choi SI, Lee JJ, Kim SH, Ahn HS, et al. Effects of intensive nutrition education on nutritional status and quality of life among postgastrectomy patients. *Ann Surg Treat Res* 2016;90:79-88.
[PUBMED](#) | [CROSSREF](#)
29. Park KB, Park JY, Lee SS, Kwon OK, Chung HY, Yu W. Impact of body mass index on the quality of life after total gastrectomy for gastric cancer. *Cancer Res Treat* 2018;50:852-860.
[PUBMED](#) | [CROSSREF](#)
30. Lee SS, Ryu SW, Kim IH, Sohn SS. 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* 2012;15:299-304.
[PUBMED](#) | [CROSSREF](#)