Original Article

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Comparison of Performance and Clinical Outcome of Three Methods of Straight, Side-to-End, and Colonic J-Pouch Colorectal Anastomosis in Patients with Rectal Cancer

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ABSTRACT

BACKGROUND AND OBJECTIVE: There are several techniques for preserving the rectum in Low Anterior Resection (LAR) and preventing permanent ostomy. However, the superiority of these techniques is still under debate. The aim of this study was to compare the performance and clinical outcome of three methods of straight, side-to-end, and colonic J-pouch colorectal anastomosis in patients with rectal cancer referred to Imam Khomeini Hospital in Sari.

METHODS: In this prospective single-blind clinical trial, all 75 patients with rectal cancer over the age of 18 years with primary rectal tumor with resection capability and position of the lower or middle rectum 4 to 12 cm from the anal canal, during the period of 2017 to 2018 referred to Imam Khomeini Hospital in Sari, were randomly divided into three groups of 25 people using block sampling: (the first group: low anterior resection with straight anastomosis, the second group: surgery with colonic J-pouch and the third group: side-to-end anastomosis). Functional outcomes (measured by Wexner criteria) and surgical complications were compared in the two groups, and patients were followed up to evaluate the functional features of the anastomosis.

FINDINGS: 60 patients including 29 women (48.33%) and 31 men were analyzed. The mean age of patients was 58.32±14.91 years. The mean length of surgery, median hospitalization and median bleeding in patients undergoing J-pouch anastomosis were 178.65±14.21 minutes, four days and 500 ml, respectively. No surgery-related complications were seen in the three groups. The Wexner criterion showed the superiority of patients who underwent J-pouch anastomosis surgery in the variables of daily defecation frequency, fecal incontinence and emergency defecation compared to the other two groups ($p<0.001$, $p<0.005$, $p<0.022$).

CONCLUSION: The results of this study showed that the performance indices of patients with rectal cancer in people undergoing J-pouch anastomosis are better compared to side-to-end and straight methods.

KEY WORDS: *Rectal Neoplasm, Proctectomy, Surgical Anastomosis.*

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Introduction

Colorectal cancer is the third most common cancer in the world after lung cancer and breast cancer, and is also the fourth leading cause of cancer death in the world. Colorectal cancer is the third most common cancer in men and the second most common cancer in women. Low Anterior Resection (LAR) from the anterior abdomen along with complete mesenteric resection is the gold standard for the treatment of lower and middle rectal cancers (1). Approximately 50% of patients with rectal cancer present refer with exacerbation of functional symptoms as well as postoperative complications such as leakage at the anastomotic site following intestinal anastomosis after low anterior resection (due to reduced rectal capacity) (2, 3).

The above-mentioned complication and symptoms cause great trouble and have a great impact on the quality of life and mortality of patients (4-6). Various techniques such as J-pouch surgery, side-to-end anastomosis, and straight end-to-end method for preserving the rectum have been reported in low anterior resection to avoid the need for permanent ostomy as well as less surgical complications. However, the superiority of these methods in scientific sources is still debated.

An alternative to the traditional straight end-to-end rectal anastomosis is to create a 6-cm-long reservoir (J-pouch) to improve patients' excretory function and eliminate the need for other treatments (7-9), but this procedure is possible in approximately 60% of patients due to technical limitations (e.g., narrow pelvis, internal anal sphincters, insufficient length of the large intestine or diverticulosis) (10). Side-to-end anastomosis with a 3-cm end piece is another option that can be performed in most non-obese patients (11). The results of the above methods have been extensively reviewed in several randomized trials and meta-analysis studies, but contradictory results have been reported (9, 11-19).

This study was designed to determine the standard method in anastomotic surgery of rectal cancer patients. The aim of this clinical trial was to compare the functional and clinical results of three methods of rectal anastomosis (straight, side-to-end, and colonic J-pouch colorectal anastomosis) in patients diagnosed with rectal cancer who were referred to Imam Khomeini Hospital in Sari.

