



Viewpoint

A reappraisal of the ileo-rectal anastomosis in ulcerative colitis

Pär Myrelid,^a Tom Øresland^b

^aDepartment of Surgery, County Council of Östergötland, and Department of Clinical and Experimental Medicine, Linköping University, Linköping, Sweden ^b Faculty of Medicine, University of Oslo, and Department of GI Surgery, Akershus University Hospital, Oslo, Norway

Corresponding author: Pär Myrelid, Department of Surgery, Linköping University Hospital, S-581 85 Linköping, Sweden. Tel: +46 10 103 1581; E-mail: par.myrelid@liu.se

Abstract

Colectomy is still frequently required in the care of ulcerative colitis. The most common indications are either non-responding colitis in the emergency setting, chronic active disease, steroid-dependent disease or neoplastic change like dysplasia or cancer. The use of the ileal pouch anal anastomosis has internationally been the gold standard, substituting the rectum with a pouch. Recently the use of the ileorectal anastomosis has increased in frequency as reconstructive method after subtotal colectomy. Data from centres using ileorectal anastomosis have shown the method to be safe, with functionality and risk of failure comparable to the ileal pouch anal anastomosis. The methods have different advantages as well as disadvantages, depending on a number of patient factors and where in life the patient is at time of reconstruction. The ileorectal anastomosis could, together with the Kock continent ileostomy, in selected cases be a complement to the ileal pouch anal anastomosis in ulcerative colitis and should be discussed with the patient before deciding on reconstructive method.

Keywords: Subtotal colectomy; ulcerative colitis; surgery; reconstruction; ileorectal anastomosis; ileal pouch anal anastomosis

1. Introduction

Emergency surgery in ulcerative colitis is indicated in patients not responding to medical management, due to the risk of otherwise developing life-threatening complications such as toxic megacolon, perforation, or refractory rectal bleeding. Elective surgery is indicated in patients with dysplasia or cancer, ulcerative colitis refractory to medical management, steroid dependence, or intolerance to long-term immunomodulation or other medical therapies. Colectomy is still frequently required in the care of ulcerative colitis and up to 30 % will in the long run be operated.¹ There are conflicting data regarding a possible recent decrease in colectomy rates due to the introduction of biologicals in the emergency situation and immune modulators as maintenance therapy.^{1,2,3}

Most patients requiring surgery are quite young and have high demands for quality of life and a life without ileostomy if possible. The first reconstructive method after colectomy in ulcerative colitis [UC] [Figure 1A] was the ileorectal anastomosis [IRA] [Figure 1 B]⁴

and later the continent ileostomy [CI] was introduced by Nils G Kock as reconstruction after proctocolectomy [Figure 2A].⁵ Both these methods were also used as reconstruction after colectomy in the hereditary carcinogenic disease familial adenomatous polyposis [FAP] or Lynch syndrome, but decreased in clinical use when the ileal pouch anal anastomosis [IPAA] [Figure 2B] became the gold standard after its introduction in the 1980s.^{6,7,8} This decrease in the utility of the CI was mainly due to the need for revisional surgeries and, in the case of IRA, due to recurrent proctitis and risk of rectal cancer in the long term. Lately long-term follow-up data have shown some problems with the ileal pouch anal anastomosis as well a yearly failure rate [diversion or excision] of approximately 0.6–1.9 %, partly dependent on hospital volumes.^{9,10,11,12,13,14,15} Topical anti-inflammatory medication together with meticulous endoscopic surveillance has led to the reintroduction of the ileorectal anastomosis in parts of the world^{9,16,17,18,19}. As medications have different advantages and disadvantages, so have surgical reconstructive methods, and we will

