The Surgical Options and Management of Intestinal Crohn's Disease

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Abstract Crohn's disease (CD) is a pan-gastrointestinal illness. It is notorious for recurrences which can develop in any segment of the gastrointestinal tract. There are many indications and surgical options for intestinal Crohn's disease. We discuss these options based on the current literature. It is important to note however, that operative treatment is based on the correct diagnosis, clinical presentation, sphincter function and patient motivation. Early and timely referral to a surgeon is paramount. The goals of continued medical therapy need to be clearly defined as do the criteria for referral to surgery.

Keywords Crohn's Disease · Inflammatory bowel disease · Gastrointestinal tract

Introduction

Surgical History of Crohn's Disease

Crohn's disease (CD) is a chronic inflammatory bowel disease of the gastrointestinal tract. Fielding [1] reviewed cases of the Pathological Society of London from 1850 to 1899 and found 31 with features of CD and 25 cases of possible CD. Interestingly, majority of these involved the large bowel. Originally these diseases were diagnosed as obstructions, strictures, and ulcerative colitis.

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In 1932, Crohn et al described “a disease of the terminal ileum, affecting mainly young adults, characterized by a subacute or chronic necrotizing and cicatrizing inflammation” [2]. They noted that the disease process frequently led to stenosis of the lumen of the intestine associated with formation of multiple fistulas. The authors called the disease “regional ileitis” and believed that it involved only the terminal ileum. The disease entity was recognized rapidly and the eponym “Crohn's disease” became widely used. The early recommendation of Crohn and his associates was that all affected bowel and its draining lymph nodes should be excised with a reasonable margin of 30 cm on each side.

Lockhart-Mummery and Morson were the first to report CD of the large intestine in 1960 [3]. Their study confirmed that CD is different from ulcerative colitis and that the two entities do not occur together in the same patient. It is now recognized that CD can occur anywhere in the gastrointestinal tract—from the mouth to the anus [4].

Indications for Surgery

Since its recognition as a pangastrointestinal disease, CD is notorious for recurrences which can develop in any segment of the gastrointestinal tract. Therefore, the objectives of operative treatment include relief of symptoms, correction of complications, restoration of health and function when medical treatment has failed, prevention of development of carcinoma, and withdrawal of medications (steroids and immunosuppressive agents). Another important objective is the establishment of a normal quality of life and restoration of growth in children.

The timing of the decision for operation in CD is based on an evaluation of the symptom severity of the disease, medical treatment failure or side effects, and perceptions of

operative risk. Optimal evaluation of these factors should result in an operation timed to the patient's best advantage, achieving maximal relief of symptoms with minimal operative disadvantage. The decision to undertake surgery is one made after appropriate consideration on the part of the patient (and their family), their gastroenterologist and the surgeon. Up to 90% of patients with CD will require some type of surgical intervention. In addition, recurrences requiring surgery in about 50–70% depending on disease location are seen [5]. Therefore, it is important to conserve as much intestine as possible.

The operative indications have not changed significantly over the years and the number one indication for surgery today remains “failed medical therapy”. The definition of “failed medical therapy” is not the same for all treating doctors or indeed for patients. In general, this may include unresponsive disease, incomplete response, excessive steroid requirements, medication related complications or non-compliance with medication. Concerns for the surgeon include a malnourished patient while being on a regimen of steroids and/or other toxic medications, and how these factors impact on the patient's surgical management. Other indications for surgery include bowel obstruction, intra-abdominal abscess, internal fistula, colocutaneous and enterocutaneous fistula, fulminant colitis, toxic megacolon, free perforation, massive bleeding, carcinoma prevention, carcinoma, extra-colonic manifestations and growth retardation (in the paediatric population).

Options for Surgery

The type of surgery undertaken will largely depend on the indications mentioned above. Three main options exist however, and these include bowel resection, strictureplasty or bypass. The most common surgical option is bowel resection with or without anastomosis. However, in the last 20 years, strictureplasty has revolutionised the surgical concept of CD. Bypass can also be used, which can be internal, with or without exclusion or an external bypass such as a stoma. Internal bypass, today, is generally avoided because of the risk of infected mucocoele, as well as cancer risk in the excluded segment. It is occasionally performed in patients with gastroduodenal CD in the form of a gastroenterostomy. At other sites, on occasions, a case for bypass can be made when the inflammatory mass firmly adheres to other organs, thus preventing a safe excision.

