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Novel Technique in Crohn's Surgery; End to End Single Sero-Muscular Manual Suture Excluding Mucosa

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Abstract

Background: An optimal method performing intestinal anastomosis in patients with Crohn's disease has not been widely accepted yet. The current research is proposing a novel hand-sew technique applied on end to end ileo-colic resection anastomosis cases.

Methods: Between January 2012 and December 2017, 63 cases previously diagnosed as Crohn's disease presented to the emergency department as fecal peritonitis secondary to ileo-caecal perforation or gangrene with or without abscess formation.

Results: Crohn's patients presented to emergency department with picture of acute abdomen secondary to perforated bowel were included in the study. All patients had pre-operative abdominal computerized tomography for diagnosis and post-operatively for follow up. Post-operatively seven patients had minor submucosal anastomotic dissection of dye that is contained within the sub-serosal layer. None of the patients needed additional surgery during their primary hospitalization nor needed surgical hospitalization during the long follow up stay.

Discussion: There was no leakage from the anastomotic line in any of the study cases. Moreover the extended follow up has revealed no needed re-operation as any recurrent disease at the region of surgical anastomosis. Comparing the current research result to that from literature proves the proposed technique superior. Surgical anastomotic technique in Crohn's disease is an important factor as patients with permanent end ileostomy seldom suffer from recurrence.

Conclusion: Application of the proposed anastomotic technique upon Crohn's cases is an extreme challenge that suggests the technique as potentially competent one in any intestinal anastomotic situation. The proposed surgical technique needs to be verified on larger sample.

Keywords: Crohn's disease; Single layer sero-muscular anastomosis; Ileo-ascending colon primary anastomosis; TPN

Abbreviations

CD: Crohn's Disease; IBD: Inflammatory Bowel Disease; ACT: Abdominal Computerized Tomography; TPN: Total Parenteral Nutrition; CDAI: The Crohn's Disease Activity Index

Introduction

Surgery plays a crucial role in the treatment of Crohn's Disease (CD) complications, with the majority of patients undergoing surgical intestinal resections within the first 10 years of diagnosis [1]. In literature, studies on surgical outcomes in this cohort have shown high rates of post-operative complications. Though the literature is heterogeneous, post-operative intra-abdominal abscess rates range from 2.6% to 14% and anastomotic leak rates from 1.2% to 16.7% [2-4]. Usage of the linear stapler for gastrointestinal anastomoses was first introduced in the 1980s. A recent Cochrane review confirmed the superiority of the stapler in preventing anastomotic leaks in ileo-caecal resections for cancer, but failed to show this benefit in Inflammatory Bowel Disease (IBD) patients [5-7]. Though smaller studies support side to side stapler anastomosis over the traditional hand- sewn end to end anastomosis in CD, the magnitude of the benefit in this population has not been established [8-11]. Over sewing of staple lines is a method with the potential to further reduce anastomotic complications. Its main application to date has been in foregut surgery where a large meta-analysis indicated that over sewing significantly reduces anastomotic leaks and overall complications in bariatric surgery [12]. The optimal method of performing an intestinal anastomosis in patients with CD has not been established yet. The obstacle to study surgical outcomes in patients with CD is the many factors that may predispose to complications such as usage of steroids, pre-operative

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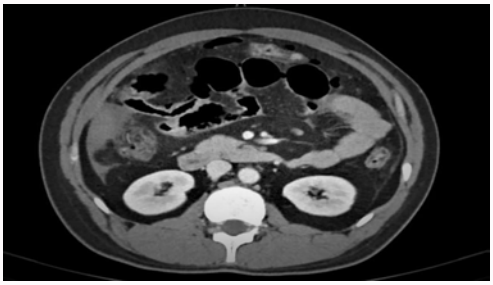

Figure 1: Pre-operative ACT showing thickened ascending colon.

infections, and the poor nutrition and have been extracted mostly from retrospective studies [2-4,8,13-16]. Review of literature reveals shy studies on small scale working on surgical complications of CD. Up to author's best knowledge, there is no study on modifying the end to end manual anastomosis technique that has been practiced as a tradition applied with variable skill levels and resulted in unsatisfactory results. This research is proposing a novel hand-sew technique applied on end to end ileo-caecal anastomosis in cases of complicated CD with potential improved results based on proved literature theoretical basis.