Methods

After approval by the Ethics Committee of Mazandaran University of Medical Sciences with the code IR.MAZUMS.IMAMHOSPITAL.REC.1397.018, this randomized, single-blind and parallel clinical trial was performed for two years from 2017 to 2018 in Imam Khomeini Hospital (Sari, Iran) affiliated to Mazandaran University of Medical Sciences. Taking into account the drop rate of 20% based on Rybakov study (20), the total sample size was 75 and the number of samples in each group was 25 people. All participants expressed their written consent before entering the study. This clinical trial has been registered in the Iranian clinical trial registration system with the code IRCT20141218020364N12.

All patients with operable primary rectal adenocarcinoma, located 4 to 12 cm from the anal opening who referred to Imam Khomeini Hospital in Sari, complete medical records, possibility of functional and oncological preservation of the anal sphincter, age of at least 18 years, anastomosis with the use of stapling and tools were included in the study.

Patients with incomplete records, continued treatment in other centers, lack of access to information, unknown tumor stage, incurable surgery, previous colon resection, hand-stitched anastomosis were excluded from the study. Patients were instructed about the clinical features of surgical procedures and then all patients were referred to the colon clinic for randomization.

Demographic information (age, gender), disease history, symptoms, tumor stage, tumor type, types of treatment, tumor differentiation, tumor size and tumor location were extracted from patients' documents and recorded in a questionnaire. Patients were educated about the clinical features of surgical procedures. Seventy-five patients with rectal cancer were randomly divided into three groups by pulling sealed envelopes and randomized block design using a computer-based random digit generator based on patient code by a surgical assistant (Figure 1).

The resection of the lower part of the rectum from the anterior abdomen was performed by total mesorectal excision method with complete excision with straight end-to-end anastomosis in group A, patients in group B underwent J-pouch anastomosis and group C underwent side-to-end anastomosis. The primary outcome of the study included the duration of surgery (minutes), hospital stay (days), and bleeding volume (cc). Postoperative follow-up was performed on days 15, 30, 60 and 180.

Secondary outcome of the study included functional outcomes and surgical complications (e.g., leakage at

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the anastomosis site and wound infection and dehiscence). Wexner Qualitative Performance Scale including the frequency of defecation (1 or 2 times, 3 to 6 times and, more than 6 times a day), stool consistency (loose, normal, fluid), stool leakage (no, diarrhea, always), feeling of urgency (normal, short), difficult defecation (yes, no), was used for postoperative bowel function. Performance evaluation was done using Wexner Qualitative Scale on the seventh day, second month and sixth month. Carcinoembryonic antigen levels, chest radiographs, abdominal ultrasounds, and sigmoidoscopy were performed to detect recurrence or metastasis 6 months after the operation. The Anticancer Association classification was used to stage rectal cancer (21).

In this single-blind study, participants were unfamiliar with the three types of anastomotic surgeries. In addition, the observer who completed the questionnaire was unfamiliar with the groups. Similarly, the data analyst was not aware of the study groups. The lead researcher (surgeon) was aware of the groups and all surgical procedures were performed by the same surgeon. The Safety and Data Monitoring Committee was informed about the study groups. The diagnosis of rectal cancer was confirmed by colonoscopy of the lower gastrointestinal tract and evaluation of a pathology faculty member according to WHO criteria. All clinical examinations and surgical procedures were performed by a colorectal surgeon.

Quantitative data were described using mean and standard deviation or median and qualitative data were analyzed using prevalence (percentage) and using Chi-square test. The mean differences between the quantitative variables in the three groups were analyzed using the ANOVA test. After examining the distribution of quantitative variables and proving that many variables do not have a distribution other than the normal distribution, Kruskal-Wallis test was used to test the difference between the mean of the variables, which has no post hoc test. The hemoglobin variable was analyzed and reported by post hoc Tukey test. IBM SPSS 21 was used for data analysis and $p<0.05$ was considered significant.

