

## RESEARCH ARTICLE

Editorial Process: Submission:01/16/2023 Acceptance:06/13/2023

# Quality of Life of Patients Depending on the Method of the Gastrointestinal Tract Reconstruction after Gastrectomy for Stomach Cancer

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### Abstract

**Objective:** The article provides the study results, the purpose of which was to check whether there is a relationship between the type of reconstructive surgery and the quality of life of patients. The results of reconstructive surgeries in 90 patients diagnosed with stomach cancer who underwent gastrectomy with D2 lymphadenectomy were analysed. **Methods:** All patients were randomised into three groups, depending on the method of gastrointestinal tract reconstruction. The study also evaluated the quality of life of patients after gastrectomy using the QLQ-C30 and QLQ-OG25 questionnaires. **Result:** The study results did not demonstrate the superiority of one method of reconstructive surgery over another. Patients who underwent Omega reconstruction generally functioned better physically and emotionally, and complained less often of pain, insomnia and diarrhoea. Patients after gastrointestinal tract reconstruction using the Roux-en-Y method reported less nausea and vomiting, eating disorder and anxiety. **Conclusion:** Based on the obtained data, it was concluded that currently it is impossible to state unequivocally which method of gastrointestinal tract reconstruction improves the quality of life of patients after gastrectomy, however, it should be clearly noted that QLQ questionnaires are a useful tool for evaluation of the quality of life of patients after gastrectomy.

**Keywords:** Adenocarcinoma- oncology- Helicobacter pylori- gastrectomy

*Asian Pac J Cancer Prev*, 24 (6), 2177-2186

### Introduction

Over the past ten years, a decrease in the prevalence of morbidity and mortality from stomach cancer (SC) has been noted, primarily in economically developed countries (Öztekin et al., 2021; Khyts, 2021). This trend is largely due to the decrease in the prevalence of *Helicobacter pylori*, infection with which causes significant consequences for the gastrointestinal tract (GIT), in particular, the development of gastric adenocarcinoma (Robins et al., 2008; Hindmarsh and Corso, 1998). Other important factors that also reduce the prevalence of SC in the population are the change in the nutrition nature in economically developed countries, as well as successes in timely diagnosis of the disease and improvement of treatment methods (Lugli et al., 2007; Abd El-Wahab et al., 2014). However, despite the modern possibilities of diagnosis and treatment, SC remains the main global problem of the healthcare system, as it continues to occupy one of the leading places in the structure of oncological pathology (Bray et al., 2018). According to the GLOBOCAN 2018 data, SC is recognised as the fifth most common malignant neoplasms and the third leading cause

of cancer-related death, which annually causes more than 783 thousand deaths worldwide (Didkowska et al., 2019). In Poland, SC is among the five most common oncological diseases and closes the top three as the key cause of death of oncological patients. According to the Polish National Cancer Registry data, the 5-year survival rate for SC is: 16.4% in men and 19.8% in women (Meder, 2011; Angelis et al., 2014; Ajani et al., 2022; Siegel et al., 2022).

The history of the development, establishment and improvement of surgical resection dates back more than 100 years, therefore, the first mention of a successful gastrectomy for pyloric cancer with gastroduodenal anastomosis was dated February 22, 1881 in Vienna by Christian Albert Theodor Billroth (Quante et al., 2022). Since then, a significant number of scientists have reported successful gastrectomies in patients with SC to one degree or another, but the key problem of surgical resections was postoperative mortality, which was from 20 to 30% of cases. For this reason, full gastrectomy was not used until the 1980s. Only advances in analgesia and anaesthesia, as well as the introduction of blood transfusions and antibiotics, allowed reducing postoperative mortality. Currently, gastrectomy is recognised as a key treatment

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option for SC. According to modern guidelines, the standard treatment is total or subtotal gastrectomy with regional lymphadenectomy in the D2 range (Ilson, 2019). However, currently there are no single international recommendations regarding the methods of restoring the continuity of the gastrointestinal tract after gastrectomy.

In recent years, several studies have been conducted on this subject by various scientists. Öztekin et al. (2021) provided an overview of *Helicobacter pylori* infection, which is one of the leading causes of gastric cancer. Khyts (2021) discussed modern eradication therapy for *Helicobacter pylori* in the context of global guidelines. Ajani et al. (2022) presented gastric cancer treatment recommendations, including surgical approaches. Siegel et al. (2022) provided a report on cancer statistics, which highlights the prevalence and impact of different types of cancers, including gastric cancer. Quante et al. (2022) questioned whether adenocarcinoma of the oesophagus is actually gastric cancer, based on recent research. Finally, Al-Batran et al. (2019) conducted a randomized phase 2/3 trial to compare the efficacy of different chemotherapy regimens in locally advanced, resectable gastric or gastro-oesophageal junction adenocarcinoma.