Study Design

This is a case series pilot study introducing a new surgical technique for intestinal resection and anastomosis in CD based on a genuine concept that is never described before.

Study inclusion criteria

Patient sample has been restricted to perforated or gangrenous ileo-caecal segment with fecal peritonitis complicating CD. Such selection assures the most difficult circumstances that could face the surgeon challenging the proposed technique for primary anastomosis without doing a protective stoma.

Study exclusion criteria

These were pregnancy; age less than 18 years, and Crohn's disease manifestation at a gastro-intestinal site other than the terminal ileum with the exception of Perianal fistulae.

Technique of intestinal resection

The resection has been designed to be segmental but not right hemicolectomy; resecting at least 5 cm from either side of the lesion area reaching apparently normal looking bowel segment.

Technique of intestinal anastomosis

Spatial rotation of the mesenteric edges 15 to 20 degrees apart from each other to avoid the crowding effect of the thickened mesentery on either side that might affect the proper opposition and approximation of the intestinal loops on the mesenteric border. The anastomosed segments are fixed to the peritoneal cavity to maintain the intestinal lumen axis being vertical and anti-gravity to increase the transient time of contents, encouraging more fluid absorption and reduce the fecal volume outcome and in the same time decreasing the tension load on the anastomotic site. The technique of anastomosis is defined as an end to end anastomosis of the ileo-ascending colon, single sero-muscular continuous layer, hand sew suturing, excluding the mucosal layer from the suture line. A second raw of interrupted sero-muscular suture to release tension on the first raw suture is achieved. No omental or any tissue flapping over the anastomosis site is done. Two abdominal drains are positioned in the left para-colic and pelvic spaces. All suturing procedure has used Vicryl 3/0 on round tip 3/6 circle needle.

Rationale behind the surgical technique of excluding the mucosal layer from the suture line is summarized in the following points:

1. The high mucosal cell turn over and the supreme healing power of the mucosal layer that could heal fast and spontaneously upon approximation without even suturing.

2. Mucosal layer suturing might jeopardy its blood supply and so delays the tissue healing potential.

3. In addition; taking the mucosal layer in the suture line might encourage "creeping out-line growth of the mucosal cells" and progression to fistula formation, especially at the thickened mesenteric circumference side.

4. More over; even if an early minor leakage through the mucosal opposition line took place, it might be contained by the serosal layer; the effectively creeping mesothelium.

Pre- and post-operative radiological assessment: Abdominal Computerized Tomography (ACT) is achieved for diagnosis pre-operatively as well as on fifth, fifteenth and thirtieth post-operative days as routine in all study cases. Ultra-sonography was used to assess peritoneal free fluids in addition to possible further intervention.

Nutritional management and medications

Total Parenteral Nutrition (TPN) as balanced formula is started from the early time of inclusion in the study for seven days. Special CD treatments including immune suppressive drugs and steroids are given without restriction. Oral feeding starts early in the form of clear fluids from the first post-operative day for five days until the first ACT is achieved assuring no leakage, then soft diet is allowed for the following three days then special diet for CD is allowed as patient tolerance.

Follow up duration is divided into

1. Short follow up period that is the first thirty days (period related to operative complications).

2. Long follow up period extended for at least further six months (period related to post-operative complications).

Materials and Methods

The protocol for this research project has been approved by the institution's Scientific and Ethics Committees and it conforms to the provisions of the Declaration of Helsinki and holding Committee Approval No (34/10/2011). All informed consent was obtained from patients included in the study. The author is responsible to submit all documents upon publisher's request. International research registration is not necessary as the research is applying only a suturing technique modification. Between January 2012 and December 2017, 63 cases previously diagnosed as CD (according to the international parameters of histology and serology) presented to the emergency department as fecal peritonitis secondary to ileo-colic perforation or gangrene with or without abscess formation. Patients were all stabilized clinically and operated as soon as possible applying the same surgical technique designed and proposed for the study. All aspects of the study including the pre-operative management, surgical technique, post-operative oral feeding and TPN and clinical and radiological follow up are all fixed to all patients.