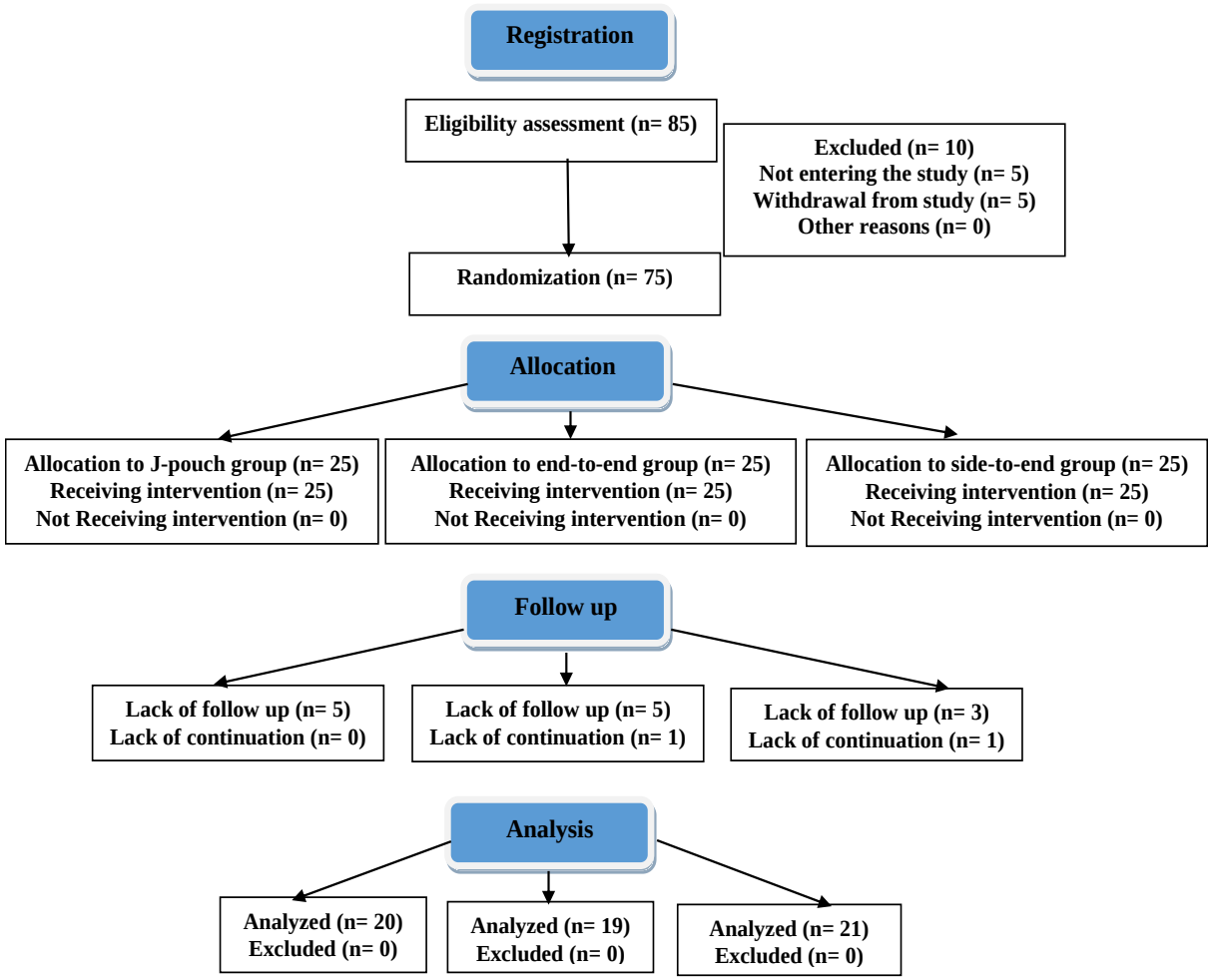

Figure 1. Diagram of patient inclusion and exclusion from the study till the data analysis stage

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Results

A total of 85 patients were evaluated for eligibility from 2017 to 2018 and 75 of them were included in the study. Ten people were excluded from the study because they either did not meet the inclusion criteria (5 people) or refused to participate in the study (5 people). Five patients withdrew from the study. Finally, 60 patients including 29 women (48.33%) and 31 men (51.66%) were statistically analyzed (Figure 1). The mean age of patients was 58.32±14.91 years. There was no significant difference between the three groups in terms of age, gender, body mass index, hemoglobin and white blood cell count. In total, 17 patients (28.3%) underwent preoperative chemoradiotherapy, of which 13 patients were in the J-pouch group (p<0.001). Corticosteroids use and smoking rates in the J-pouch group and side-to-end anastomosis group were 20% and 28.6%, respectively. These rates were not statistically significant. Tumor distance from anal verge in J-pouch, side-to-end and end-to-end groups were 7.15±2.10 cm, 6.61±1.88 cm and 7.47±1.61 cm, respectively (p=0.275). The distance from the anastomosis site to the anal verge in the J-pouch, side-to-end and end-to-end groups were 4.85±1.75 cm, 4.52±1.69 cm and 5.17±0.30 cm, respectively (p=0.418). The mean length of surgery, median hospitalization and median bleeding in patients undergoing patch anastomosis were 178.65±14.21 minutes, four days and 500 ml, respectively. No surgery-related complications were seen in the three groups. The mean length of surgery, median hospitalization and median bleeding in patients undergoing J-pouch anastomosis were higher compared to the other two groups (p<0.001) (Table 1).