Surgical resection is currently the procedure of choice. This can be performed either open or laparoscopically. In both circumstances, the dissection needs to be meticulous. There should be adequate mobilisation and minimal contamination. If the open technique is used, a midline laparotomy should be performed as opposed to a transverse incision as this may interfere with stomas which may be

needed on either side of the abdomen. A midline incision also gives good access and is more easily opened in the future. At each operation a full laparotomy should be carried out to stage the disease and the length of remaining and resected bowel should be measured.

There is usually a very thick mesentery in the diseased area and therefore the mesentery should be suture ligated. Fazio et al showed that conservative resection margins of approximately 2 cm are acceptable even when microscopic CD is present [6]. A randomised controlled trial of patients ($N=152$) undergoing limited (2 cm) versus wide (12 cm) margins of resection beyond macroscopically diseased bowel, showed that extended resection margins are unnecessary and have no advantage in reducing cumulative recurrence rates. This is important also because small aphthous ulcers may be seen at sites away from the resected specimen. These ulcers can be ignored since there is no evidence that leaving such lesions in situ adversely affects recurrence rates. This is particularly important in patients with an already shortened intestinal length.

The surgical resection margin can be determined intra-operatively by using the thumb and index finger to feel the mesenteric border of the bowel. If thumb and forefinger can be felt with minimal thickening and the bowel edges are soft, then this is the area to be used for the surgical margin of resection rather than a frozen section (Fig. 1). In addition the presence of strictures can be assessed with bi-digital palpation or with the help of a Foley catheter filled to a diameter of 2.5 cm. Alternatively a marble can also be used. These can be passed into the small bowel via a resection site or a strictureplasty site.

Different types of anastomoses can be used in bowel resection for CD. No single type is proven to be superior.

Fig. 1 Technique to determine area of bowel to resect

The following configurations and techniques have been shown to be unrelated to recurrence: side to end versus end to end; side to side versus end to end; side to side versus end to side; and stapled versus hand sewn [7–9]. More recently however, stapling devices have become popular worldwide. Functional end-to-end anastomosis using a linear stapler is the most frequently used method in intestinal surgery. Many comparative studies have been designed between hand-sewn and stapled anastomoses. In a meta-analysis of eight studies, less leakage, morbidity, and anastomotic recurrence, as well as shorter hospital stay were observed in stapled anastomosis as compared to the hand-sewn type [10]. Among these studies, better results were reported in stapled anastomosis [9–12] in contrast to other studies that reported no significant differences between the two methods of anastomosis [13–15]. Although no definitive conclusion has been reached, and many surgeons may disagree, stapled anastomosis is becoming more commonly used in surgical practice [16].

Laparoscopic resection is a viable option in selected patients. A meta-analysis by Tilney et al looked at 15 studies comparing laparoscopic and open ileocaecal resection for CD [17]. Seven hundred and eighty three patients undergoing 338 laparoscopic procedures were analyzed. Laparoscopy had longer operative time but comparable morbidity rates. Laparoscopy also had earlier return of bowel function, tolerance to diet and shorter length of stay. The overall conversion rate was 6.8%. Factors for conversion included large fixed masses, multiple fistulae and abscesses. Body image and quality of life favoured laparoscopy. There was no difference with regards to recurrence of disease.

A randomised controlled trial from a single institution compared laparoscopic – assisted versus open ileocolic resection in 60 patients with CD [18]. Morbidity, hospital stay and costs were lower in the laparoscopic group, although there were no significant differences in quality of life at 3 months follow up. In a long term follow up study, the recurrence rates in laparoscopic ileocolic resection compared favourably with conventional surgery [19]. Some centres also make a policy of starting most cases laparoscopically in order to offer the potential benefits of laparoscopic surgery without increased morbidity [20].

