Results of Reconstruction with Jejunal Pouch after Gastrectomy: Correlation with Gastrointestinal Motor Activity

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Key Words

Gastrointestinal motility · Jejunal pouch · Gastrectomy, proximal · Gastrectomy, total

Abstract

Background/Aims: To investigate if restoration of esophago-intestinal or esophago-gastric continuity with a jejunal pouch after total or proximal gastrectomy has clinical benefits. **Methods:** We reviewed all relevant reports published after 1990 that dealt with the clinical results of reconstruction with a jejunal pouch after total and proximal gastrectomies and correlated those findings with results for gastrointestinal motility. Reports were chosen from a search of the literature using PubMed. **Results:** After total gastrectomy, the benefit of a jejunal J pouch interposition was not apparent compared to simple jejunal interposition; indeed, one trial concluded that simple interposition was better than pouch interposition in terms of food intake. In contrast, results with a jejunal J pouch during Roux-en-Y (RY) type reconstruction were better than with conventional RY reconstruction in terms of food intake, nutritional status, body weight (BW) and symptoms. Advantages were also shown for a jejunal pouch with an inverted U shape interposed between the esophagus and residual stomach after proximal gastrectomy. Reconstruction using a jejunal pouch after proximal gastrectomy was better than esophagogastrotomy or simple jejunal interposition in terms of food intake, BW

and symptoms. There were not enough data to conclude any benefits of a jejunal J pouch between the gastric remnant and the duodenum after distal gastrectomy. **Conclusions:** Clinical results of restoration of intestinal continuity with a jejunal pouch after total and proximal gastrectomies may be attributed, at least in part, to the relationship between the motor activity of the gastric remnant, duodenum and jejunal pouch.

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Introduction

The incidence of early gastric cancer is increasing in Japan; patients with stage IA and IB gastric cancer according to the Japanese classification of gastric carcinoma [1] account for more than half of all patients with gastric cancer, and 5-year survival rates for stage IA and IB cancer are 93.4 and 87.0%, respectively [2]. Therefore, curative operative procedures that do not impair a patient's quality of life (QOL) would be optimal.

Many techniques for the restoration of intestinal continuity after gastrectomy have been proposed, both to compensate for the lost function of the stomach and in attempts to prevent postgastrectomy syndromes. Reconstruction with a jejunal pouch as a gastric substitute has been used for more than 50 years [3–6]. This construction of a jejunal pouch has been proposed after both total and

Fig. 1. Jejunal pouch reconstruction as a gastric substitute after total, proximal and distal gastrectomy. **a** JPI-T. **b** JPRY-T. **c** JPI-P. **d** JPI-D.

proximal gastrectomies and sometimes even after distal gastrectomy. Although the purpose of reconstruction with a jejunal pouch is to increase the storage capacity for ingested food, the benefits of this method of reconstruction are not yet obvious, and a jejunal pouch cannot be considered the standard reconstructive method. When surgeons create a jejunal pouch as a gastric substitute, they should consider the motor, exocrine and endocrine functions of the stomach and small intestine as they relate to the form of gastrectomy undertaken. The motor function of the stomach differs greatly between the proximal and distal stomach, and upper gastrointestinal motor activity differs between digestive (postprandial) and interdigestive (fasting) states. In the digestive state, food in the stomach is emptied into the duodenum by a very well-organized antro-pyloro-duodenal coordination. As far as we know, few attempts have been undertaken to

interpret the clinical results after jejunal pouch reconstruction from the viewpoint of gastrointestinal motor physiology.

In this review, we present an overview of the physiology of upper gastrointestinal motor activity and the clinical results of reconstruction utilizing a jejunal pouch after total, proximal and distal gastrectomies. The aims of our present study were (1) to investigate if reconstruction with a jejunal pouch has clinical benefit in terms of patients' symptoms, body weight (BW), eating habits, nutritional status and overall QOL and (2) to correlate these results with the motor activity of the upper gastrointestinal tract.