Table 1: Patients' epidemiology & pre-operative data.

Variant	Value/Mean (± SD)	Percentage
Gender : Male : Female	56:07:00	-
Age (years)	27.4 ± 8.5	-
BMI	22.1 ± 2.4	-
CDAI	199 ± 64.7	-
Smoker	16	25.4
Medication Type		
Not committed on medication	16	25.4
Immunosuppressive therapy	13	20.6
Mesalazine	21	33.3
Prednisolone+ Immunosuppressive therapy	4	6.1
Prednisolone+ Mesalazine	6	9.5
Prednisolone+ Mesalazine + Immunosuppressive therapy	3	4.8
Patients presented with septic shock	4	6.1
ASA Class		
Class II	20	31.8
Class III	37	58.7
Class IV	6	9.5
Number operated upon as first laparotomy	47	74.6
Number of patients previously laparotomized	16	25.4

Data collection

Pre-operative information involved demographic and clinical data including "The Crohn's Disease Activity Index" (CDAI). Crohn-specific pre-operative treatment is documented. Surgical details were recorded in addition to postoperative complications and duration of hospital stay.

Data analysis

All results are presented in a descriptive manner. Base-line characteristics and intraoperative and postoperative data are given as mean and standard deviation for continuous variables and percentages for categorical and ordinal data.

Results and Discussion

All study patients presented to emergency department with picture of acute abdomen but only 4 (6.1%) presented with septic shock. Forty seven patients (74.6%) had no previous laparotomy. Most of study patients were males (88.9%) with median of middle age category. Medication type or no medication is recorded in detail. Pre-operative evaluation and assessment was achieved to all patients as described in Table 1. All patients had had pre-operative ACT for diagnosis. All signs of ileo-caecal granulation and perforation in addition to fecal peritonitis were demonstrated in all the study patients (Figure 1 and 2). Intra-operatively study patients presented with ileal perforation and ileo-caecal gangrene frequency was 29 & 34 respectively. All patients showed diffuse mesenteric thickening and 57 patients showed gross mesenteric lymphadenopathy. Intra-operative details are shown in Table 2. Post-operatively, the anastomotic line was assessed by ACT using both oral and intravenous contrast. Seven patients showed linear anastomotic submucosal dye dissection that was contained below the serosal layer (Figure 3). Intra-abdominal fluid collection noticed in 4 patients as detected by ultrasonography

Table 2: Patients' intra-operative data.

Variant	Value/Mean (± SD)	Percentage
Patients with fecal peritonitis	63	100
Patients presented with ileal perforation	29	46
Patients with gangrenous ileo-caecal junction	34	54
Patients with gross mesenteric lymphadenitis	57	90.5
Patients operated as designed in the study	63	100
Patients had ileostomy, colostomy, or no bowel anastomosis for a second stage procedure	0	0
Patients had resection limited to ileo-caecal region	63	100
Patients had resection beyond the ileo-caecal region	0	0
Duration of surgery (minutes)	121.6 (± 37.2)	-

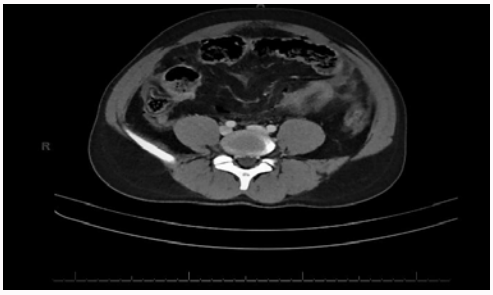

Figure 2: Pre-operative ACT views showing thickened ileo-caecal junction, thickened mesentery and Pneumo-peritoneum.