Strictureplasty is an important tool in intestinal CD as it is an effective method to preserve bowel length. Intestinal strictureplasty was first described in India in 1977 by Katariya et al for multiple tubercular strictures causing bowel obstruction [21]. This was followed by Lee and Papaioannou who published their results on strictureplasty for CD patients in 1982 [22]. Their patient group underwent either strictureplasty alone or combined strictureplasty and

resection, both of which were shown to be safe and efficacious. Multiple studies have been published since then describing the safety and efficacy of strictureplasty in CD [23, 24].

The most recent study was a meta-analysis by Yamamoto in 2007 [25]. They included 23 studies with 1,112 patients undergoing 3,259 strictureplasties from 1975 to 2005. Of these, 81% were of the Heineke-Mikulicz type, 10% Finney's type and 5% were side to side isoperistaltic. Septic complications occurred in 4% of patients. The overall recurrence rate was 23%. Ninety percent occurred at a non-strictureplasty site while only 3% were site specific recurrences. They concluded that strictureplasty is a safe and effective procedure for jejunoileal CD, including ileocolonic recurrence, and has the advantage of protecting against further small bowel loss. However, they stated that the place for strictureplasty is less well defined in duodenal and colonic disease.

The indications for strictureplasty include multiple strictures in a long segment, existing or impending short bowel syndrome related to prior resections, or if there is a non-phlegmonous fibrotic stricture. Relative contraindications include multiple strictures in a short segment, phlegmonous or fistula-related stricture, free or contained perforation, hypoalbuminaemia (<20 g/L) and rigid thickened bowel segments of any length. A contraindication to strictureplasty is colonic strictures because of the concern of malignancy. Indeed, the indication for strictureplasty is less well defined in the large bowel, as the risk of malabsorption from short bowel syndrome is not present, and it is unlikely that multiple large bowel resections will be required for CD.

There are several types of strictureplasties. Their use depends on the length of the strictures. Short length strictures (<5 cm) are amenable to Heineke-Mikulicz strictureplasty (Fig. 2).

This is most commonly used and involves incising the bowel longitudinally and closing it transversely. This allows

Fig. 2 Heineke-Mikulicz strictureplasty

the obstructed or narrowed area to become larger. For medium length strictures (5–20 cm) the options are either a Finney's strictureplasty (which is a side to side anastomosis – Fig. 3) or the Jaboulay strictureplasty where the loop of intestine containing the stricture is positioned in a U shape, similar to that of the Finney procedure. However, instead of incising the whole section, two separate incisions in relatively healthy facing sections of the bowel are made without traversing through the main strictured area. This enables an enteroenterostomy to be completed.

Michelassi strictureplasty is another type which is used for strictures greater than 20 cm and in patients with impending short bowel syndrome (Fig. 4) [26]. This involves a side-to-side iso-peristaltic anastomosis and avoids the loss of a long segment of small bowel. The Poggioli technique is a slight variation which uses a side-to-side diseased to disease free anastomosis [27].

Strictureplasty can also be performed at anastomotic sites with recurrent disease. Tjandra and Fazio reported a series of 22 patients who underwent strictureplasty across ileocolic anastomotic strictures and reported no mortality, no major morbidity and a recurrence rate of 9% [28]. Yamamoto and Keighley reported 42 patients who underwent anastomotic strictureplasty with no mortality, no major complications, 21% minor complications, with a 57% recurrence rate [29]. The high recurrence rate is consistent with a long median follow-up of 99 months. This report along with others demonstrates that strictureplasty at anastomotic sites is a safe and efficacious procedure and should be considered an option in any patient who is a candidate.

The largest series on strictureplasty shows a morbidity rate of 18%, most of which are self-limiting. The predis-

Fig. 3 Finney's strictureplasty

Fig. 4 Michelassi strictureplasty

posing factors for these include older age and preoperative weight loss. Septic complications accounted for 5% while bleeding accounted for 7%. Ninety-eight per cent of patients were free of symptoms within 6 months while only 19% remained on steroids [30]. One concern with strictureplasty is the risk of cancer developing at that site. Marchetti et al reported the first such case in 1996 [31]. Since then, a few more cases have been reported at strictureplasty sites [32, 33].