Methods

We searched on PubMed for reports after 1990 dealing with clinical results with a jejunal pouch reconstruction after total, proximal or distal gastrectomy. Keywords for this search were gastrectomy and jejunal pouch. We judged results to be 'better' only when specific comparisons reached statistical significance; when *p* values were not shown or only a tendency was described, the comparisons were considered as showing 'no difference'. The effect of the pouch was regarded as 'positive' when at least one investigated factor was better in the pouch group and as 'negative' when all factors studied were not different from or worse than the control group.

Total Gastrectomy

We summarized the clinical results of the 2 most representative reconstructions using a jejunal pouch (inverted J shape) after total gastrectomy: jejunal pouch interposition between the esophagus and the duodenum (JPI-T; fig. 1a) and Roux-en-Y (RY) type reconstruction with a jejunal pouch between the esophagus and the jejunum (JPRY-T; fig. 1b). In most reports, a jejunal pouch with an inverted J shape was used; however, several papers evaluated a jejunal S pouch reconstruction. We excluded papers that (1) investigated the appropriate size or length of the pouch, (2) reported techniques leaving the sphincter or creating a neo-sphincter and (3) described results after total and subtotal gastrectomy together as one group. We also excluded reports in which the jejunal pouch was created at the site of the jejunojejunostomy (pouch created using a long side-to-side jejunojejunostomy) during conventional RY reconstruction.

Proximal Gastrectomy

We reviewed the clinical results of reconstruction in which an inverted, U-shaped jejunal pouch was interposed between the esophagus and remnant stomach (JPI-P; fig. 1c).

Distal Gastrectomy

We also reviewed the clinical results of reconstruction in which a jejunal pouch with an inverted J shape was interposed between the gastric remnant and the duodenum (JPI-D; fig. 1d).

Results

Gastroduodenal Motor Pattern and Postprandial Gastric Emptying

In dogs, the physiology of gastrointestinal motility has been well documented, including diurnal changes in motor patterns. The motor physiology of the canine stomach is very similar to that of the human stomach [7]. Patterns of motor activity of the stomach and small intestine in dogs are largely divided into digestive and interdigestive states; indeed, very similar patterns are recognized in humans [8, 9].

Figure 2 shows the motor activity of the upper gastrointestinal tract in a dog. In the interdigestive state before feeding, a band of strong contractions migrating from the gastric body to the upper jejunum occurs at regular intervals of 90–120 min. This cyclic pattern of motor activity in the interdigestive state has been referred to as the migrating motor complexes (MMCs) [10, 11]. The role of these high-amplitude, peristaltic MMC contractions is believed to be to propel undigested solid foods distally to prepare for the next meal [12]. There is a distally oriented, decreasing gradient in peak amplitude and frequency of interdigestive contractions that occurs from the duodenum to the jejunoileum; these gradients contribute to aboral propulsions of intraluminal contents in the small intestine, and coordinated contractions in the antrum propel gastric content across the pylorus [13].

With feeding, the MMCs are interrupted and motor activity in the stomach and small intestine changes into a digestive pattern. In the proximal stomach, a vagally mediated decrease in baseline tone occurs after feeding (fig. 2), referred to as ‘receptive relaxation’ and ‘gastric accommodation’. This proximal gastric relaxation serves to receive the bolus of ingesta from the esophagus and to accept increasing intragastric volumes without increasing intragastric pressure substantially. In contrast, regular and continuous phasic postprandial peristaltic contractions are observed in the gastric antrum, duodenum and jejunum (fig. 2). The postprandial gastro-pyloro-duodenal contractile pattern is divided into 3 phases: ‘early’ (the first 20–30 min after feeding), ‘intermediate’ (from 20–30 to 90–120 min after feeding) and ‘late’ (6–8 h after the intermediate phase) (fig. 3) [14].