Table 1. Comparison of main demographic, clinical and surgical components of rectal cancer patients referred to Imam Khomeini Hospital in Sari in each group

Items	Groups based on the type of anastomosis Side-to-end (21) Number(%) or Mean±SD	J-pouch (20) Number(%) or Mean±SD	End-to-end (19) Number(%) or Mean±SD	p-value
Age (median)	61(24)	5(24.75)	61(21)	0.85*
gender				
male	10(47.6)	13(65)	8(42.1)	0.29**
female	11(52.3)	7(35)	11(57.9)	
Body Mass Index (Median)	21(4.25)	22.5(2.75)	20.5(2.5)	0.07*
hemoglobin	10.8(2.8)[a]	12(1.3) a	11.1(1.7) a	0.14***
White blood cells (Median)	6350(3175)	6989(2000)	7347(2800)	0.34*
Corticosteroids use				
yes	1(4.8)	4(20)	0(0)	0.06**
no	20(95.2)	16(80)	19(100)	
Frequency of receiving chemoradiotherapy				
yes	1(4.8)	13(65)	3(15.8)	0.001**
no	20(95.2)	7(35)	16(84.2)	
Smoking				
yes	6(28.6)	5(25)	4(21.1)	0.86**
no	15(71.4)	15(75)	15(78.9)	
Surgical drainage catheter				
yes	9(43)	19(95)	16(84)	0.001**
no	12(57)	1(5)	3(16)	
Underlying disease				
Multiple	2(9.6)	0(0)	0(0)	0.13**
Heart disease	0(0)	1(5)	0(0)	
Anemia	4(19)	0(0)	0(0)	
High blood pressure	1(4.8)	1(5)	0(0)	
High Blood lipids	0(0)	1(5)	0(0)	
Inflammatory bowel disease	0(0)	1(5)	0(0)	
Rheumatoid arthritis	0(0)	1(5)	0(0)	
None	14(66.7)	15(75)	19(100)	
Duration of surgery (minutes)	117.47±6.46	178.65±14.21	167.36±17.66	0.001*
Day of hospitalization (median)	3(0)	4(1)	3(2)	0.001*
Blood lost (cc, median)	300(50)	500(162.5)	345(100)	0.001*
Tumor location (cm)	6.61±1.88	7.15±2.10	7.47±1.61	0.275*
Anastomosis level of anal verge	4.52±1.69	4.85±1.75	5.17±1.30	0.418*
Disease stage				
1	2(9.52)	4(20)	3(15.78)	-
2 a	10(47.61)	5(25)	7(36.84)	
2 b	2(9.52)	4(20)	3(15.78)	
3 a	2(9.52)	2(10)	1(5.26)	
3 b	2(9.52)	4(20)	2(10.52)	
3 c	3(14.28)	1(5)	3(15.78)	

*Kruskal–Wallis statistical test, **Chi-squared, ***ANOVA (Post-hoc test (Tukey))

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In general, 9 patients were in stage 1 (15%), 31 patients were in stage 2 (51.7%) and 20 patients were in stage 3 (33.3%). There was no significant difference between the groups in terms of tumor stage. According to Wexner criteria, the number of normal bowel movements was reported in 70% of patients in the J-pouch group, while in the other two groups it occurred more frequently (62%, 53%, p<0.001). Liquid stools and diarrhea were observed in 6 patients (31%) in the end-to-end anastomosis group and 5 patients (24%) in the side-to-end anastomosis group, but none of the patients in the J-pouch group had liquid bowel movements (p=0.029).

The results showed that patients in the J-pouch group had better results in terms of fecal leakage and sense of emergency excretion compared to other methods. There was no significant difference between groups in terms of difficult defecation (Table 2).