In addition, the progress of intensive care, as well as parenteral and enteral nutrition, has reduced the mortality of patients, and currently medicine faces the question of not only life prolonging of patients, but first of all, improving it and bringing it closer to the quality of life that existed before the disease. Therefore, currently, the development of the most reliable and physiological method of reconstruction after gastrectomy, which can ensure a normal quality of life for patients, has become a priority direction of numerous studies.

A study was conducted the purpose of which was to evaluate the presence of an association between the type of reconstructive surgery for SC and the development of inflammatory changes in the GIT in the future. The study purpose was to study:

1. Is there a connection between the performed surgery type and the occurrence of inflammatory changes in the oesophagus?
2. Does patients' quality of life improve with time after surgery?
3. Is there a statistically significant correlation between changes during endoscopic study and patients' quality of life, evaluated using QLQ questionnaires?
4. For which surgery is the QLQ quality of life the best?
5. Are QLQ questionnaires a useful tool for evaluating the quality of life of patients after gastrectomy?

## Materials and Methods

The study included 90 patients with a diagnosis SC type III (classification according to J.R. Siewert, 1998), of which 64 were men and 26 were women, the average age was 70-74 years. All participants in the study were informed about the purpose, methods, and potential risks and benefits of the research before giving their written consent to participate. They were assured that their participation was voluntary and that they could

withdraw from the study at any time without any negative consequences. The study was conducted in accordance with the principles of the Declaration of Helsinki and approved by the Ethical Committee of Medical University of Silesia (No. C-239). Patients underwent gastrectomy with D2 lymphadenectomy and reconstructive surgery. All patients were randomised into three groups, depending on the gastrointestinal reconstruction method: A (patients who underwent D2 gastrectomy with Roux-en-Y anastomosis, n=30), B (patients who underwent D2 gastrectomy with Omega-reconstruction, n=30) and C (patients after subtotal resection using the method of gastrointestinal anastomosis according to the Billroth II type, n=30) (Figure 1, Table 1). The exclusion criteria from the study were pronounced manifestations of gastroesophageal reflux disease (GORD) in the preoperative period and inoperability of the SC.

To evaluate the quality of life in the postoperative period, all patients underwent a control evaluation using the EORTC QLQ-OG25 and QLQ-OG30 questionnaires. Also, all patients before and after surgery underwent an endoscopic test with sample collection, followed by an evaluation of the endoscopic changes dynamics (according to the Los Angeles scale, 1999) and the results of histopathological examination. The obtained data were compared with the quality-of-life data obtained from the QLQ-OG25 and QLQ-OG30 questionnaires. The questionnaires included 30 questions that allowed to evaluate the quality of life of patients after gastrectomy using a general health evaluation scale, five functional scales (physical, activity, emotions, social, cognitive functions) and nine accompanying symptom scales (fatigue, pain, nausea and vomiting, shortness of breath, sleep disturbances, constipation, diarrhoea and financial well-being).

Comparative evaluation in the studied groups consisted in determining the presence and possible changes in the severity of inflammatory infiltrates in the studied samples in the same patient (which is important in patients with subclinical GORD before surgery), in relation to the applied methods of GIT reconstructive surgery.

To answer the research questions, statistical analysis was conducted using the statistical analysis package IBM SPSS Statistics 25. It was used to analyse main descriptive statistics, Shapiro-Wilk test, Kruskal-Wallis test, Mann-Whitney test (Shih and Aisner, 2021). The significance level in this chapter was considered to be  $\alpha=0,05$ . Results valid on levels of  $0.05 < p < 0.1$  were considered valid at the statistical trend level.

To verify the assumption that the distributions of the measured quantitative variables correspond to a normal distribution, main descriptive statistics analysis was at first conducted together with the Shapiro-Wilk test. The main descriptive statistics together with the Shapiro-Wilk test result are presented in Table 2.

The test result was statistically significant for all variables, which means that their distribution was statistically significant different from the normal curve. Therefore, nonparametric tests were conducted.