These 3 phases of the postprandial motor pattern are closely associated with gastric emptying. The patterns of gastric emptying of liquids, digestible solids and indigestible solids are very different [15]. Liquid is emptied by the gradient in pressure which develops between the stomach and the duodenum primarily during the early

Fig. 2. Representative tracing of upper gastrointestinal motility in dogs. The motor activity of the upper gastrointestinal tract can be divided into two patterns, i.e., the interdigestive (fasting) and the digestive (postprandial) patterns. In the interdigestive state before feeding, cyclic changes in motor activity are observed at 90- to 120-min intervals. Arrowheads indicate a band of high-amplitude contractions, i.e. the MMCs. With feeding, this cyclic change in motility was disrupted temporarily. Receptive relaxation (decrease of tone) to store food without increasing intragastric pressure was identified in the gastric body, while continuous contractions appeared in the gastric antrum, duodenum and jejunum.

and intermediate phases (fig. 3). During the intermediate phase, solids are ground or triturated into small particles (less than 1 mm) within the stomach by gastric antral contractions, the so-called antro-pyloric pump. While part of these triturated small particles empties from the stomach across the pylorus, the particles greater than 1 mm are repulsed back into the more proximal stomach, become suspended in the liquid phase of the gastric content and may empty with the liquid [15]. Digestible solids remaining in the stomach after the early and intermediate phases are effectively and actively emptied by contractions in the gastric antrum synchronized with pyloric relaxations and duodenal contractions (antro-pyloro-duodenal coordination) during the late phase (fig. 3). Indigestible solids which remain in the stomach despite all these emptying processes are emptied with the very high-amplitude MMC contractions that occur in the antrum thereafter during restoration of the interdigestive state [15].

Results of Jejunal Pouch Reconstruction after Total Gastrectomy

Construction of a jejunal J pouch after total gastrectomy involves the proximal ‘folded’ portion (proximal pouch) and distal straight portion (distal conduit); the

Fig. 3. A tracing showing the 3 phases of the upper gastrointestinal motor pattern after feeding (from Ueno et al. [14] with permission). Liquid is emptied by the pressure gradient between the stomach and duodenum during the early-intermediate phase. During the intermediate phase, intraluminal solids are triturated into small particles within the stomach by the antral contractions directed toward the pylorus. Because the pylorus is generally 'closed' in the intermediate phase, the small particles of less than

1 mm empty from the stomach across the pylorus, while the larger particles are repelled back into the stomach. Some of the small particles become suspended in the liquid phase of the gastric content and empty with the liquid. Digestible solids remaining in the stomach after the early and intermediate phases are effectively and actively emptied by contraction in the gastric antrum synchronized with pyloric and proximal duodenal relaxation (gastro-pyloro-duodenal coordination) during the late phase.

length of these two portions varies from 7 to 23 cm and from 10 to 33 cm, respectively [16–21].

We found 5 papers that compared clinical results using a JPI-T with those using a straight jejunal interposition (JI-T; table 1). Two studies suggested a benefit with JPI-T, while 3 studies found no benefits. The earliest report retrospectively compared the results across 5 reconstruction types including JPI-T and JI-T and concluded that the jejunal pouch had no advantage with regard to BW and total protein (TP); however, the number of patients evaluated was not satisfactory [21]. Two randomized, controlled trials (RCTs) were published by the same group [19, 22]; the later report in 2002 [22] had more patients and concluded that the clinical results in patients with JPI-T were superior to those with JI-T in terms of eating habits (change in food consumption pattern and number of meals daily) and global health status as examined by the questionnaire validated by the European Organization for Research and Treatment of Cancer. However, the BW and the degree of each symptom examined in the European Organization for Research and

Treatment of Cancer questionnaire did not differ between the groups [22]. In another RCT, Tono et al. [20] found that JPI-T had advantages in terms of BW and TP, but at the same time, patients with JPI-T had more symptoms than those with JI-T. Taken together, these studies suggest that reconstruction with JPI-T has advantages with regard to eating habits, BW and TP, but patients with JPI-T tend to have more symptoms compared to those with JI-T. It should be noted that Mochiki et al. [23] found that patients with a JI-T had better food consumption than patients with a JPI-T, suggesting that the reconstruction using an interposition pouch was detrimental.

