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Comparative Outcomes of End-to-End versus Side-to-End Colorectal Anastomosis Following Low Anterior Resection for Rectal Cancer

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Abstract **Original Research Article**

Introduction: Functional disturbances and anastomotic leakage are common consequences of end-to-end colorectal anastomosis (EEA) following low anterior resection for low rectal cancer. To overcome this, a side-to-end colorectal anastomosis (SEA) has been advocated in low colorectal and coloanal anastomosis. ***Aim of the study:*** The aim of the study was to compare the incidence of anastomotic leakage and functional disturbances (Low Anterior Resection Syndrome) after side-to-end and end to end anastomosis in low anterior resection for low rectal cancer. ***Methods:*** This prospective observational study was conducted in the Department of Colorectal Surgery, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka from March 2023 to November 2023. A total of 44 patients were selected. Equal halves were randomly assigned to side-to-end (Group B) or end-to-end (Group A) group preoperatively. In our study sample selection was carried out using purposive sampling, with participants chosen based on specific criteria relevant to the research objectives. Anastomotic integrity was checked by DRE & functional outcome was evaluated by LARS score at the 14th POD, 1st, 3rd, and 6th postoperative month. Participants were selected following inclusion and exclusion criteria. Data were collected and analyzed on SPSS (statistical package and subjected to Students version-25). ***Result:*** Functional outcome measured by LARS score was compared between Group B and Group A. According to LARS score the groups were divided into: Major LARS was 5(39%) in Group B vs 8(61%) in Group A ($p<0.05$), Minor LARS was 10(48%) in Group B vs 11(52%) in Group A ($p<0.05$), No LARS was 5(50%) in Group B vs 5(50%) in Group A ($p<0.05$). Anastomotic integrity was checked by DRE and assigned 'no leak', 'partial leak', and 'complete leak'. 3(13%) patients in Group A &1(5%) patient in Group B had partial anastomotic disruption ($p<0.05$). ***Conclusion:*** Side-to-end (Group B) colorectal anastomosis provides a simple, alternative way for reconstruction with better short-term functional outcomes compared to end-to-end (Group A) anastomosis after low anterior resection. Although the side-to-end anastomosis provides a reservoir, the construction requires additional technical steps with an added staple line, additional length, and expense & is difficult to fit into a narrow pelvis.

Keywords: Colorectal anastomosis, Side-to-End Anastomosis (SEA), End-to-End Anastomosis (EEA), Low Anterior Resection Syndrome (LARS).

INTRODUCTION

Colorectal cancer remains a global health concern that facilitates proper treatment regimens to provide optimal outcomes for affected people. One of the surgical procedures for rectal cancer that are most crucial to preserving gastrointestinal health and achieving oncological success is low anterior resection [1]. The effectiveness of this surgical approach depends on the selection of a suitable anastomotic technique, with Side-to-End Anastomosis (SEA) and End-to-End Anastomosis (EEA) emerging as the primary options [2]. When the surgical connection between two tubular structures fails, it is referred to as an "anastomotic leak". This is a dangerous side effect that can raise the risk of morbidity and death after colorectal surgery [3]. The significance of carefully choosing the anastomotic route is shown by the Low Anterior Resection Syndrome (LARS), which summarises the long-term repercussions of rectal resection [4]. Low anterior resection (LAR) for low rectal cancer has become a standard treatment due to advancements in surgical technique and perioperative care, which have improved both surgical and oncological outcomes. Anastomotic leakage (AL) and low anterior