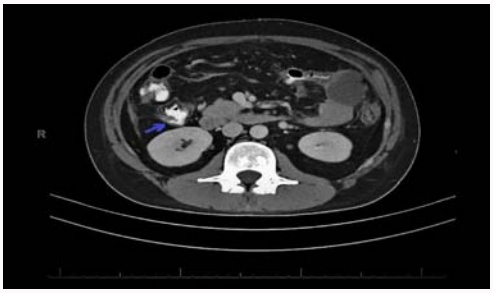

Figure 3: Post-operative ACT views showing anastomotic sub-mucosal dye dissection sign without free leakage.

and guided aspiration revealed reactionary serous fluid volume ranging between 15 ml and 30 ml. In all the four cases fluid aspirated was analyzed biochemically for bilirubin and was negative. Contained sub-serosal dye dissection within the intestinal wall was detected by ACT in 7 patients without showing free peritoneal fluid or prolonged ileus. Minor complications of delayed wound healing and wound site superficial infection were experienced. No anastomotic leakage (bilirubin negative extra-luminal intra-abdominal fluid) occurred in any of the patients. None of the patients needed additional surgery during their primary hospitalization stay nor needed surgical hospitalization during the long follow up for anastomotic site stricture or obstruction. The mean hospital stay duration was below fourteen days. Detailed results of post-operative follow up are shown in Table 3. Post-operative complications and re-operation in CD can occur due to the recurrent nature of the disease. Several factors may influence the outcomes after surgical treatment for CD, including the surgical technique [17,18]. Regarding the surgical anastomotic technique, a crucial research conclusion states that "surgical anastomosis is considered to be an important factor because patients

Table 3: Patients' postoperative & follow up data.

Complication Type	NO. of patients/ Median ± SD
Postoperative bleeding	0
Contained sub-serosal dye dissection within the intestinal wall (ACT detected)	7
Anastomotic leak or anastomotic line breakage	0
Ultrasound guided serous abdominal collection aspiration (aspiration volume ≤ 30 ml)	4 (6.4%)
Mean abdominal collection aspirated volume (ml)	19.7 (± 3.1)
Number of patients whom aspirated abdominal fluid (bilirubin assay came negative for all)	4 (100%)
Intra-abdominal abscess collection	0
Deep venous thrombosis (lower limb)	1
Atelectasis	3
Patients had delayed wound healing without infection (≤ 21 days)	5
Mean duration of prolonged wound healing in 5 patients (days)	11.5 (± 1.2)
Patients had wound infection	4 (6.3%)
Mean duration of infected wound recovery in 4 patients (days)	14.3 (± 2.5)
First postoperative bowel motion timing (days)	2.3 (± 0.3)
Patients needed re-operation during hospital stay	0
Duration of hospital stay (days)	13.8 (± 3.2)
Mortality	0
Patients needed surgical re-hospitalization for surgical reason	0
Patients commenced on medical treatment post-operatively	63
Re-operation for recurrence during follow up duration	0
Patients showed intestinal obstruction/stricture during the follow up duration	0
Follow up duration (months)	32.3 (± 6.4)