There were 9 studies that compared results after the use of a JPRY-T with conventional RY (RY-T; table 2), 4 of which used a jejunal S pouch reconstruction [24–27]. These 4 studies failed to find any advantage of JPRY-T when assessed less than 1 year postoperatively; however, when assessed 3 years postoperatively, the JPRY-T was better in terms of nutrition and symptoms. Bozzetti et al. [28] reported that there were no differences in BW and

Table 1. Summary of studies comparing JPI-T with JI-T

Report	Year	Trial type	Reconstruction types (number of patients)	Longest follow-up period	Results	Benefit of pouch
de Almeida et al. [21]	1994	non-RCT	JPI-T ¹ (5), JI-T (6), JPRY-T (5), RY-T (46), omega ² (2)	15 years	no difference in BW and TP between groups	negative
Hokschi et al. [19]	1999	RCT	JPI-T (19), JI-T (8)	1 year	no difference in eating habits	negative
Hokschi et al. [22]	2002	RCT	JPI-T (28), JI-T (13)	1 year	better eating habits and global health status with JPI-T; no difference in BW and symptoms assessed by the EORTC questionnaire (QLQ-C30)	positive
Tono et al. [20]	2003	non-RCT	JPI-T (11), JI-T (9)	2 years	better BW and TP with JPI-T; more symptoms with JPI-T	positive
Mochiki et al. [23]	2004	RCT	JPI-T (14), JI-T (12)	58 months	better food consumption with JI-T	negative

EORTC = European Organization for Research and Treatment of Cancer.

¹ The pouch was a modified Kock's pouch. ² A Braun (omega) loop anastomosis.

eating habits between these 2 groups but that after JPRY-T, there were less gastrointestinal symptoms; although they concluded that there was no substantive benefit of pouch reconstruction, we classified their results as 'positive' according to our definition. The remaining 4 studies showed a benefit with JPRY-T in terms of eating capacity, food intake, BW, nutrition and symptoms [29–32]. When considered together, these 9 studies suggest that the postoperative results of JPRY-T are generally more favorable than those of RY-T.

Six reports compared the clinical results of JPI-T with those of JPRY-T (table 3); 3 studies compared JPI-T with JPRY-T, while the 3 remaining studies compared JPI-T, JPRY-T and RY-T. The comparisons of JPI-T and JPRY-T found no differences in symptoms, BW and QOL [17, 33, 34]. Nakane et al. [16] reported that after JPRY-T, a benefit was noted in terms of symptoms, food intake and BW recovery compared to JPI-T and RY-T. Schwarz et al. [18] found that the postoperative QOL as assessed by life quality score was greater with JPI-T than with JRY-T and RY-T. They also found that hormone secretion (insulin, cholecystokinin, motilin and pancreatic polypeptide) was more 'physiologic' after JPI-T than after the other 2 types of reconstruction; despite these findings, no differences in BW were observed amongst the 3 groups. Adachi et al. [35] suggested a long-term advantage of pouch reconstruction, because the results after JPRY-T were good in the first 3 years postoperatively, while the results after JPI-T were

better after 3 years postoperatively. Overall, although the use of a J pouch for reconstruction seems beneficial, it remains difficult to suggest which type of pouch reconstruction (JPI-T or JPRY-T) is superior in terms of postoperative QOL.

Results of Jejunal Pouch Reconstruction after Proximal Gastrectomy

Six studies evaluated the clinical results after JPI-P (table 4). Five studies found benefits with a jejunal pouch reconstruction, while 1 study was negative. As a control group for comparison with JPI-P, we believe that esophagogastrectomy or simple jejunal interposition between the esophagus and the remnant stomach (JI-P) would be appropriate. One non-RCT showed that JPI-P was better than JI-P in terms of gastrointestinal symptoms, BW and TP [36]. One RCT found that JPI-P was superior to JI-P in terms of food intake and BW; however, we judged the benefit of the pouch in this report as 'negative,' because *p* values were greater than 0.05 [37]. When JPI-P was compared with esophagogastrectomy, 1 study [38] found that food intake was greater after JPI-P, and gastrointestinal symptoms were fewer with JPI-P than esophagogastrectomy, while the other study reported no benefit of JPI-P [39]. These results indicate that the JPI-P reconstruction appears to have advantages in comparison with JI-P, while any benefit of JPI-P compared with esophagogastrectomy remains uncertain. It should be noted that the