## Results

### Type of conducted procedure and quality of life after the procedure

As part of the first of the study questions, it was decided to check whether the type of performed gastrectomy differ the respondents by the quality of life. For this purpose, the Kruskal-Wallis test was performed, and the Bonferroni-Dunn test was used to test the effects. The following variables were excluded from the study: financial difficulties, choking on swallowing, shortness of breath, constipation intensification, swallowing saliva difficulty, swallowing difficulty, which when dividing subjects into groups became constant. The study showed statistically significant differences for the following variables:

– physical functioning – subjects who underwent the Roux procedure show a statistically significant higher result compared to subjects who underwent subtotal resection or Omega-resection with no differences between subjects from the latter two groups;

– emotional functioning – subjects from the Roux group showed a statistically significant higher level of variable compared to subjects from the Omega group, with no other differences between groups;

– cognitive functioning – subjects from the subtotal resection group show a statistically significant higher level on the abovementioned scale compared to subjects from the Omega group, with no other differences between groups;

– nausea and vomiting – patients after Omega-resection show a statistically significant higher result compared to the Roux group, with no other differences between groups;

– pain – subjects from the Roux group show a statistically significant higher result compared to subjects from the Omega group, with no other differences between

groups;

– insomnia – the Roux group shows a statistically significant higher level of the variable than the subtotal resection group, with no other differences between the groups;

– diarrhoea severity – subjects who underwent the procedure with Omega reconstruction showed a statistically significant lower level of the variable compared to the Roux group and a significantly, at the statistical trend level, a lower result compared to the subtotal resection group with no differences between resection in the Roux group and subtotal one;

– dysphagia – subjects from the subtotal resection group show a statistically significant lower level of the variable compared to the other groups, with no differences between subjects from the Roux and Omega groups;

– eating disorder – respondents after Omega-reconstruction show a statistically significant higher level of the variable than other groups, which do not differ from each other in terms of points on the discussed scale;

– reflux – subjects from the Omega group show a statistically significantly higher level of the variable than other groups that do not differ from each other in terms of the result on this scale;

– anxiety – subjects from the Omega group show a statistically significant higher level of the variable compared to the Roux group, with no other differences between the compared groups;

– hair loss – subjects from the Omega group show a statistically significant lower result on the discussed scale than other groups that do not differ in this variable.

In the case of the remaining variables, the evaluation results were statistically insignificant.

### Inflammatory changes and quality of life after gastrectomy

At the next stage, it was tested whether people with grade B oesophageal affection ( $\geq 1$  erosion  $> 5$  mm long,

Table 1. Clinical Material is a Characteristic of the Studied Groups by Gender and Age of Patients

n=90	Omega-reconstruction n=30	Roux-en-Y n=30	Subtotal resection according to the Billroth II type n=30
Men	18	22	21
Women	12	8	9
Middle age (years)	70	70	74

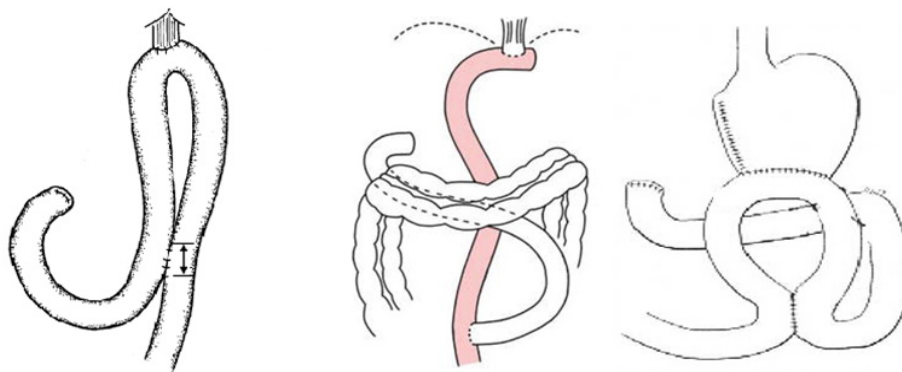


Figure 1. Methods Comparison of GIT Reconstructive Operations

Table 2. The Main Descriptive Statistics with Shapiro-Wilk Test Regarding Age, Time after Surgery and Key Measures QLQ-C30 and QLQ-OG25 in all respondents