Table 2. Comparison of functional outcomes using Wexner criterion between study groups

Items	Groups based on type of anastomosis			p-value
	Side-to-end (21) A	J-pouch (20) B	End-to-end (19) C	
Frequency of defecation				
Normal	4(19)[a]	14(70)[a]	2(10)[a]	
Frequent	13(62)[a]	6(30)[a]	10(53)[a]	0.001*
More than 6 times	4(19)a	0(0)[b]	7(37)[a]	
Stool consistency				
Normal	4(14)[a]	9(45)[a]	3(16)[a]	
Loose	13(62)[a]	11(55)[a]	10(53)[a]	0.029*
Liquid	5(24)[a]	0(0)[b]	6(31)[a]	
Stool leakage				
Never	4(19)[a]	14(70)[b]	4(21)[a]	
Diarrhea	11(52)[a]	6(30)[a]	11(58)[a]	0.005*
Always	6(29)[a]	0(0)[b]	4(21)[a]	
Feeling of emergency defecation				
Normal	4(19)[a]	13(65)[b]	7(37)[a,b]	0.022*
Short	17(81)[a]	7(35)[b]	12(63)[a,b]	
Hard stools				
Yes	0(0)[a]	1(5)[a]	1(6)[a]	0.580*
No	21(100)[a]	19(95)[a]	18(94)[a]	

*Chi-square (Cochran's and Mantel-Haenszel statistics)

Discussion

The results of the present study showed that the J-pouch anastomosis technique has better functional outcomes compared to the other two methods in our colorectal surgery center. Approximately 70% of patients in the J-pouch group had a normal sequence of bowel movements, whereas in the end-to-end and side-to-end anastomosis patients, this parameter was lower. The results showed that the J-pouch method leads to less feeling of urgency and less stool leakage. Previous studies have shown that the J-pouch colonic reservoir creates a new and larger rectal reservoir compared to the straight end-to-end anastomosis method (22). In this method, the 8 cm end of the colon is used to create a bag with an initial volume of 60 to 105 ml, the optimal capacity that facilitates emptying without damaging the defecation (7-9, 23, 24). As in the present study, Hüttner et al. reported that the J-pouch reservoir resulted in better functional outcomes than straight colon anastomosis in the first eight months after surgery. Certainly, a G-shaped reservoir has fewer bowel movements per day and the patient will need less antidiarrheal drugs in the short term (11). In various studies, compared to straight end-to-end anastomosis, the J-pouch method had no more mortality and morbidity (anastomotic leakage or stenosis, bleeding, reoperation) (11, 13, 14, 19, 25, 26). However, in a recent meta-analysis, it was reported that colon reconstruction with the J-pouch did not reduce anastomotic site leakage and postoperative complications compared with straight end-to-end anastomosis (17). In the present study, no surgical complications were reported. In general, in those patients who are not candidates for the J - pouch method for technical reasons (19), side-to-end colon anastomosis can be used to increase the capacity of the new rectum. In a randomized clinical trial, Rybakov et al. compared the results of side-to-end and straight end-to-end colorectal anastomosis after anterior rectal

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resection. There was no statistically significant difference in morbidity between the two groups (20). In the short term, Wexner criterion in side-to-end method was better than end-to-end anastomosis. But they did not make a difference over a longer period of time. Performance and quality of life in the present study were also better in the short term in the side-to-end anastomosis group.

In a study that evaluated J-pouch colon anastomosis and straight colorectal anastomosis using the QLQ-C30 Quality of Life Questionnaire (EORTC) after surgery, anastomotic site leakage was similar in both groups and quality of life score, mean daily bowel movements and urgency fecal excretion was significantly better in the J-pouch group than in cases of straight coloanal anastomosis (27). In a study by Mehrvarz et al., J-pouch colon anastomosis performed better than end-to-end anastomosis and improved quality of life (27). Therefore, it can be a better choice.

In one study, anastomotic site leakage, frequency of bowel movements, use of antidiarrheal drugs, and fecal incontinence were higher in SA anastomosis than in J-pouch colon anastomosis over a period of more than 30 months. Colonic J-pouch had better performance results than SA and improved overall quality of life (27). Doeksen et al. compared colloidal J-pouch anastomosis and side-to-end anastomosis and showed similar functional outcome and quality of life score between the two groups. Although the functional outcomes of the J-pouch were slightly better than side-to-end anastomosis, technically the colonic J-pouch anastomosis is more difficult and the side-to-end anastomosis seems to be a viable alternative to sphincter protection surgery (28).