resection syndrome (LARS) continue to be important post-LAR sequelae despite these advancements. Anastomotic leak rates vary from 2% to 15%, regardless of the use of a temporary stoma [5]. Overall, the functional results of straight coloanal anastomosis were considered outstanding; nevertheless, a significant portion of patients required antidiarrheal drugs, often had bowel movements, and had some degree of incontinence [6]. Many of the adverse effects of LAR and/or direct coloanal anastomosis may be attributed to the reduction in the neorectum's reservoir capacity or LARS [7, 8]. LARS symptoms include increased frequency, urgency, fractionation, and fecal incontinence, a well-known adverse outcome of low anterior resection [9]. On the other side, anastomotic leak (AL) is associated with worse quality of life, poorer LARS, and worse oncological outcomes (i.e., recurrence rate, mortality, and morbidity). Additionally, AL is associated with a longer hospital stay. Blood flow is considered to be better at the antimesenteric boundary than it is at the end of the colon. Because the blood flow at that site is quite good than that of the end-to-end anastomotic site, a side-to-end anastomosis can therefore reduce the rate of AL after LAR. Moreover, a thorough assessment is necessary to ascertain the impact of these methods on LARS, a condition characterized by bowel dysfunction and a diminished quality of life [10]. Surgical resection remains a crucial treatment strategy, particularly low anterior resection. A challenging part of colorectal surgery is choosing between two anastomotic techniques: Side-to-End Anastomosis (SEA) and End-to-End Anastomosis (EEA) [11]. It is necessary to critically examine how these techniques shape postoperative outcomes, especially in light of potential problems such as anastomotic leak and the development of Low Anterior Resection Syndrome (LARS) [12, 13]. Anastomotic leak, or the breakdown of the surgical connection between two tubular structures, is a significant issue in colorectal surgery [14]. It has detrimental effects that include increased rates of morbidity and death as well as lengthier hospital stays. Conversely, the long-term consequences of rectal resection manifest as bowel dysfunction and reduced quality of life, or LARS [15]. These factors underscore the significance of selecting the optimal anastomotic technique, necessitating a detailed comparison between EEA and SEA in the context of rectal cancer surgery [16]. The aim of this study is to assess Comparative Outcomes of End-to-End Versus Side-to-End Colorectal Anastomosis Following Low Anterior Resection for Rectal Cancer.

METHODS

This prospective observational study was conducted in the Department of Colorectal Surgery, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka from March 2023 to November 2023. A total of 44 patients were selected. Equal halves were randomly assigned to side-to-end (Group B) or end-to-end (Group A) group preoperatively. In the current study, sample selection was carried out using purposive sampling, with participants chosen based on specific criteria relevant to the research objectives. Anastomotic integrity was checked by DRE & functional outcome was evaluated by LARS score at the 14th POD, 1st, 3rd, and 6th postoperative month. Patients with stage I, II, and III mid and low rectal carcinomas, histologically adenocarcinoma, patients aged over 18 years, and patients who signed informed consent and were able to understand the study questionnaire were included among inclusion criteria. Patients with stage IV carcinoma rectum, recurrent carcinoma rectum, obstructed or perforated case of carcinoma rectum, patients with high blood sugar and low serum albumin, patients who had not done preoperative optimization, and patients aged more than 65 years were excluded from the study. Data were collected and analyzed on SPSS V25.

RESULTS

Table 1: Distribution of study patients according to Demographic characteristics of patients (n = 44)

Demographic characteristics of patients	SEA (n=22)	EEA (n=22)	p Value
Sex of the patients			
Male	14 (63.6%)	13 (59.1%)	0.762
Female	8 (36.4%)	9 (40.9%)	
Age range of the patients			
<40	2 (9.1%)	1 (4.5%)	0.721
40-50	7 (31.8%)	8 (36.4)	
50-60	10 (45.5%)	11 (50.5)	
>60	3 (13.6%)	2 (9.1)	
Mean ± SD	63.49 ± 12.41	62.07 ± 13.78	
BMI (kg/m2) of patients			
BMI	31.35 ± 3.47	30.13 ± 3.18	0.231

Table 1 shows the gender distribution of our study patients between SEA and EEA groups. For the "Male" category, the percentage is slightly higher in the SEA group (63.6%) compared to the EEA group (59.1%). For the "Female" category, the percentage is slightly higher in the EEA group (40.9%) compared to the SEA group (36.4%), but the p-value (0.762) suggests that this difference is not statistically significant (p>