Table 2. Summary of studies comparing JPRY-T with RY-T

Report	Year	Trial type	Reconstruction types (number of patients)	Longest follow-up period	Results	Benefit of pouch
Bozzetti et al. [28]	1996	RCT	JPRY-T (15), RY-T (12)	2 years	no difference in BW, eating habits, TP and albumin; improvement in symptoms with JPRY-T	positive
Liedman et al. [24]	1996	RCT	JPRY-T ¹ (28), RY-T (49), SG (12)	1 year	improvement in symptoms with RY-T; no difference in energy intake and BW	negative
Svedlund et al. [25]	1997	RCT	JPRY-T ¹ (20), RY-T (31), SG (13)	1 year	better QOL with SG compared to JPRY-T and RY-T	negative
Liedman et al. [26]	1998	RCT	JPRY-T ¹ (13), RY-T (23)	over 3 years	improvement in BW and loss of fat stores with JPRY-T; no difference in food intake.	positive
Svedlund et al. [27]	1999	RCT	JPRY-T ¹ (20), RY-T (31), SG (13)	5 years	improvement in indigestion symptoms assessed by GSRS score with JPRY-T	positive
Iivonen et al. [29]	2000	RCT	JPRY-T (20), RY-T (14)	8 years	improvement in eating capacity, dumping, early satiety and BW loss with JPRY-T at 3 years after surgery, but no difference at 8 years	positive
Miyoshi et al. [30]	2001	non-RCT	JPRY-T (22), RY-T (12)	2 years	improvement in eating capacity, QOL assessed by GSRS score and reflux symptoms with JPRY-T; no change in number of meals per day and BW	positive
Nozoe et al. [31]	2001	non-RCT	JPRY-T (14), RY-T (16)	2 years	improvement in BW and serum albumin at 1 year and in prognostic nutritional index ratio at 1 and 3 months with JPRY-T; no difference in heartburn and BW	positive
Kono et al. [32]	2003	RCT	JPRY-T (23), RY-T (24)	3–48 months	improvement in food intake, QOL assessed by GSRS score, BW and bile regurgitation with JPRY-T; no difference in TP, albumin and hemoglobin	positive

SG = Subtotal gastrectomy; GSRS = Gastrointestinal Symptom Rating Scale.

¹ Jejunum S pouch.

jejunal pouch was extremely dilated in some patients after JPI-P and a reoperation was often necessary in this condition [40, 41].

Results of Jejunal Pouch Reconstruction after Distal Gastrectomy

Although several papers described the technique of reconstruction using a JPI-D [42, 43], there were only 2 reports that retrospectively studied the postoperative results after JPI-D. Miwa et al. [44] performed JPI-D in 101 patients and compared the clinical outcome with the results in 64 patients who underwent distal gastrectomy and Billroth I reconstruction; the JPI-D reconstruction proved better in terms of the number of meals able to be ingested per day, dumping syndrome and symptoms of heartburn. Another group reported that JPI-D was better than simple jejunal interposition and Billroth I reconstruction in terms of food intake and symptoms of heartburn [45]. Thus, although advantages of reconstruction

using a jejunal pouch interposition after distal gastrectomy have been reported, only 2 studies have been carried out, and both were retrospective reviews.

Discussion

When the postoperative results after JPI-T are compared with those after JI-T, the benefits of a pouch reconstruction remain controversial for several reasons; firstly, only 2 of the 5 studies concluded that JPI-T was beneficial, and even in those 2 reports, no differences were found in some of the factors evaluated such as gastrointestinal symptoms. Secondly, one RCT showed that food consumption was greater with JI-T than with JPI-T. In contrast, the benefit of a pouch during an RY reconstruction appears to be established; only 2 of 9 studies found no difference in clinical outcomes when JPRY-T was compared to RY-T, while the more recent 6 studies in which patients with