While the relative risk of developing small bowel adenocarcinoma in CD patients is higher than the general population, the reported incidence of carcinoma at a strictureplasty site is still quite low. This may change as follow-up periods for such patients increase from years to decades but at present there is no reason not to continue performing strictureplasty. Consideration should be given to biopsy with frozen section of the strictureplasty site should there be any suspicion of malignancy. All strictureplasty sites should be marked with a metallic clip for future reference.

The formation of a stoma is another surgical option in CD. Obviously, these are preferably avoided since the majority of patients are young and permanent stomas are not ideal. There are some situations, however, where a temporary stoma can be useful. A loop ileostomy can be considered if there is incompletely drained sepsis at the time of surgery, excessive blood loss, prolonged operative time >4 h, or if the patient is very malnourished (hypoalbuminaemia <25 g/L). Edwards et al assessed the effect of faecal diversion on the natural history of a refractory Crohn's colitis and severe perianal disease [34]. Seventy-three patients underwent a defunctioning stoma (55 for refractory Crohn's colitis and 18 for perianal disease). Acute remission was achieved in 63 patients (48 for refractory Crohn's colitis and 15 for perianal disease). Twenty-nine patients had subsequent closure of the defunctioning stoma (25 of 48 acute responders

with refractory Crohn's colitis and 4 of 15 acute responders with perianal disease). Eleven patients with a refractory Crohn's colitis and two with perianal disease achieved good long-term function without disease relapse (median follow-up 36 months). Overall, 52 patients underwent proctocolectomy or remain with a defunctioning stoma (37 with refractory Crohn's colitis and 15 with perianal disease). They concluded that faecal diversion is associated with acute clinical remission in majority of patients with refractory Crohn's colitis and perianal disease, but sustained benefit occurs less often. For selected patients, diversion alone offers a realistic alternative to major bowel resection.

From a surgeon's perspective, use of a significant amount of immunosuppressants including infliximab may lower the threshold for consideration of a stoma as these may contribute to peri-operative morbidity, in particular anastomotic leaks and wound complications. In a study by Appau et al in 2008, the use of infliximab 3 months before ileo-colic resection in CD appeared to be associated with an increased risk of postoperative complications such as sepsis, abscess formation and readmission rates [35]. However, the presence of a stoma proximal to the anastomosis seemed to decrease these risks. It is unclear whether it is due to the drug itself or because the patient group is a lot sicker. A more recent study by Indar et al at the Mayo clinic investigated the outcomes of CD patients undergoing intestinal resection while on preoperative immunosuppressants [36]. Of 112 patients, 47 were on corticosteroids, 39 on immunomodulators and 17 on tumour necrosis factor alpha antibodies. They concluded that occurrence of complications in CD patients undergoing intestinal resection was not associated with the use of immunosuppressive medication. Another study by Colombel et al concluded that early complications after elective abdominal surgery for CD are not associated with steroid dose, immunosuppressive therapy, or infliximab use [37].

In summary, for patients with small bowel and ileocolic CD the most common surgical procedure is resection with or without anastomosis depending on the clinical situation. Strictureplasty is a valid option if the indications mentioned previously are met. The decision for a diverting stoma is made on a case by case basis depending on the severity of disease and the patient's overall health status. Internal bypass is not performed very often but is used for the fixed ileocaecal mass which is adhered to the retroperitoneum and iliac vessels.

One of the more common reasons patients are referred to surgeons is because of colonic CD. The operation of choice depends on many factors including age, distribution of the disease and its severity, previous resections, rectal compliance and anal continence. In the emergency setting, toxic patients or those with severe perineal disease or sepsis would undergo a total colectomy (TC) and end ileostomy (EI) without proctectomy. The rectum would then be removed at a later

date, usually 6 months, once the patient has recovered from the toxic state. The rectal stump has traditionally been exteriorised for safety, however, if there is rectal sparing, it may be oversewn or stapled at the sacral promontory [38].