	M.	Mdn	SD	Sk.	Kurtosis	Min.	Max.	W	p
Age	71.41	73	11.16	-0.72	0.67	37	92	0.963	0.012
Time after surgery	3.07	3	1.8	0.4	-1.16	1	7	0.886	<0.001
QLQ-C30									
General state of health	4.68	4.75	1.15	0.01	-0.79	2.5	7	0.96	0.007
Physical functioning	1.59	1.4	0.53	0.86	-0.26	1	3	0.883	<0.001
Emotional functioning	1.59	1.5	0.56	0.49	-0.77	1	3	0.876	<0.001
Cognitive functioning	1.49	1.5	0.51	1.09	1.03	1	3	0.82	<0.001
Social functioning	1.32	1	0.51	1.61	2.13	1	3	0.67	<0.001
Fatigue	1.7	1.67	0.64	0.57	-0.73	1	3.33	0.893	<0.001
Nausea and vomiting	1.21	1	0.37	1.58	1.44	1	2.5	0.619	<0.001
Pain	1.33	1	0.57	1.76	2.41	1	3.5	0.64	<0.001
Shortness of breath	1.17	1	0.4	2.33	4.88	1	3	0.448	<0.001
Insomnia	1.61	1	0.98	1.37	0.52	1	4	0.656	<0.001
Loss of appetite	1.34	1	0.62	1.63	1.48	1	3	0.59	<0.001
Constipation intensification	1	1	0	-	-	1	1	-	-
Diarrhoea intensification	1.42	1	0.65	1.29	0.46	1	3	0.652	<0.001
QLQ-OG25									
Dysphagia	1.29	1	0.47	1.67	1.76	1	2.67	0.675	<0.001
Eating disorder	1.61	1.5	0.57	0.67	-0.52	1	3	0.893	<0.001
Reflux	1.74	1.5	0.75	0.48	-1.01	1	3.5	0.84	<0.001
Odynophagia	1.36	1	0.48	0.93	-0.17	1	3	0.694	<0.001
Discomfort	1.48	1	0.66	1.21	0.46	1	3	0.73	<0.001
Anxiety	2.47	2	0.68	0.39	-1.28	1.5	3.5	0.85	0.001
Dry mouth	1.23	1	0.73	3.05	8.47	1	4	0.36	<0.001
Problems with the sense of taste	1.33	1	0.8	2.31	4.26	1	4	0.47	<0.001
Own-Body Perception	1.3	1	0.75	2.59	6.13	1	4	0.47	<0.001
Swallowing saliva difficulty	1	1	0	-	-	1	1	-	-
Choking on swallowing	1.13	1	0.35	2.27	3.39	1	2	0.4	<0.001
Cough	1.03	1	0.18	5.48	30	1	2	0.18	<0.001
Weight loss	1.57	1	0.82	1.4	1.41	1	4	0.71	<0.001
Hair loss	0.97	1	0.56	-0.02	0.62	0	2	0.73	<0.001

M, middle; Mdn, median; SD, standard deviation; Sk, skew; Kurtosis, excess; Min. and Max, the smallest and largest distribution value; W, Shapiro-Wilk test statistic; p, significance.

not occupying the entire distance between 2 adjacent oesophageal folds) according to the classification of reflux esophagitis (Los Angeles) differ in quality of life from people without damage to the oesophagus (Table 3). For this purpose, the Mann-Whitney test was conducted.

The study showed statistically significant differences in general state of health and dry mouth, where subjects without oesophageal affection showing a higher level on the abovementioned scales. In addition, subjects with no oesophageal changes showed a statistically significant higher level on the diarrhoea severity scale. The effect severity coefficient indicates weak, moderately strong or large differences in terms of the mentioned variables.

#### Gender and quality of life after surgery

Then it was decided to check whether there is a correlation between the gender of the respondents and

the quality of life after the operation (Table 4). For this purpose, the Mann-Whitney test was again performed.

The study showed significant differences at the level of a statistical trend only in the case of one variable: choking on swallowing. It turned out that women show a higher level of this variable than men.

In the next step, it was checked whether the age of the study participants was connected with their quality of life after gastrectomy. For this purpose, a correlation analysis was conducted using the Spearman's rank correlation coefficient (Table 5).

The study showed a statistically significant connection between age and cough, and the correlation coefficient indicated a weak positive connection. The positive nature of the connection indicates that the older the study participants, the higher the level on the cough scale. In addition, age is significantly correlated at the level of a

Table 3. Differences between Subjects with/without Oesophageal Affection in Terms of Quality of Life