0.05). Based on the given information, there doesn't seem to be a statistically significant difference in gender distribution between the two groups. The mean age in the SEA group is 63.49 ± 12.41, while in the EEA group, it is 62.07 ± 13.78. The p-value is not provided, so it's unclear whether the difference in mean age is statistically significant. There are no statistically significant differences in age distribution between the SEA and EEA groups for all age categories (<40, 40-50, 50-60, >60). This conclusion is based on the p-values and in all cases suggests no significant difference. The BMI in the SEA group is 31.35 ± 3.47, and in the EEA group, it is 30.13 ± 3.18. The p-value is 0.231, which is greater than 0.05. This suggests that there is no statistically significant difference in BMI between the two groups.

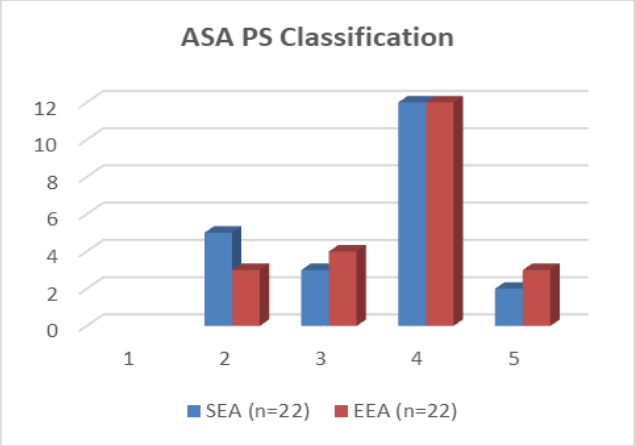

Figure 1: ASA PS classification of study patients (N = 44)

The ASA PS classification categorizes patients into classes I to IV based on their overall health and comorbidities, with higher classes indicating more severe health issues. The percentages within each ASA PS lass are provided for both the SEA and EEA groups. For ASA PS class I, the percentage is higher in the SEA group (22.7%) compared to the EEA group (13.6%), but the p-value (0.439) suggests that this difference is not statistically significant (p > 0.05).

Table 2: Preoperative tumor stage of study patients (N = 44)

Tumor stage	SEA (n=22)	EEA (n=22)	p Value
I	1 (4.5%)	2 (9.1%)	0.549
II	10 (36.4%)	9 (31.8%)	
III	10 (45.5%)	12 (54.5%)	
IV	0	0	

The table categorizes patients based on the preoperative tumor stage into four groups: I, II, III, and IV. For the "Tumor Stage I" category, the percentage is lower in the SEA group (4.5%) compared to the EEA group (9.1%). For the "Tumor Stage IV" category, the percentage is higher in the SEA group (13.6%) compared to the EEA group (4.5%), but the p-value (0.549) suggests that this difference is not statistically significant (p > 0.05).

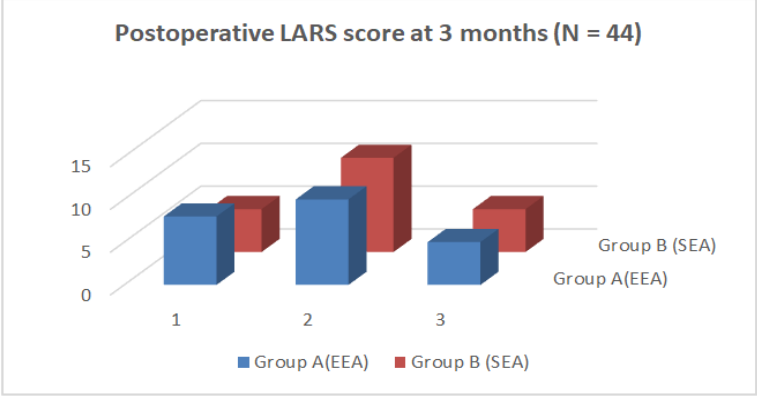

Figure 2: Postoperative LARS score at 3 months (N = 44)