with permanent end ileostomy seldom suffer from recurrence, and nearly 90% of recurrences of disease occur in the peri-anastomotic segment "[19,20]. This conclusion should direct surgeons' interest to find a technical anastomotic procedure for the resected diseased segment that might reduce the complications of leakage and disease recurrence. Post-operative early and frequent recurrence of Crohn's disease is common in patients who underwent resection surgery with 88% of the recurrent activity observed in the neo-terminal ileum and the anastomotic site as well [21]. That is why the topographic configuration of the anastomosis has been considered a leading factor in the recurrence rate. Retrospective studies comparing side-to-side anastomosis with various other configurations of the anastomosis revealed ambiguous results [22-26]. Such studies had different views to spot, e.g. stapled and hand-sewn anastomoses were compared without considering the configuration of the anastomosis. One trial included 86 patients and reported recurrence rates of 23% and 31% for side-to-side versus end-to-end anastomosis, respectively without statistical significance [27]. Another trial investigated stapled versus hand-sewn anastomosis after multiple intestinal resections using different anastomotic configurations. The post-operative recurrence rate after stapled anastomosis was lower than after hand sewn anastomosis (18.9% *vs.* 37.8%). A subgroup analysis that included only patients after ileo-caecal resection showed a recurrence rate of 9.1% after side-to-side compared to 28.6% after end-to-end anastomosis (N=21) [28]. One leading prospective study has published the results on 170 patients. A figure of 37.9% showed recurrent disease endoscopically in the side-to-side group while 42.9% in the end-to-end group. The symptomatic disease recurrence was (22.7% in the end-to-end *vs.* 21.9% in the side-to-side anastomosis group) and the study concluded that the rate of disease recurrence is independent of the configuration of the anastomosis [29]. Munoz-Juarez et al. reported early postoperative complication rate 20% with hand sewn end-to-end anastomosis compared to 7% in the side-to-side anastomosis. Anastomotic leakage was described in 4.5% in the former *vs.* 2.8% in the later group. Recurrent disease activity was reported in 57% the former and in 24% in the later group [25]. They concluded that unnoticed technical factor in the hand sewn procedure is reason causing such higher incidence of complications. Simillis et al. compared conventional hand sewn end-to-end anastomosis *vs.* other anastomotic configurations after resection in CD. The anastomotic leakage was significantly higher in the end-to-end anastomosis group (6.7% of 382 patients) compared to the other anastomotic configurations group (2.3% of 259 patients received a side-to-side anastomosis). In addition, they showed no significant difference regarding the overall postoperative complications [7]. In literature, only one of the included surveys comparing end-to-end anastomoses versus side-to-side anastomoses was a prospective randomized controlled trial; the others represented non-randomized, retrospective studies [7,24,29]. The overall postoperative complications other than anastomotic leak were decreased in the side-to-side group. These literature contradictive and inconclusive results; all offer a potential proof that there is a still missing standard technique to rely on whether staple- or hand- based in resection and anastomosis in CD patients. Such contemporary situation of the ileo-colic anastomosis in CD complicated cases demands further research considering trial of new anastomotic techniques. From the previous review of literature, it is concluded that side to side ilio-colic anastomosis using either stapler or hand sew technique are both superior to end to end anastomosis regarding operative complications and in addition have less local recurrence disease with no difference regarding systemic disease. The author proposes an explanation for such results as follows: CD as an immune derived disease and lymphatics play a major role in the pathogenesis. By applying the side to side anastomosis using hand sew technique or stapler the circumferential lymphatics in the intestinal wall are interrupted isolating the anastomotic site from the immune lymphatic drive and local recurrence of the disease is decreased. In addition the traditional end to end multi-layer anastomosis using either hand sew or stapler techniques preserve the circumferential lymphatic connection and so local recurrence of the disease at the anastomotic site is high. In addition the later technique might jeopardy the blood supply to the healing anastomosed layers and more over might create a mucosal tissue intervening through the wall thickness initiating an intestinal fistula. These explanations are just theoretical suggestions that remain with no proofs but have leaded the author to think seriously to save the end to end hand sew anastomosis from the ambiguous incriminations without any explanation.

Conclusion

The surgical technique described in this study is thought genuine and based on a strong theory basis. Intestinal fistula formation always starts with mucosal healing defect or mucosal transposition in an abnormal tissue plane through the anastomotic plane is both avoided by mucosal exclusion from the suture line as in the proposed technique. The intestinal mucosa is proved to hold the highest cellular turn-over among all the body cell types; leaving no doubt concerning its capacity to growth and healing without suturing assistance. Approximation of the submucosal floor that is; the sero-muscular

layer, offers the basis for mucosal healing and anastomotic plane closure with no hindrance of its blood supply. The sero-muscular layer is considered the anchor holding the opposed mucosa layers together to heal and in the same time acts as a guarding flap to contain any minimal possible leakage as proved radiologically in minority cases. It is of great worth to mention that the seven patients who got sub-serosal dye dissection showed the highest CDAI scores in the patients' sample. Such correlation indicates a prognostic value of the CDAI in predicting CD patients prone to post-anastomotic leakage. In addition it proves the efficacy of the proposed anastomotic technique. Upon review of literature the study is unique proposing an end to end hand sewn technique in CD patients as a primary anastomosis without doing a protective stoma. The study case sample is relatively small and the proposed surgical technique need verification on a larger study sample. Critic is invited.