Patients with CD of the colon who require elective surgery may undergo segmental or total colectomy with or without a primary anastomosis. Tekkis et al in their meta-analysis in 2006 compared segmental versus subtotal/total colectomy for colonic CD [39]. Six studies, consisting of 488 patients (223 colectomy with ileorectal anastomosis (IRA) and 265 segmental colectomy) were included. Analysis of the data suggested that there was no significant difference between IRA and segmental colectomy in recurrence of CD. Time to recurrence was longer in the IRA group by 4.4 years. There was no difference between the incidence of postoperative complications or the need for a permanent stoma between the two groups. Patients with two or more colonic segments involved were associated with a lower re-operation rate in the IRA group, a difference which did not reach statistical significance. They concluded that both procedures were equally effective as treatment options for colonic CD however, patients in the segmental colectomy group exhibited recurrence earlier than those in the IRA group. The choice of operation is dependent on the extent of colonic disease, with a trend towards better outcomes with IRA if two or more colonic segments are involved. Since no prospective randomised study has been undertaken, a clear view about which approach is more suitable for localised colonic CD cannot be obtained at present. Symptomatic disease of the colon with rectal sparing can also be managed either with segmental resection or by total colectomy [40].

The surgical options in severe rectal disease include total proctocolectomy (TPC) with end ileostomy (EI), proctectomy and colostomy, or rarely, proctectomy and anastomosis. TPC and EI should be considered in patients with extensive colonic and rectal disease. It can be the procedure of choice because it is often the quickest and best way that a patient can get on with their life. Patients understandably may not be keen on it but evidence shows that this procedure is associated with the lowest recurrence rates. Goligher reported a 15% recurrence after 15 years of follow-up in 162 patients who underwent TPC and EI [41]. More recently, a prospective study by Fichera et al looked at the long term outcomes of surgically treated Crohn's colitis [42]. They compared patients who had undergone segmental colectomy, total colectomy and total proctocolectomy for Crohn's colitis. Segmental colectomy patients had a significantly shorter time to first recurrence than TPC patients. TPC patients were also significantly less likely to be still taking medications 1 year after the index operation compared with total abdominal colectomy and segmental colectomy patients. In addition, patients with isolated distal disease were significantly more likely to

require a permanent stoma than patients with isolated proximal disease. They concluded that a more aggressive approach should be considered in patients with diffuse and distal Crohn's colitis and that TPC in properly selected patients is associated with low morbidity, lower risk of recurrence, and longer time to recurrence. They also found that patients after TPC are more likely to be weaned off all Crohn's related medications. Finally, the long-term rate of permanent faecal diversion was significantly higher in patients with distal disease.

The role of ileal pouch anal anastomosis (IPAA) is controversial in CD although it is considered the procedure of choice in ulcerative colitis. Melton et al studied 204 pts after IPAA with median follow up of 7.4 year [43]. A preoperative diagnosis of CD was made in 10% of patients while 47% were diagnosed post-operatively. Forty three percent had a delayed diagnosis. The pouch retention rate was 71% at 10 years. A delayed diagnosis, pouch vaginal fistula and postoperative sepsis were associated with higher failure rates. They concluded that for CD patients with IPAA, when the diagnosis is established preoperatively or immediately following surgery, pouch loss rates are low and functional results are favourable. Outcomes in patients with delayed diagnosis are worse but half of them retain their pouch at 10 years with good functional outcomes. IPAA for CD is not widely practiced however, since other centres have reported poor outcomes in contrast to the above study [44, 45].

Conclusion

In conclusion, the treatment of CD focuses on the elimination of disease symptoms while minimising morbidity and maintaining intestinal continuity. The operative treatment is based on the correct diagnosis, clinical presentation, sphincter function and patient motivation. Early and timely referral to a surgeon is paramount. Patient perceptions are perhaps the most frustrating aspect for the surgeon and it is something that is unique to inflammatory bowel disease patients. It is important to work as a team with gastroenterology colleagues. Early discussion of surgical options and outcomes with the patient by both the gastroenterologist and surgeon is required. The goals of continued medical therapy need to be clearly defined as do the criteria for referral to surgery.