	Oesophagus without change (n=69)		Grade B oesophageal affection (n=21)		DIF.	p	$\eta^2$
	M.	SD	M.	SD			
<b>QLQ-C30</b>							
General state of health	4.88	1.12	4	1	-2.95	0.003	0.1
Physical functioning	1.56	0.49	1.68	0.65	-0.26	0.795	<0.01
Emotional functioning	1.53	0.54	1.79	0.57	-2.05	0.04	0.05
Cognitive functioning	1.52	0.55	1.4	0.34	-0.48	0.63	<0.01
Social functioning	1.28	0.52	1.48	0.46	-2.26	0.024	0.06
Fatigue	1.63	0.56	1.94	0.8	-1.59	0.112	0.03
Nausea and vomiting	1.23	0.4	1.14	0.23	-0.43	0.666	<0.01
Pain	1.27	0.47	1.52	0.8	-0.78	0.433	0.01
Shortness of breath	1.19	0.43	1.1	0.3	-0.88	0.379	0.01
Insomnia	1.46	0.74	2.1	1.45	-1.46	0.144	0.02
Loss of appetite	1.23	0.52	1.71	0.78	-3.11	0.002	0.11
Constipation intensification	1.26	0.53	1.38	0.5	-1.34	0.181	0.02
Diarrhoea intensification	1.49	0.7	1.19	0.4	-1.74	0.083	0.03
<b>QLQ-OG25</b>							
Dysphagia	1.28	0.49	1.33	0.39	-1.63	0.103	0.03
Eating disorder	1.58	0.54	1.74	0.65	-0.86	0.391	0.01
Reflux	1.47	0.59	2.62	50	-5.9	<0.001	0.39
Odynophagia	1.3	0.47	1.52	0.46	-2.14	0.033	0.05
Discomfort	1.42	0.62	1.5	0.47	-1.25	0.212	0.02
Anxiety	2.14	0.73	2.02	0.72	-0.85	0.395	0.01
Dry mouth	1.3	0.73	1	0	-2.13	0.033	0.05
Problems with the sense of taste	1.3	0.73	1.1	0.44	-1.51	0.132	0.03
Own-Body perception	1.46	0.92	1.33	0.58	-0.06	0.955	<0.01
Swallowing saliva difficulty	1.1	0.46	1	<0.01	-1.12	0.262	0.01
Choking on swallowing	1.07	0.26	1.05	0.22	-0.4	0.691	<0.01
Cough	1.09	0.28	1.05	0.22	-0.59	0.558	<0.01
Weight loss	1.45	0.72	1.29	0.46	-0.65	0.519	<0.01
Hair loss	0.68	0.58	0.86	0.57	-1.22	0.221	0.02

statistical trend with dysphagia (weak positive connection) and dry mouth. In the case of the latter, Spearman's rho coefficient indicates a weak negative connection. This means that the older the study participants, the lower the dry mouth level. In the case of other variables not listed, the results of the study did not determine a statistically significant result.

As part of the last study hypothesis, it was checked whether the time after gastrectomy is correlated with the respondents' quality of life. For this purpose, a correlation analysis with Spearman's rho coefficient was again performed. The study showed a statistically significant connection between time after surgery and physical, emotional, cognitive, social functioning, fatigue, pain, insomnia, loss of appetite, constipation intensification, severity of diarrhoea, eating disorder, acid reflux, odynophagia, pain, discomfort, and dry mouth. In all cases, it is referred to weak and moderately strong associations. This means that the less time that has passed after the procedure, the higher the results on the abovementioned scales are shown by the respondents. In

addition, time after surgery is significantly correlated at the level of a statistical trend with general state of health (weakly positive), with subjects who had more time after the procedure showing a higher level on this scale. In the case of other variables not listed, the study provided a statistically insignificant result.

## Discussion

Surgical resection continues to be the main treatment option for SC. The history of the development, establishment and improvement of gastrectomy dates back more than 100 years. During this period, the development of the most reliable and physiological method of reconstruction after gastrectomy, which can ensure the normal quality of life of patients, became the priority direction of numerous studies. This data from the literature shows that due to the development of modern medicine, the survival rates of patients with SC are improving every year, accordingly, the issue of the quality of life of patients of this group is becoming more urgent problem,

Table 4. Differences between men and Women in Terms of Quality of Life

	Men (n=61)		Women (n=29)		DIF.	p	$\eta^2$
	M.	SD	M.	SD			
<b>QLQ-C30</b>							
General state of health	4.72	1.22	4.59	1.02	-0.5	0.619	<0.01
Physical functioning	1.57	0.53	1.61	0.55	-0.32	0.75	<0.01
Emotional functioning	1.57	0.58	1.63	0.52	-0.6	0.55	<0.01
Cognitive functioning	1.49	0.47	1.5	0.58	-0.35	0.728	<0.01
Social functioning	1.32	0.49	1.33	0.56	-0.29	0.773	<0.01
Fatigue	1.65	0.61	1.8	0.68	-0.91	0.363	0.01
Nausea and vomiting	1.21	0.38	1.21	0.34	-0.17	0.862	<0.01
Pain	1.3	0.54	1.38	0.62	-0.69	0.491	0.01
Shortness of breath	1.18	0.43	1.14	0.35	-0.34	0.731	<0.01
Insomnia	1.57	0.96	1.69	1.04	-0.36	0.718	<0.01
Loss of appetite	1.34	0.6	1.34	0.67	-0.24	0.81	<0.01
Constipation intensification	1.33	0.57	1.21	0.41	-0.82	0.41	0.01
Diarrhoea intensification	1.41	0.64	1.45	0.69	-0.21	0.835	<0.01
<b>QLQ-OG25</b>							
Dysphagia	1.31	0.49	1.25	0.42	-0.42	0.674	<0.01
Eating disorder	1.61	0.58	1.63	0.55	-0.42	0.674	<0.01
Reflux	1.76	0.77	1.69	0.7	-0.34	0.734	<0.01
Odynophagia	1.39	0.49	1.29	0.43	-0.79	0.431	0.01
Discomfort	1.41	0.55	1.5	0.65	-0.45	0.65	<0.01
Anxiety	2.08	0.67	2.17	0.85	-0.36	0.717	<0.01
Dry mouth	1.23	0.64	1.24	0.69	-0.09	0.932	<0.01
Problems with the sense of taste	1.21	0.64	1.34	0.77	-0.94	0.348	0.01
Own-Body perception	1.44	0.83	1.41	0.91	-0.56	0.576	<0.01
Swallowing saliva difficulty	1.07	0.4	1.1	0.41	-0.76	0.446	0.01
Choking on swallowing	1.08	0.28	1.07	0.26	-0.21	0.831	<0.01
Cough	1.41	0.69	1.41	0.63	-0.24	0.813	<0.01
Weight loss	0.7	0.59	0.76	0.58	-0.43	0.666	<0.01