References

1. Bernell O, Lapidus A, Hellers G. Risk factors for surgery and recurrence in 907 patients with primary ileocaecal Crohn's disease. Br J Surg. 2000;87(12):1697-701.
2. Post S, Betzler M, von Ditfurth B, Schürmann G, Küppers P, Herfarth C. Risks of intestinal anastomoses in Crohn's disease. Ann Surg. 1991;213(1):37-42.
3. Colombel JF, Loftus EV Jr, Tremaine WJ, Pemberton JH, Wolff BG, Young-Fadok T, et al. Early postoperative complications are not increased in patients with Crohn's disease treated perioperatively with infliximab or immunosuppressive therapy. Am J Gastroenterol. 2004;99(5):878-83.
4. Yamamoto T, Allan N, Keighley R. Risk factors for intra-abdominal sepsis after surgery in Crohn's disease. Dis Colon Rectum.2000;43(8):1141-5.
5. Kracht M, Hay JM, Fagniez PL, Fingerhut A. Ileocolonic anastomosis after right hemicolectomy for carcinoma: stapled or hand-sewn? A prospective, multicenter, randomized trial. Int J Colorectal Dis. 1993;8(1):29-33.
6. Choy PY, Bissett IP, Docherty JG, Parry BR, Merrie AE. Stapled versus hand sewn methods for ileocolic anastomoses. Cochrane Database Syst Rev. 2007;(3):CD004320.
7. Resegotti A, Astegiano M, Farina EC, Ciccone G, Avagnina G, Giustetto A, et al. Side-to-side stapled anastomosis strongly reduces anastomotic leak rates in Crohn's disease surgery. Dis Colon Rectum. 2005;48(3):464-8.
8. Yang SS, Yu CS, Yoon YS, Yoon SN, Lim SB, Kim JC. Risk factors for complications after bowel surgery in Korean patients with Crohn's disease. J Korean Surg Soc. 2012;83(3):141-8.
9. He X, Chen Z, Huang J, Lian L, Rouniyar S, Wu X, et al. Stapled side-to-side anastomosis might be better than handsewn end-to-end anastomosis in ileocolic resection for Crohn's disease: a meta-analysis. Dig Dis Sci. 2014;59(7):1544-51.
10. Huang WP, Chen JF, Yang JQ, Dong CC, Liang ZX, Chen XG. Risk factors associated with anastomotic leak in patients with Crohn disease undergoing bowel resections. Zhonghua Wei Chang Wai Ke Za Zhi. 2013;16(4):332-5.
11. Tzivanakis A, Singh JC, Guy RJ, Travis SP, Mortensen NJ, George BD. Influence of risk factors on the safety of ileocolic anastomosis in Crohn's disease surgery. Dis Colon Rectum. 2012;55(5):558-62.
12. Choi YY, Bae J, Hur KY, Choi D, Kim YJ. Reinforcing the staple line during laparoscopic sleeve gastrectomy: does it have advantages? A meta-analysis. Obes Surg. 2012; 22(8):1206-13.
13. Aberra FN, Lewis JD, Hass D, Rombeau JL, Osborne B, Lichtenstein GR. Corticosteroids and immune-modulators: postoperative infectious complication risk in inflammatory bowel disease patients. Gastroenterology. 2003;125(2):320-7.
14. Alves A, Panis Y, Bouhnik Y, Pocard M, Vicaut E, Valleur P. Risk factors for intra-abdominal septic complications after a first ileocecal resection for Crohn's disease: a multivariate analysis in 161 consecutive patients. Dis Colon Rectum. 2007;50(3):331-6.
15. Riss S, Bittermann C, Zandl S, Kristo I, Stift A, Papay P, et al. Short-term complications of wide-lumen stapled anastomosis after ileocolic resection for Crohn's disease: who is at risk? Colorectal Dis. 2010;12(10):298-303.