References

- Fielding JF (1984) Crohn's disease in London in the latter half of the nineteenth century. *Ir J Med Sci* 153:214
- Crohn BB, Ginzburg L, Oppenheimer GD (1932) Regional ileitis. *JAMA* 99:1323
- Lockhart-Mummery HE, Morson BC (1960) Crohn's disease (regional enteritis) of the large intestine and its distinction from ulcerative colitis. *Gut* 1:87
- Janowitz HD (1981) Crohn's disease—50 years later. *N Engl J Med* 304:1600
- Whelan G, Farmer RG, Fazio VW et al (1985) Recurrence after surgery in Crohn's disease. Relationship to location of disease (clinical pattern) and surgical indication. *Gastroenterology* 88:1826
- Fazio VW, Marchetti F, Church M et al (1996) Effect of resection margins on the recurrence of Crohn's disease in the small bowel. A randomized controlled trial. *Ann Surg* 224:563
- Cameron JL, Hamilton SR, Coleman J et al (1992) Patterns of ileal recurrence in Crohn's disease. A prospective randomized study. *Ann Surg* 215:546
- Scott NA, Sue-Ling HM, Hughes LE (1995) Anastomotic configuration does not affect recurrence of Crohn's disease after ileocolonic resection. *Int J Colorect Dis* 10:67
- Munoz-Juarez M, Yamamoto T, Wolff BG et al (2001) Wide-lumen stapled anastomosis vs. conventional end-to-end anastomosis in the treatment of Crohn's disease. *Dis Colon Rectum* 44:20
- Simillis C, Purkayastha S, Yamamoto T et al (2007) A meta-analysis comparing conventional end-to-end anastomosis vs. other anastomotic configurations after resection in Crohn's disease. *Dis Colon Rectum* 50:1674
- Yamamoto T, Bain IM, Mylonakis E et al (1999) Stapled functional end-to-end anastomosis versus sutured end-to-end anastomosis after ileocolonic resection in Crohn's disease. *Scand J Gastroenterol* 34:708
- Ikeuchi H, Kusunoki M, Yamamura T (2000) Long-term results of stapled and hand-sewn anastomosis in patients with Crohn's disease. *Dig Surg* 17:493
- Moskovitz D, McLeod RS, Greenberg GR et al (1999) Operative and environmental risk factors for recurrence of Crohn's disease. *Int J Colorectal Dis* 14:224
- Tersigni R, Alessandrini L, Barreca M et al (2003) Does stapled functional end-to-end anastomosis affect recurrence of Crohn's disease after ileocolonic resection? *Hepatogastroenterology* 50:1422
- Hashemi M, Novell JR, Lewis AAM (1998) Side-to-side stapled anastomosis may delay recurrence in Crohn's disease. *Dis Colon Rectum* 41:1293
- Funayama Y, Takahashi K, Sasaki I (2010) Surgical management in intestinal Crohn's disease. *Clin J Gastroenterol* 3:1
- Tilney HS, Constantinides VA, Heriot AG et al (2006) Comparison of laparoscopic and open ileocecal resection for Crohn's disease: a metaanalysis. *Surg Endosc* 20:1036
- Maartense S, Dunker MS, Slors JF et al (2006) Laparoscopic-assisted versus open ileo-colic resection for Crohn's disease: a randomised trial. *Ann Surg* 243:143
- Lowney JK, Dietz DW, Birnbaum EH et al (2006) Is there any difference in recurrence rates in laparoscopic ileocolic resection for Crohn's disease compared with conventional surgery? A long term follow-up study. *Dis Colon Rectum* 49:58
- Casillas S, Delaney CP (2005) Laparoscopic surgery for inflammatory bowel disease. *Dig Surg* 22:135
- Katariya RN, Sood S, Rao PG et al (1977) Strictureplasty for tubercular strictures of the gastro-intestinal tract. *Br J Surg* 64:496
- Lee EC, Papaioannou N (1982) Minimal surgery for chronic obstruction in patients with extensive or universal Crohn's disease. *Ann R Coll Surg Engl* 64:229
- Dehn TCB, Kettlewell MGW, Mortensen NJM et al (1989) Ten-year experience of strictureplasty for obstructive Crohn's disease. *Br J Surg* 76:339