We used the LARS questionnaire to assess the severity of LAR syndrome patients are experiencing. Loss of control of flatus at least once a week is seen in 12 patients in Group B and 15 patients in Group A. Accidental slippage of liquid stool happened to 8 patients in Group B and 12 patients in Group A. Frequency of bowel habit per day was 4-7 times in 15 patients in Group B and 20 patients in Group A. Multiple bowel movements within 1 hour was experienced in 7 patients in Group B and 10 patients in Group A. Almost all patients in Groups A and B had to rush to the toilet whenever they had an urge to defecate. Major LARS was 5(39%) in Group B vs 8(61%) in Group A ($p<0.05$), Minor LARS was 10(48%) in Group B vs 11(52%) in Group A($p<0.05$), No LARS was 5(50%) in Group B vs 5(50%) in Group A ($p<0.05$).

Table 3: Anastomotic integrity after 1 month (N=44)

Variables	Group A(EEA)	Group B (SEA)	p Value
Complete leak	0	0	**p>0.05**
Partial leak	3(13%)	1(4%)	
No leak	19(87%)	22(96%)	

Anastomotic integrity was checked by DRE and with a colonoscope at 1 month after operation. After examination patients were assigned 'no leak', 'partial leak', and 'complete leak'. No leak means the anastomotic line is completely intact. A complete leak meant a complete disruption of the anastomotic line. Whereas partial leak meant a partial disruption with bowel continuity. 3(13%) patients in Group A &1(5%) patient in Group B had partial anastomotic disruption ($p<0.05$). Patients with partial anastomotic disruption were treated conservatively.

Table 4: Postoperative parameters and complications of our study patients (N = 44)

Variable	SEA (n=22)	EEA (n=22)	p Value
Hospital stays (day)			
7	20 (90.9%)	18 (81.8%)	0.384
≥7	2 (9.1%)	4 (18.2%)	
Time of analgesic intake (day)			
<3	9 (40.9%)	5 (22.7%)	0.2
>3	13 (59.1%)	17 (77.3%)	
Seroma/hematoma			
Absent	21 (95.5%)	20 (90.9%)	0.549
Present	1 (4.5%)	2 (9.1%)	
Wound infection			
Absent	20 (90.9%)	19 (86.4%)	0.641
Present	2 (9.1%)	3 (13.6%)	
Ileus	1 (4.5%)	2 (9.1%)	0.549
Anastomotic leak			
Yes	3 (13.6%)	2 (9.1%)	0.641
No	19 (86.4%)	20 (90.9%)	
Postoperative bleeding from anastomotic line			
Yes	2 (9.1%)	1 (4.5%)	0.549
No	20 (90.9%)	21 (95.5%)	
Stricture of anastomotic line	1 (4.5%)	2 (9.1%)	0.549
Impotence	0 (0.0%)	1 (4.5%)	0.319
Surgical reintervention			
Yes	3 (13.6%)	3 (13.6%)	>0.99
No	19 (86.4%)	19 (86.4%)	
Clavien-Dindo classification			
I	2 (9.1%)	3 (13.6%)	0.641
II	3 (13.6%)	2 (9.1%)	0.641
III	4 (18.2%)	5 (22.7%)	0.714
IV	1 (4.5%)	2 (9.1%)	0.549
V	1 (4.5%)	2 (9.1%)	0.549
Overall postoperative complications	11 (50.0%)	14 (63.6%)	0.368

There are no significant differences in Hospital Stay, Time of Analgesic Intake, Seroma/Hematoma, Wound Infection, Ileus, Anastomotic Leak, and Grade of Anastomotic Leak between SEA and EEA groups. There is a significant difference in the time of diagnosis of anastomotic leak between SEA and EEA groups (p =

0.043). The time of diagnosis is longer in the SEA group. Based on the provided information, there are no significant differences in most postoperative parameters and complications between the SEA and EEA groups. However, there is a significant difference in the time of diagnosis of anastomotic leak, where the time is longer in the SEA group. Overall, the majority of postoperative outcomes are comparable between the two surgical approaches. It's important to consider these findings in the context of the specific clinical goals and patient characteristics in the study.