Table 3. Summary of studies comparing JPI-T with JPRY-T

Report	Year	Trial type	Reconstruction types (number of patients)	Longest follow-up period	Results	Benefit of pouch	Which pouch is better
Nakane et al. [16]	1995	RCT	JPI-T (10), JPRY-T (10), RY-T (10)	64 months	improvement in symptoms, food intake and BW recovery with JPRY-T compared to JPI-T and RY-T	positive	JPRY-T
Fuchs et al. [17]	1995	RCT	JPI-T (53), JPRY-T (53)	over 5 years	no difference in BW and QOL assessed by Visick score and Spitzer index	–	no difference
Schwarz et al. [18]	1996	RCT	JPI-T (24), JPRY-T (24), RY-T (12)	6 months	better QOL score, hormone secretion, serum iron levels and hemoglobin with JPI-T; no difference in BW	positive	JPI-T
Nakane et al. [33]	2001	RCT	JPI-T (15), JPRY-T (15)	less than 2 years	no difference in postprandial symptoms, food intake, BW and nutritional parameters; food stasis with JPRY-T but not significant	–	no difference
Adachi et al. [35]	2003	RCT	JPI-T (10), JPRY-T (10), RY-T (10)	over 5 years	better in terms of heartburn, dumping and BW with JPI-T and JPRY-T; better in terms of nutritional evaluation with JPI-T than JPRY-T; better in terms of nutrition risk index with JPI-T than RY-T	positive	short term: JPRY-T; long term: JPI-T
Takeshita et al. [34]	2007	non-RCT	JPI-T (12), JPRY-T (12)	15 years	no significant difference in symptoms between the 2 groups	–	no difference

JPRY-T were followed for more than 2 years concluded that JPRY-T was superior to RY-T in terms of gastrointestinal symptoms, QOL, eating capacity, BW and nutrition.

We believe that the motor activity of the jejunal pouch could account for this difference between JPI-T and JPRY-T. The jejunal pouches in JPI-T and JPRY-T are created in an attempt to compensate for the loss of the reservoir function of the proximal stomach. Although the jejunum does not have the ability to undergo ‘receptive relaxation’, contractile activity of the proximal, folded portion of the jejunal J pouch decreases due to the longitudinal transection performed during the creation of the pouch [23]. Therefore, the jejunal pouch appears to function as a reservoir at least to some extent. After a JPI-T, the ‘distal conduit’ of the jejunal pouch has to empty the food stored in the proximal part of the pouch into the duodenum, where the contractile activity (amplitude and frequency of contractions) is greater than in the jejunum. As we mentioned above during the discussion of the motor physiology of the upper gastrointestinal tract, the contractile force decreases progressively from the gastric antrum to the jejunum, and the frequency of contractions decreases from the duodenum to the jejunum, and this phenomenon is associated in part with the progressive transit of intraluminal contents in the aboral direction. Postprandial gastric emptying is very well organized in terms of the strong peristaltic contractions in the gastric antrum and is associated temporally with antro-pyloro-duodenal coordina-

tion. It would not be expected that the distal conduit of the jejunal pouch would function similarly to the gastric antrum; indeed, the contractile activity of the distal jejunal conduit of the J pouch probably does not allow smooth pouch-duodenal emptying, and thus the pouch in JPI-T could act as a reservoir but with a poor emptying function. The situation is different with JPRY-T, because the distal jejunal conduit of the pouch does not have to empty food toward a site (duodenum) which has a greater inherent frequency and amplitude of contractions. Therefore, the transit of intraluminal contents after they leave the jejunal pouch after JPRY-T may be considered more ‘physiologic’ than after JPI-T. We hypothesize that the relatively poor ‘emptying’ of a JPI-T might lead to the higher incidence of postprandial gastrointestinal symptoms.

Although the results above suggest that JPRY-T seems advantageous compared to JPI-T, long-term postoperative results were not so different when direct comparisons were made between JPRY-T and JPI-T (table 3). A multicenter RCT comparing JI-T, JPI-T, RY-T and JPRY-T would help resolve this issue. Comparison between JPI-T and JPRY-T also begs the question of whether the passage of ingested content through the duodenum is important to maximize patients’ QOL. Two review papers concluded that this ‘duodenal passage’ was not associated with improvement in postoperative QOL [46, 47].