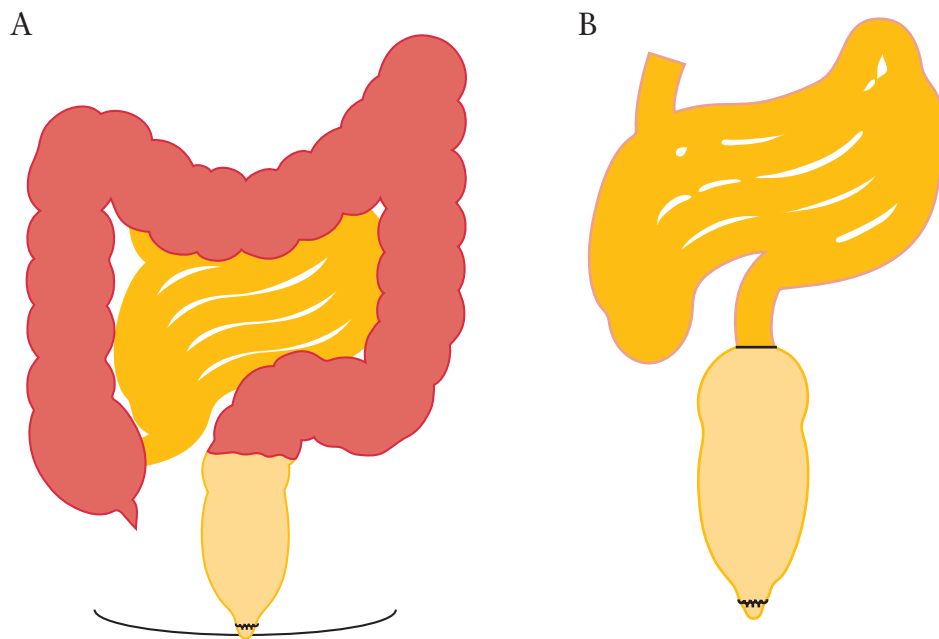


Figure 1. Subtotal colectomy [A] and ileorectal anastomosis [B].

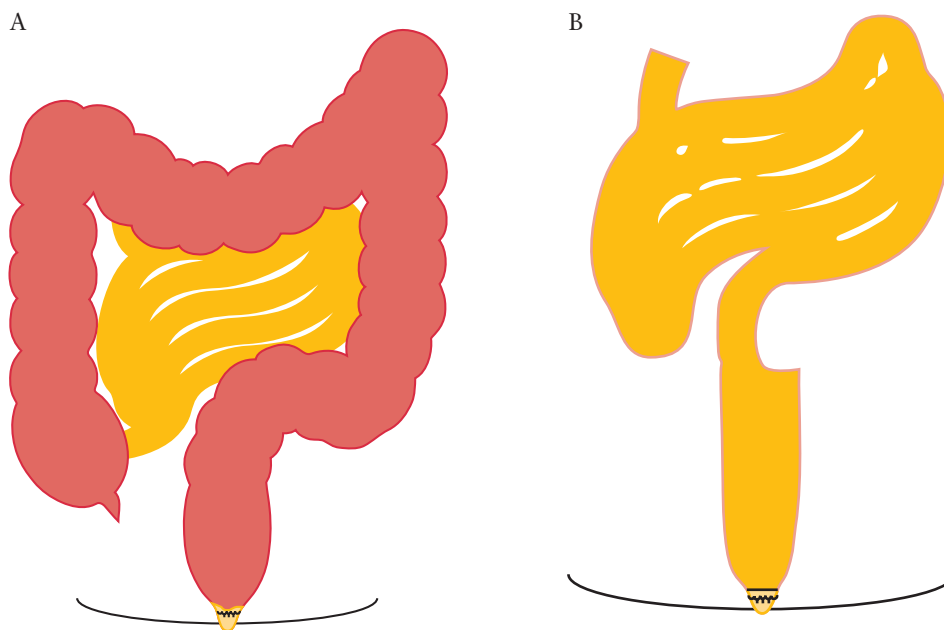


Figure 2. Proctocolectomy [A] and ileal pouch anal anastomosis [B].

try to shed some light on the ileorectal anastomosis in this context both in general as used in FAP and Crohn's disease [CD] and also its use specifically in UC.