which became the area of interest in the conducted study (Angelis et al., 2014; Didkowska et al., 2019; Ajani et al., 2022). Angelis et al. (2014) reported that survival rates for patients with stomach cancer have improved over time, with the five-year relative survival rate increasing from 19.0% to 22.7% for men and from 20.7% to 25.2% for women between the periods of 1999-2001 and 2005-2007. These findings highlight the importance of improving the quality of life of patients with stomach cancer after treatment, which can be achieved through the development of effective methods of gastrointestinal reconstruction.

The key task of modern medicine is not only to extend the life of patients, but first of all, to improve and approach the quality of life of patients that was before the disease. Therefore, currently there is an increasing interest in studies aimed at evaluating the quality of life of patients suffering from chronic pathology (Siewert and Stein, 1998; Siegel et al., 2022; Quante et al., 2022; Ilson, 2019). J.R. Siewert and H.J. Stein (1998) discuss the classification of adenocarcinoma of the esophagogastric junction, which is important for diagnosis and treatment planning. The classification system proposed by these authors is still

widely used today. In the treatment process, in addition to medical purposes, an important place is provided to non-medical purposes, which include improving the patient's well-being, ensuring effective physical and social functioning. This is especially important in the case of chronic or incurable diseases, in which it is impossible to fully achieve the intended medical purposes. It is in such cases where the purposes aimed at increasing the comfort of the patient's life come to the fore (Lauren, 1965; Kalmar et al., 2011). Lauren (1965) proposes a histo-clinical classification of gastric carcinoma based on two main histological types: diffuse and so-called intestinal-type carcinoma. This classification system is still in use today and is helpful in determining prognosis and treatment options for patients with gastric cancer.

Currently, to evaluate the patient's quality of life, two aspects are taken into account: objective and subjective. Purely technical, objective physical examinations focus on evaluating the effect of therapy on symptom control and complication rates. While the subjective quality of life can be evaluated based on questions aimed at the patient. The conducted study for the first time determines the quality of

Table 5. The Connection between Age and Quality of Life

		Age
QLQ-C30		
General state of health	Spearman's rho	-0.08
Physical functioning	Relevance	0.431
Emotional functioning	Spearman's rho	-0.05
Cognitive functioning	Relevance	0.616
Social functioning	Relevance	0.247
Fatigue	Spearman's rho	0
Nausea and vomiting	Relevance	0.987
Pain	Spearman's rho	-0.04
Shortness of breath	Relevance	0.7
Insomnia	Spearman's rho	-0.02
Loss of appetite	Relevance	0.882
Constipation intensification	Spearman's rho	0,08
	Relevance	0.432
General state of health	Spearman's rho	-0.11
Physical functioning	Relevance	0.305
Emotional functioning	Spearman's rho	0.09
Cognitive functioning	Relevance	0.428
Social functioning	Spearman's rho	-0.01
Fatigue	Relevance	0.939
Nausea and vomiting	Spearman's rho	-0.03
Pain	Relevance	0.771
Shortness of breath	Spearman's rho	-0.08
Insomnia	Relevance	0.455
Loss of appetite	Spearman's rho	-0.05
Constipation intensification	Relevance	0.664
Diarrhoea intensification	Spearman's rho	0.1
	Relevance	0.372
	Relevance	0.656
QLQ-OG25		
Dysphagia	Spearman's rho	0.2
	Relevance	0.062
Eating disorder	Spearman's rho	0.01
	Relevance	0.938
Reflux	Spearman's rho	-0.13
	Relevance	0.212
Odynophagia	Spearman's rho	0.07
	Relevance	0.537
Discomfort	Spearman's rho	-0.01
	Relevance	0.956
Anxiety	Spearman's rho	-0.06
	Relevance	0.565
	Spearman's rho	0.615
Dry mouth	Spearman's rho	-0.19
	Relevance	0.075
Problems with the sense of taste	Spearman's rho	-0.02
	Relevance	0.841
Own-Body perception	Spearman's rho	-0.08
	Relevance	0.471