With regard to proximal gastrectomy, most studies have reported that a JPI-P offers a benefit compared to a

Table 4. Summary of results with JPI-P

Report	Year	Trial type	Reconstruction types (number of patients)	Longest follow-up period	Results	Benefit of pouch
Takeshita et al. [50]	1997	non-RCT	JPI-P (12), JI-P (UK), JI-T (UK)	2 years	physiological in terms of gastric emptying determined by radio-opaque markers	positive
Kameyama et al. [36]	2004	non-RCT	JPI-P (59), JI-P (13)	17 years	improvement in symptoms, BW and TP with JPI-P	positive
Yoo et al. [51]	2005	RCT	JPI (25), RY-T (26)	3 years	better in terms of frequency of postgastrectomy syndrome, food intake, BW, hemoglobin and vitamin B ₁₂ with JPI-P; no difference in TP and albumin	positive
Iwata et al. [37]	2006	RCT	JPI-P (4), JI-P (5)	3 months	better food intake and BW (p values greater than 0.05)	negative
Hoshikawa et al. [38]	2001	non-RCT	JPI-P (21), EG (23)	3 years	improvement in BW and symptoms; no difference in TP and albumin	positive
Okino et al. [39]	2008	non-RCT	JPI-P (14), EG (22)	10 years	no difference in symptoms, food intake, BW and nutrition; more food residue in JPI-P	negative

UK = Unknown; EG = esophagogastrostomy.

JI-P or esophagogastrostomy. The rationale for the use of a pouch is that it would help to restore the gastric reservoir function lost after proximal gastrectomy. The hepatic and celiac branches of the vagus nerves are often preserved after proximal gastrectomy [48], but the vagal innervation to the gastric antrum (nerves of Latarjet) is transected. If the postprandial, antro-pyloro-duodenal coordination is preserved after proximal gastrectomy, interposing a jejunal pouch between the esophagus and the distal gastric remnant as a reservoir would appear quite rational. One factor affecting antro-pyloro-duodenal coordination is the size of the gastric remnant. It is unknown whether transection of the gastric body at various levels and transection of the hepatic-pyloric, celiac or antral vagal branches alter postprandial antro-pyloro-duodenal coordination, and the effects of these and other variables during proximal gastrectomy will likely prove important.

We do not have enough data to conclude that JPI-D offers any clinical advantage. After distal gastrectomy, the reservoir function of the proximal stomach, although greatly impaired, still remains [10]. Therefore, JPI-D is designed to replace the emptying function of the gastric antrum lost after distal gastrectomy. As with JPI-T, it is unknown if the jejunum can empty food smoothly and effectively into the duodenum. More information is nec-

essary to conclude that a JPI-D offers any clinical advantages over a Billroth I gastroduodenostomy.

Several factors other than motor activity are also considered to influence the function of the gastric remnant and the jejunal pouch, which may affect patients' symptoms. The degree of extrinsic denervation of the gastric remnant affects not only motor but also exocrine and endocrine functions. The length and volume of the jejunal pouch are also considered to be important factors for the function of the pouch [16, 49] and will require further investigation.

As seen in tables 1–4, the numbers of patients who underwent each type of reconstruction were less than 20 in many studies and about 50 at most, limiting the reliability of the conclusions. Because of difficulties with standardizing reconstructive techniques between institutions, performing a multicenter trial to acquire a statistically valid number of patients is never easy. Therefore, it is not possible to make strong conclusions based on the current literature about which types of reconstructive procedures are superior in terms of QOL. Another problem noted in the interpretation of the various outcomes is that the primary end point(s) often varied across studies. There are many parameters used to assess global QOL, such as BW, eating capacity or eating habits, overall nutritional status, gastrointestinal symptoms and physi-

cal functioning assessed by various scores; which of these measures of overall QOL are superior remains unknown. In addition, from the patient's perspective, the importance of any one parameter will likely vary between individuals.

We conclude that when compared to RY-T, JPRY-T offers benefits in terms of postoperative QOL as assessed by food intake, gastrointestinal symptoms and nutritional parameters, including BW. There was no obvious benefit of JPI-T when compared to JI-T. JPI-P may be advantageous compared to JI-P and esophagogastrostomy, but there were too few studies to reach any valid, evidence-

based conclusions. When considered in the context of motor activity, we believe that many of the findings regarding pouch function can, at least in part, be attributed to the motor activity of the residual stomach, duodenum and jejunal pouch.

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