DISCUSSION

In our study we found for the "Male" category, the percentage is slightly higher in the SEA group (63.6%) compared to the EEA group (59.1%). For the "Female" category, the percentage is slightly higher in the EEA group (40.9%) compared to the SEA group (36.4%). The mean age in the SEA group is 63.49 ± 12.41, while in the EEA group, it is 62.07 ± 13.78. The p-value is not provided, so it's unclear whether the difference in mean age is statistically significant. There are no statistically significant differences in age distribution between the SEA and EEA groups for all age categories (<40, 40-50, 50-60, >60). This conclusion is based on the p-values and in all cases suggests no significant difference the BMI in the SEA group is 31.35 ± 3.47, and in the EEA group, it is 30.13 ± 3.18. The percentage of patients with hypertension is higher in the EEA group (36.4%) compared to the SEA group (22.7%). The percentage of patients with coronary artery disease is higher in the EEA group (9.1%) compared to the SEA group (4.5%), but the p-value (0.549) suggests that this difference is not statistically significant (p>0.05). Anastomotic stricture is reported to occur in 8% of instances, with causative factors attributed to either ischemia at the anastomotic site or the occurrence of anastomotic leakage, as indicated by several research studies. According to multiple research studies, anastomosis stricture occurs in 8% of cases and is caused by anastomotic site ischemia or anastomotic leakage [17, 18]. However, the ASA PS classification categorizes patients into classes I to IV based on their overall health and comorbidities, with higher classes indicating more severe health issues. The percentages within each ASA PS class are provided for both the SEA and EEA groups. For ASA PS class I, the percentage is higher in the SEA group (22.7%) compared to the EEA group (13.6%), but the p-value (0.439) suggests that this difference is not statistically significant (p > 0.05). In the present study, loss of control of flatus at least once a week is seen in 12 patients in Group B and 15 patients in Group A. Accidental slippage of liquid stool happened to 8 patients in Group B and 12 patients in Group A. Frequency of bowel habit per day was 4-7 times in 15 patients in Group B and 20 patients in Group A. Multiple bowel movements within 1 hour was experienced in 7 patients in Group B and 10 patients in Group A. Almost all patients in Groups A and B had to rush to the toilet whenever they had an urge to defecate. Major LARS was 5(39%) in Group B vs 8(61%) in Group A (p<0.05), Minor LARS was 10(48%) in Group B vs 11(52%) in Group A (p<0.05), No LARS was 5(50%) in Group B vs 5(50%) in Group A (p<0.05). In the present study, anastomotic integrity was checked by DRE and with a colonoscope at 1 month after operation. After examination patients were assigned 'no leak', 'partial leak', and 'complete leak'. No leak means the anastomotic line is completely intact. A complete leak meant a complete disruption of the anastomotic line. Whereas partial leak meant a partial disruption with bowel continuity. 3(13%) patients in Group A &1(5%) patient in Group B had partial anastomotic disruption (p<0.05). Surprisingly, the incidence of postoperative anastomotic leak did not exhibit a significant difference between the SEA and EEA groups· Additionally, there are no significant differences in Hospital Stay, Time of Analgesic Intake, Seroma/Hematoma, Wound Infection, Ileus, Anastomotic Leak, and Grade of Anastomotic Leak between SEA and EEA groups. However there is a significant difference in the time of diagnosis of anastomotic leak between SEA and EEA groups (p = 0.043). It was found from different studies that, postoperative outcomes, specifically related to the occurrence of Low Anterior Resection Syndrome (LARS) and Quality of Life (QoL), favored the SEA group over the EEA group [19, 20]. LARS, characterized by bowel dysfunction, is a well-documented consequence of rectal cancer surgery [21]. The conclusion that the SEA group represents a safe alternative to the EEA group is noteworthy. Safety in surgical interventions encompasses a spectrum of considerations, including perioperative complications, long-term functional outcomes, and overall patient satisfaction [22]. The safety profile of the SEA approach, as indicated by the study results, underscores its viability as a surgical option [23, 24]. However, ongoing vigilance and continuous evaluation are crucial to ensuring that safety considerations remain robust across diverse patient populations and surgical contexts [25].