Table 5. Continued

		Age
QLQ-OG25		
Swallowing saliva difficulty	Spearman's rho	-0.08
	Relevance	0.428
Choking on swallowing	Spearman's rho	0.1
	Relevance	0.372
Cough	Spearman's rho	0.27
	Relevance	0.011
	Relevance	0.495
Weight loss	Spearman's rho	-0.04
	Relevance	0.743
Hair loss	Spearman's rho	0.05
	Relevance	0.661

life according to the QLQ-C30 and QLQ-OG25 scales and correlates them with the result of an endoscopic study of the upper GIT aspects, comparing the subjective feelings of patients with an objective endoscopic evaluation.

GORD, as a result of partial or total gastrectomy, has long been a serious medical problem. Clinical symptoms of GORD, which include pain in the epigastrium, heartburn, bile eructation, vomiting, etc., in some cases can be so pronounced that they significantly affect the quality of life of patients. However, the pathophysiological consequences of gastrectomy are not limited to GORD, but are accompanied by a number of accompanying symptoms and conditions, including: postprandial overload syndrome (abdominal pain, tympany, epigastric fullness, nausea, vomiting and sudden diarrhoea), as well as vasomotor symptoms: blanching of skin, face redness, feeling of general weakness, sudden urge to lie down, headaches, palpitations), temporary obstruction, gastrointestinal motility disorder, anaemia, weight loss, malabsorption of fat-soluble vitamins and trace elements, such as zinc, iron and calcium. The latter factor is also associated with bone disorder.

This study did not compare all consequences of gastrectomy, but focused on the results of endoscopic studies and the subjective feelings of patients to evaluate the association between them. Considering that the measurement of quality of life is a complex, multidimensional and time-consuming process, a constant problem in the study of quality of life and mortality of patients is primarily the loss of contact with the patient and the lack of observation data due to the omission of answers to some questions. The questionnaires used in this study (QLQ-C30 and QLQ-OG25) were created by the European Organization for Research and Treatment of Cancer (EORTC) and are designed to evaluate the quality of life of cancer patients. Their usefulness is confirmed by many international scientific studies. In 2013, the accuracy and reliability of the Polish translation was confirmed in a clinical study conducted by Kalmar et al., (2011).

As it was mentioned above, there are no clear recommendations regarding the gastrectomy technique in SC. The results of the conducted studies demonstrate

the superiority of the Roux-en-Y technique, at least from the perspective of the GORD presence. A factor of reducing the risk of gastrointestinal dysfunction after total gastrectomy should be the use of reconstruction methods with preservation of the duodenal passage. The food passage through the duodenum reduces the disturbance of carbohydrate metabolism, and the glycaemia level is similar to the control group. The postprandial increase in insulin concentration is bigger than in physiological conditions, but significantly lower than in the group of patients without a duodenal passage, this is not provided by any of the studied methods (WHOQOL, 1995; Lugli et al., 2007; Ajani et al., 2022). Ajani et al., (2022) in their research on gastric cancer have discussed the clinical practice guidelines in oncology. The study focused on different treatment options for gastric cancer, including chemotherapy and surgical procedures. The authors have suggested that duodenal passage can be an effective method to reduce the disturbance of carbohydrate metabolism and maintain a stable glycaemia level in patients undergoing gastrectomy. They have also noted that the postprandial increase in insulin concentration is significantly lower in patients with a duodenal passage than in those without it. This study provides important insights into the benefits of duodenal passage as a method for improving the metabolic outcomes of patients undergoing gastrectomy.

During the results analysis of the conducted study, first of all, it is necessary to pay attention to the lack of connection between the type of conducted procedure and inflammatory changes during endoscopic examination, the result is statistically insignificant. Therefore, it can be concluded that this is the key and only one completely objective result of this work. This means that considering only the results of imaging and histopathological studies, it does not matter what type of restoration of GIT continuity will be performed after gastrectomy. However, if it is taken into account, the subjective impressions of the patients, evaluated by the QLQ scales, the results are not so obvious. Participants who underwent GIT reconstruction using the Omega-reconstruction method functioned better physically and emotionally, less often complained of pain and insomnia. They also reported a significantly lower incidence of diarrhoea. Patients after GIT reconstruction according to Roux-en-Y method reported less nausea and vomiting, eating disorder and anxiety. They were also less likely to have GORD symptoms. Patients after subtotal gastrectomy were less likely to report symptoms of dysphagia and had a statistically worse evaluation of cognitive functioning. There was also no difference in the frequency of dysphagia and cognitive functioning in the Omega-reconstruction and Roux-en-Y groups.