24. Sayfan J, Wilson DAL, Allan A et al (1989) Recurrence after strictureplasty or resection for Crohn's disease. *Br J Surg* 76:335
25. Yamamoto T, Fazio VW, Tekkis PP (2007) Safety and efficacy of strictureplasty for Crohn's disease: a systematic review and meta-analysis. *Dis Colon Rectum* 50:1968
26. Michelassi F, Hurst RD, Melis M et al (2000) Side-to-side isoperistaltic strictureplasty in extensive Crohn's disease: a prospective longitudinal study. *Ann Surg* 232:401
27. Poggioli G, Laureti S, Pierangeli F et al (2003) A new model of strictureplasty for multiple and long stenoses in Crohn's ileitis: side-to-side diseased to disease-free anastomosis. *Dis Colon Rectum* 46:127
28. Tjandra JJ, Fazio VW (1993) Strictureplasty for ileocolic anastomotic strictures in Crohn's disease. *Dis Colon Rectum* 36:1099
29. Yamamoto T, Keighley MRB (1999) Long-term results of strictureplasty for ileocolonic anastomotic recurrence in Crohn's disease. *J Gastrointest Surg* 3:555
30. Dietz DW, Laureti S, Strong SA et al (2001) Safety and long term efficacy of strictureplasty in 314 patients with obstructing small bowel Crohn's disease. *J Am Coll Surg* 192:330
31. Marchetti F, Fazio VW, Ozuner G (1996) Adenocarcinoma arising from a strictureplasty site in Crohn's disease: report of a case. *Dis Colon Rectum* 39:1315
32. Jaskowiak NT, Michelassi F (2001) Adenocarcinoma at a strictureplasty site in Crohn's disease: report of a case. *Dis Colon Rectum* 44:284
33. Menon AM, Mirza AH, Moolla S et al (2007) Adenocarcinoma of the small bowel arising from a previous strictureplasty for Crohn's disease: report of a case. *Dis Colon Rectum* 50:257
34. Edwards CM, George BD, Jewell DP et al (2000) Role of a defunctioning stoma in the management of large bowel Crohn's disease. *Br J Surg* 87:1063
35. Appau KA, Fazio VW, Shen B et al (2008) Use of infliximab within 3 months of ileocolic resection is associated with adverse postoperative outcomes in Crohn's patients. *J Gastrointest Surg* 12:1738
36. Indar AA, Young-Fadok TM, Heppell J (2009) Effect of perioperative immunosuppressive medication on early outcome in Crohn's disease patients. *World J Surg* 33:1049
37. Colombel JF, Loftus EV Jr, Tremaine WJ et al (2004) Early postoperative complications are not increased in patients with Crohn's disease treated perioperatively with infliximab or immunosuppressive therapy. *Am J Gastroenterol* 99:878
38. McKee RF, Keenan RA, Munro A (1995) Colectomy for acute colitis: is it safe to close the rectal stump? *Int J Colorectal Dis* 10:222
39. Tekkis PP, Purkayastha S, Lanitis S et al (2006) A comparison of segmental vs subtotal/ total colectomy for colonic Crohn's disease: a meta-analysis. *Colorectal Dis* 8:82
40. Scott A, Strong MD, Walter A et al (2007) Practice parameters for the surgical management of Crohn's disease. *Dis Colon Rectum* 50:1735
41. Goligher JC (1985) The long term results of excisional surgery for primary and recurrent Crohn's disease of the large intestine. *Dis Colon Rectum* 28:5
42. Fichera A, McCormack R, Rubin MA et al (2005) Long term outcome of surgically treated Crohn's colitis: a prospective study. *Dis Colon Rectum* 48:963
43. Melton GB, Fazio VW, Kiran RP et al (2008) Outcomes of ileal pouch-anal anastomosis and Crohn's disease. *Ann Surg* 248:608
44. Braveman JM, Schoetz DJ Jr, Marcello PW et al (2004) The fate of the ileal pouch in patients developing Crohn's disease. *Dis Colon Rectum* 47:1613
45. Brown CJ, Maclean AR, Cohen Z et al (2005) Crohn's disease and indeterminate colitis and the ileal pouch-anal anastomosis: outcomes and patterns of failure. *Dis Colon Rectum* 48:1542