In our study, the frequency of normal excretion was observed in most cases (70%) of J-pouch and some cases of side-to-end anastomosis (19%) and straight coloanal anastomosis (10%). Urgency and stool leakage were also lower in the J-pouch group than in the other two groups. In our study, no difference in defecation difficulty was observed between the three groups.

The limitations of this study were the small number of subjects and that the process of the present study was not consistent with radiotherapy factors. Preoperative performance evaluation between groups should be considered in a future study. Neoadjuvant chemoradiotherapy is an important and determining factor in the performance of rectal cancer surgery. This study showed the results of short-term performance of six months. The lack of evaluation of stool control performance using anorectal manometry is quite felt in this study. The study groups are heterogeneous. Significant differences in the frequency of chemoradiotherapy between groups may be the reason for the difference in performance. In general, functional outcomes did not differ with respect to functional reservoir six months after the operation.

Although a larger size appears to provide more storage space for feces, studies have shown that the cause of better pouch performance is stool movement delay rather than storing performance. Despite the good results of this method, it should be noted that the J-pouch colorectal surgery method is more complex than the other two methods and is especially difficult to perform in male patients with narrow pelvis and short colon mesentery.

The results of this study showed that the functional results of J-pouch colon anastomosis were better than side-to-end and straight end-to-end colorectal anastomosis. We suggest that the colorectal surgeon select the patient for one of the above methods based on anatomical diversity, gender, comorbidity, and financial constraints of health care.

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[DOI: 10.22088/jbums.23.1.244]

References

1.Heald RJ, Moran BJ, Ryall RD, Sexton R, MacFarlane JK. Rectal cancer: the Basingstoke experience of total mesorectal excision, 1978-1997. Arch Surg. 1998;133(8):894-9.

2.Hain E, Manceau G, Maggiori L, Mongin C, À la Denise JP, Panis Y. Bowel dysfunction after anastomotic leakage in laparoscopic sphincter-saving operative intervention for rectal cancer: A case-matched study in 46 patients using the Low Anterior Resection Score. Surgery. 2017;161(4):1028-39.

3.Rubin F, Douard R, Wind P. The functional outcomes of coloanal and low colorectal anastomoses with reservoirs after low rectal cancer resections. Am Surg. 2014;80(12):1222-9.

4.Emmertsen KJ, Laurberg S, Rectal Cancer Function Study Group. Impact of bowel dysfunction on quality of life after sphincter-preserving resection for rectal cancer. Br J Surg. 2013;100(10):1377-87.

5.Dinnewitzer A, Jäger T, Nawara C, Buchner S, Wolfgang H, Öfner D. Cumulative incidence of permanent stoma after sphincter preserving low anterior resection of mid and low rectal cancer. Dis Colon Rectum. 2013;56(10):1134-42.

6.Cong Z-j, Hu L-h, Xing J-j, Bian Z-q, Fu C-g, Yu E-d, et al. Incidence and mortality of anastomotic dehiscence requiring reoperation after rectal carcinoma resection. Int Surg. 2014;99(2):112-9.

7.Lazorthes F, Fages P, Chiotasso P, Bugat R. Synchronous abdominotrans-sphincteric resection of low rectal cancer: New technique for direct colo-anal anastomosis. Br J Surg. 1986;73(7):573-5.

8.Parc R, Tiret E, Frileux P, Moszkowski E, Loygue J. Resection and colo-anal anastomosis with colonic reservoir for rectal carcinoma. Br J Surg. 1986;73(2):139-41.

9.Lazorthes F, Gamagami R, Chiotasso P, Istvan G, Muhammad S. Prospective, randomized study comparing clinical results between small and large colonic J-pouch following coloanal anastomosis. Dis Colon Rectum. 1997;40(12):1409-13.

10.Harris GJ, Lavery IJ, Fazio VW. Reasons for failure to construct the colonic J-pouch. What can be done to improve the size of the neorectal reservoir should it occur?. Dis Colon Rectum. 2002;45(10):1304-8.