The study results also demonstrated a statistically significant positive connection between the development of inflammatory changes in the oesophagus and emotional and social functioning, loss of appetite, acid reflux and odynophagia. This means that the usefulness of the developed questionnaires for evaluating the quality of life in relation to the result of a subjective study was confirmed. A difference evaluation in quality of life between men and women found only more frequent

choking on swallowing among women. Another study conclusion is the connection between the patient's age and quality of life: the older the study participants, the more often they complained of cough, dysphagia, dry mouth, other variables were statistically insignificant.

A very important study result is the connection between time after surgery and physical, emotional, cognitive and social functioning, fatigue, pain, insomnia, loss of appetite, constipation intensification, diarrhoea severity, eating disorder, acid reflux, odynophagia, painful discomfort and dry mouth. Therefore, the following dependence can be observed: the more time passed after the operation, the less often the studied patients complained of the abovementioned symptoms (WHOQOL, 1995; Tomaszewski et al., 2013; Al-Batran et al., 2019; Japanese Gastric Cancer Association, 2022). Only the feeling of anxiety appeared more often in patients in later years after surgery. Similar correlations were observed in the study by Tomaszewski et al., (2013), according to which mechanical and metabolic consequences (overload syndrome, afferent loop syndrome, Roux loop syndrome, GORD) are most severe within 2 years after surgery.

Considering the provided results, it is impossible to state unequivocally which method of gastrointestinal tract reconstruction increases the quality of life of patients after gastrectomy. Summarising this part, it should be noted that, considering the study results, the Roux-en-Y method is burdened by the percentage of comorbidities that worsen the quality of life of patients, Omega-reconstruction and subtotal resection may be alternative options for GIT reconstruction after gastrectomy, and with the corresponding rehabilitation procedures Omega-reconstruction can be an equivalent method. The most optimal solution is a partial gastrectomy, but only with appropriate oncological indications.

In conclusions, The choice of surgical tactics and methods of patients' treatment with SC is a current problem of surgical gastroenterology, which requires further study and development of an individualised approach to the use of reconstructive techniques. Based on the obtained data, it can be concluded that currently it is impossible to unequivocally state which method of gastrointestinal tract reconstruction increases the quality of life of patients after gastrectomy. In particular, the results analysis of the study showed the lack of connection between the type of performed reconstructive surgery and inflammatory changes during endoscopic examination: the result is statistically insignificant. The study was unable to clearly determine which surgical intervention had the best quality of life according to the QLQ scales: individual components of the questionnaires showed different results in different aspects of functioning for the studied patient groups.

Participants who underwent gastrointestinal tract reconstruction using the Omega-reconstruction method functioned better physically and emotionally, less often complained of pain syndrome and insomnia. Patients after GIT reconstruction according to the Roux-en-Y method were less likely to report nausea and vomiting, eating disorder and anxiety. They were also less likely to have



GORD symptoms. Patients in the subtotal gastrectomy group were less likely to report symptoms of dysphagia and had statistically worse cognitive functioning. In the remote period after gastrectomy, the quality of life of patients improved regardless of the chosen reconstruction method. In addition, the study results also showed that QLQ questionnaires are a useful tool for evaluating the quality of life of patients after gastrectomy.

The study found that there was no correlation between the type of surgery performed and the occurrence of inflammatory changes in the esophagus. However, there was a statistically significant correlation between the QOL of patients and the time after surgery. Moreover, changes in endoscopic study were significantly correlated with QOL evaluated in QLQ forms. Interestingly, the study could not clearly determine which surgical intervention had the best QOL according to the QLQ scales. Individual components of the questionnaires showed different results in different functioning aspects for the studied groups of patients. Nevertheless, the QLQ questionnaires proved to be a useful tool for evaluating the QOL of patients after gastrectomy.

Thus, further studies are necessary to confirm the association between the type of reconstructive surgery in SC and the occurrence of inflammatory changes in the GIT.

## Author Contribution Statement

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by Wiktor Krawczyk, Zbigniew Lorenc and Mateusz Mietla. The first draft of the manuscript was written by Michael Nycz and Michael Swiech and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

## Acknowledgements

### Approval

The study was approved by the Ethical Committee of Medical University of Silesia (No. C-239).

### Ethical Declaration

The study was conducted in accordance with the principles of the Declaration of Helsinki.

### Data Availability

Our data is enclosed within this manuscript.

### Informed consent

All participants in the study were informed about the purpose, methods, and potential risks and benefits of the research before giving their written consent to participate. They were assured that their participation was voluntary and that they could withdraw from the study at any time without any negative consequences.

### Conflict of Interest

No conflicts of interest to disclose.

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