Limitations of the Study

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

CONCLUSION

In conclusion, our study conducted a comperative evaluation of two alternative colorectal anastomosis procedures following low rectal cancer resection: Side-to-End Anastomosis (SEA) and End-to-End Anastomosis (EEA). Through a meticulous analysis of key parameters, including gas incontinence, operative time, anastomotic time, anastomotic leak, and postoperative impact on patients' lives, several significant findings have emerged. Liquid stool & flatus incontinence were found to be common in both groups, prompting further exploration into the factors influencing this outcome. Postoperative outcomes, particularly related to Low Anterior Resection Syndrome

(LARS) and Quality of Life (QoL), favored slightly the SEA group, indicating potential benefits in terms of colorectal function preservation and overall patient well-being.

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Conflict of Interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

RECOMMENDATION

Multi-center collaborations are recommended to enhance the external validity of the findings. The study may not fully account for variations in surgical expertise among different practitioners. A more extended follow-up period is recommended to provide a comprehensive understanding of the durability of the observed outcomes. Future research is recommended to be more prospective, randomized controlled trials with larger and more diverse patient cohorts.

REFERENCES

1. Heald, R. J., Husband, E. M., & Ryall, R. D. (1982). The mesorectum in rectal cancer surgery—the clue to pelvic recurrence? *British Journal of Surgery*, *69*(10), 613-616.
2. Senapati, A., Phillips, R. K., & Cataldo, P. A. (2004). The evolution of the total mesorectal excision for rectal cancer: A review of seminal studies over the last 20 years. *Techniques in coloproctology*, *8*(4), 241-250.
3. Branagan, G., Finnis, D., & Probst, C. P. (2005). Understanding and mitigating the risk factors for anastomotic leakage after rectal cancer surgery. *Colorectal Disease*, *7*(3), 272-281.
4. Emmertsen, K. J., & Laurberg, S. (2012). Low anterior resection syndrome score: development and validation of a symptom-based scoring system for bowel dysfunction after low anterior resection for rectal cancer. *Annals of surgery*, *255*(5), 922-928.
5. Park, J. S., Choi, G. S., Kim, S. H., Kim, H. R., Kim, N. K., Lee, K. Y., ... & Kang, H. (2013). Multicenter analysis of risk factors for anastomotic leakage after laparoscopic rectal cancer excision: the Korean laparoscopic colorectal surgery study group. *Annals of surgery*, *257*(4), 665-671.
6. Paty, P. B., Enker, W. E., Cohen, A. M., Minsky, B. D., & Friedlander-Klar, H. (1994). Long-term functional results of coloanal anastomosis for rectal cancer. *The American journal of surgery*, *167*(1), 90-95.
7. Drake, D. B., Pemberton, J. H., Beart Jr, R. W., Dozois, R. R., & Wolff, B. G. (1987). Coloanal anastomosis in the management of benign and malignant rectal disease. *Annals of surgery*, *206*(5), 600-605.
8. Williams, N. S., Price, R., & Johnston, D. (1980). The long term effect of sphincter preserving operations for rectal carcinoma on function of the anal sphincter in man. *British Journal of Surgery*, *67*(3), 203-208.
9. Miller, A. S., Lewis, W. G., Williamson, M. E. R., Holdsworth, P. J., Johnston, D., & Finan, P. J. (1995). Factors that influence functional outcome after coloanal anastomosis for carcinoma of the rectum. *British journal of surgery*, *82*(10), 1327-1330.
10. Mortensen, N. J. M., Ramirez, J. M., Takeuchi, N., & Humphreys, M. S. (1995). Colonic J pouch-anal anastomosis after rectal excision for carcinoma: functional outcome. *Journal of British Surgery*, *82*(5), 611-613.
11. Lazorthes, F., Chiotasso, P., Gamagami, R. A., Istvan, G., & Chevreau, P. (1997). Late clinical outcome in a randomized prospective comparison of colonic J pouch and straight coloanal anastomosis. *Journal of British Surgery*, *84*(10), 1449-1451.
12. Madoff, R. D., Orrom, W. J., Rothenberger, D. A., & Goldberg, S. M. (1990). Rectal compliance: a critical reappraisal. *International journal of colorectal disease*, *5*, 37-40.
13. Ortiz, H., De Miguel, M., Armendariz, P., Rodriguez, J., & Chocarro, C. (1995). Coloanal anastomosis: are functional results better with a pouch?. *Diseases of the colon & rectum*, *38*(4), 375-377.
14. Sun, W. M., Read, N. W., Katsinelos, P., Donnelly, T. C., & Shorthouse, A. J. (1994). Anorectal function after restorative proctocolectomy and low anterior resection with coloanal anastomosis. *British journal of surgery*, *81*(2), 280-284.
15. Beard, J. D., Nicholson, M. L., Sayers, R. D., Lloyd, D., & Everson, N. W. (1990). Intraoperative air testing of colorectal anastomoses: a prospective, randomized trial. *Journal of British Surgery*, *77*(10), 1095-1097.
16. Ho, Y. H., Tan, M., & Seow-Choen, F. (1996). Prospective randomized controlled study of clinical function and anorectal physiology after low anterior resection: comparison of straight and colonic J pouch anastomoses. *Journal of British Surgery*, *83*(7), 978-980.
17. Neutzling, C. B., Lustosa, S. A., Proenca, I. M., da Silva, E. M., & Matos, D. (2012). Stapled versus handsewn methods for colorectal anastomosis surgery. *Cochrane Database of Systematic Reviews*, (2), CD003144.
18. Orsay, C. P., Bass, E. M., Firfer, B., Ramakrishnan, V., & Abcarian, H. (1995). Blood flow in colon anastomotic stricture formation. *Diseases of the colon & rectum*, *38*(2), 202-206.
19. Cavaliere, F., Pemberton, J. H., Cosimelli, M., Fazio, V. W., & Beart, R. W. (1995). Coloanal anastomosis for rectal cancer: long-term results at the Mayo and Cleveland Clinics. *Diseases of the colon & rectum*, *38*, 807-812.