11.Hüttner FJ, Tenckhoff S, Jensen K, Uhlmann L, Kulu Y, Büchler MW, et al. Meta-analysis of reconstruction techniques after low anterior resection for rectal cancer. Br J Surg. 2015;102(7):735-45.

12.Fürst A, Burghofer K, Hutzel L, Jauch K-W. Neorectal reservoir is not the functional principle of the colonic J-pouch: the volume of a short colonic J-pouch does not differ from a straight coloanal anastomosis. Dis Colon Rectum. 2002;45(5):660-7.

13.Hallböök O, Påhlman L, Krog M, Wexner SD, Sjödahl R. Randomized comparison of straight and colonic J pouch anastomosis after low anterior resection. Ann Surg. 1996; 224(1):58-65.

14.Ho YH, Seow-Choen F, Tan M. Colonic J-pouch function at six months versus straight coloanal anastomosis at two years: randomized controlled trial. World J Surg. 2001;25(7):876-81.

15.Liang J-T, Lai H-S, Lee P-H, Huang K-C. Comparison of functional and surgical outcomes of laparoscopic-assisted colonic J-pouch versus straight reconstruction after total mesorectal excision for lower rectal cancer. Ann Surg Oncol. 2007;14(7):1972-9.

16.Sailer M, Fuchs K-H, Fein M, Thiede A. Randomized clinical trial comparing quality of life after straight and pouch coloanal reconstruction. Br J Surg. 2002;89(9):1108-17.

17.Pucciarelli S, Del Bianco P, Pace U, Bianco F, Restivo A, Maretto I, et al. Multicentre randomized clinical trial of colonic J pouch or straight stapled colorectal reconstruction after low anterior resection for rectal cancer. Br J Surg. 2019;106(9):1147-55.

18.Heriot AG, Tekkis PP, Constantinides V, Paraskevas P, Nicholls RJ, Darzi A, et al. Meta-analysis of colonic reservoirs versus straight coloanal anastomosis after anterior resection. Br J Surg. 2006;93(1):19-32.

19.Brown CJ, Fenech DS, McLeod RS. Reconstructive techniques after rectal resection for rectal cancer. Cochrane Database Syst Rev. 2008;(2):CD006040.

20.Rybakov EG, Pikunov DY, Fomenko OY, Chernyshov SV, Shelygin YA. Side-to-end vs. straight stapled colorectal anastomosis after low anterior resection: results of randomized clinical trial. Int J Colorectal Dis. 2016;31(8):1419-26.

21.Kolligs FT. Diagnostics and epidemiology of colorectal cancer. Visc Med. 2016;32(3):158-64.

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[DOI: 10.22088/jbums.23.1.244]

22.Hida J-i, Okuno K. Pouch operation for rectal cancer. Surg Today. 2010;40(4):307-14.
23.Banerjee AK, Parc R. Prediction of optimum dimensions of colonic pouch reservoir. Dis Colon Rectum. 1996;39(11):1293-5.
24.De la Fuente SG, Mantyh CR. Reconstruction techniques after proctectomy: what's the best?. Clin Colon Rectal Surg. 2007;20(3):221-30.
25.Machado M, Nygren J, Goldman S, Ljungqvist O. Similar outcome after colonic pouch and side-to-end anastomosis in low anterior resection for rectal cancer: a prospective randomized trial. Ann Surg. 2003;238(2):214-20.
26.Joo JS, Latulippe JF, Alabaz O, Weiss EG, Nogueras JJ, Wexner SD. Long-term functional evaluation of straight coloanal anastomosis and colonic J-pouch: is the functional superiority of colonic J-pouch sustained?. Dis Colon Rectum. 1998;41(6):740-6.
27.Mehrvarz S, Towliat SM, Mohebbi HA, Derakhshani S, Abavisani M. Comparison of colonic J-pouch and straight coloanal anastomosis after low anterior resection. Iran Red Crescent Med J. 2013;15(1):32-35.
28.Doeksen A, Bakx R, Vincent A, van Tets WF, Sprangers MA, Gerhards MF, et al. J-pouch vs side-to-end coloanal anastomosis after preoperative radiotherapy and total mesorectal excision for rectal cancer: a multicentre randomized trial. Colorectal Dis. 2012;14(6):705-13.

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