16. Neumann PA, Rijcken EJ, Bruewer M. Current status of laparoscopic surgery for patients with Crohn's disease. Int J Colorectal Dis. 2013;28(5):599-610.
17. Gao X, Yang RP, Chen MH, Xiao YL, He Y, Chen BL, et al. Risk factors for surgery and postoperative recurrence: analysis of a south China cohort with Crohn's disease. Scand J Gastroenterol. 2012;47(10):1181-91.
18. Li Y, Zhu W, Zuo L, Zhang W, Gong J, Gu L, et al. Frequency and risk factors of postoperative recurrence of Crohn's disease after intestinal resection in the Chinese population. J Gastrointest Surg. 2012;16(8):1539-47.
19. Scammell B, Ambrose NS, Alexander-Williams J, Allan RN, Keighley MR. Recurrent small bowel Crohn's disease is more frequent after subtotal colectomy and ileorectal anastomosis than proctocolectomy. Dis Colon Rectum. 1985;28(11):770-1.
20. Farmer RG, Hawk WA, Turnbull RB Jr. Clinical patterns in Crohn's disease: a statistical study of 615 cases. Gastroenterology. 1975;68(4-1):627-35.
21. Rutgeerts P, Geboes K, Vantrappen G, Kerremans R, Coenegrachts JL, Coremans G. Natural history of recurrent Crohn's disease at the ileocolonic anastomosis after curative surgery. Gut. 1984;25(6):665-72.
22. Scarpa M, Angriman I, Barollo M, Polese L, Ruffolo C, Bertin M, et al. Role of stapled and hand-sewn anastomoses in recurrence of Crohn's disease. Hepatogastroenterology. 2004;51(58):1053-7.
23. Tersigni R, Alessandroni L, Barreca M, Piovanello P, Prantera C. Does stapled functional end-to-end anastomosis affect recurrence of Crohn's disease after ileocolonic resection? Hepatogastroenterology. 2003;50(53):1422-5.
24. Muñoz-Juárez M, Yamamoto T, Wolff BG, Keighley MR. Wide-lumen stapled anastomosis *vs.* conventional end-to-end anastomosis in the treatment of Crohn's disease. Dis Colon Rectum. 2001;44(1):20-5;discussion 25-6.
25. esalnieks I, Kilger A, Kalisch B, Obermeier F, Schlitt HJ, Agha A. Treatment of the anastomotic complications in patients with Crohn's disease. Int J Colorectal Dis. 2011; 26(2):239-44.
26. Cameron JL, Hamilton SR, Coleman J, Sitzmann JV, Bayless TM. Patterns of ileal recurrence in Crohn's disease. A prospective randomized study. Ann Surg. 1992;215(5): 546-51, discussion 551-42.
27. Kusunoki M, Ikeuchi H, Yanagi H, Shoji Y, Yamamura T. A comparison of stapled and hand-sewn anastomoses in Crohn's disease. Dig Surg. 1998;15(6):679-82.
28. Simillis C, Purkayastha S, Yamamoto T. A meta-analysis comparing conventional end-to-end anastomosis vs. other anastomotic configurations after resection in Crohn's disease. Dis Colon Rectum. 2007;50(10):1674-87.
29. McLeod RS, Wolff BG, Ross S, Parkes R, McKenzie M; Investigators of the CAST Trial. Investigators of the CAST Trial. Recurrence of Crohn's disease after ileocolic resection is not affected by anastomotic type: results of a multicenter, randomized, controlled trial. Dis Colon Rectum. 2009;52(5):919-27.