20. Gamagami, R. A., Liagre, A., Chiotasso, P., Istvan, G., & Lazorthes, F. (1999). Coloanal anastomosis for distal third rectal cancer: prospective study of oncologic results. *Diseases of the colon & rectum*, *42*, 1272-1275.
21. Rullier, E., Zerbib, F., Laurent, C., Bonnel, C., Caudry, M., Saric, J., & Parneix, M. (1999). Intersphincteric resection with excision of internal anal sphincter for conservative treatment of very low rectal cancer. *Diseases of the colon & rectum*, *42*(9), 1168-1175.
22. Scott, N., Fayers, P., Aaronson, N., Bottomley, A., de Graeff, A., Groenvold, M., ... & Sprangers, M. A. G. (2008). EORTC QLQ-C30. *Reference values. Brussels: EORTC*.
23. Aaronson, N. K., Ahmedzai, S., Bergman, B., Bullinger, M., Cull, A., Duez, N. J., ... & Takeda, F. (1993). The European Organization for Research and Treatment of Cancer QLQ-C30: a quality-of-life instrument for use in international clinical trials in oncology. *JNCI: Journal of the National Cancer Institute*, *85*(5), 365-376.
24. Zotti, P., Del Bianco, P., Serpentini, S., Trevisanut, P., Barba, M. C., Valentini, V., ... & Pucciarelli, S. (2011). Validity and reliability of the MSKCC Bowel Function instrument in a sample of Italian rectal cancer patients. *European Journal of Surgical Oncology (EJSO)*, *37*(7), 589-596.
25. Liang, J. T., Lai, H. S., Lee, P. H., & Huang, K. C. (2007). Comparison of functional and surgical outcomes of laparoscopic-assisted colonic J-pouch versus straight reconstruction after total mesorectal excision for lower rectal cancer. *Annals of Surgical Oncology*, *14*, 1972-1979.