2. Functional outcome

The main concern patients have regarding functional outcome after a reconstruction is the number of bowel movements [day and night], continence, and urgency to evacuate their bowels. This will be influenced by any ongoing inflammation [proctitis, pouchitis, or cuffitis], and the volume and compliance of the rectum or the pouch, as well as the sensory function.^{20,21}

In published reports on both FAP and UC, the number of bowel movements during 24h range between three and six for the IRA^{9,16,19,22,23} compared with five to seven for the IPAA.²⁴ The need for night-time evacuations has also been studied, showing an advantage for the IRA compared with the IPAA at 13–41 % and 53%, respectively.^{16,24,25,26,27} [Table 1].

In FAP the IRA has been shown to give better function in comparison with IPAA regarding the number of bowel movements, leakages, need for a protective pad, capability to distinguish gas from stool as well as need for dietary restrictions.²⁸ Continence has been studied less in any comparative fashion between the ileorectal anastomosis and the pelvic pouch, but a study by Günter *et al.* showed

a significant advantage for the IRA compared with IPAA measured with both Wexner and Jostardtnt incontinence scores in patients with FAP.²⁵ Patients with FAP do not have the risks of developing proctitis, thus their function will be more stable over time.

In patients with UC there are less data, but Börjesson *et al.* found soiling or a need for protective pads in 11% and urgency in 33% of IRA patients in comparison with 28–34% and 16%, respectively, in IPAA patients from the same unit.²⁰ Urgency was also found to be more common in a report from the Cleveland clinic by Moreira *et al.*²⁷ However, at the same time they also found the IRA to have less frequent bowel movements and less nightly seepage [Table 1]. In the latest report from Andersson *et al.*, in Sweden patients with IRA [$n = 89$] reported significantly less bowel movements in comparison with patients with IPAA [$n = 108$].⁹

3. Sexual function and fecundity

Sexual function is important in general and probably of even higher importance in the IBD population consisting of a young population. The effect of reconstructive surgery has been evaluated in FAP, showing a less favourable outcome for IPAA regarding physical functioning and sexual impact, so that the authors advocate IRA as a first-step procedure in young individuals and if possible postponement of the IPAA until the person is in a long-term relationship.²⁹ Van Balkom *et al.* reported on young patients [11 males and 15 females] with FAP [$n = 10$] and UC [$n = 16$] being reconstructed with IPAA. All the males reported acceptable sexual function but 50% of the females showed signs indicating sexual dysfunction.³⁰ Similar reports have been published showing a sexual dysfunction in almost half of the IPAA patients³¹ and, as in the report from van Balkom *et al.*, especially among females.³² These findings are however quite different from two Scandinavian reports indicating a favourable outcome in UC patients going through IPAA.^{33,34} Koivusalo *et al.* reported 84% satisfactory sexual function and 68% enjoyable sex life in adult UC patients going through IPAA during childhood or adolescence.³³ Fecundity is the actual reproductive rate and is often expressed as the fecundability or the probability of conception in a specific time period. In FAP the fecundability is unchanged after an IRA and comparable to that

of the general population, whereas it drops to 0.54 [$p = 0.004$] after IPAA.³⁵ The same finding was seen after IPAA in UC females where it dropped to 0.20 [$p < 0.0001$], from a preoperative level the same as within the general population.³⁶ A meta-analysis showed that the IPAA increases the infertility rate from 20% before to 63% after the operation, in both FAP and UC patients³⁷ [Table 1]. The mechanism is thought to be occlusion of the fallopian tubes by pelvic scarring and adhesions.³⁸

Two smaller studies including patients from five European expert centres, comparing complete laparoscopic and/or hand-assisted laparoscopic IPAA with open procedures, found the laparoscopic approach to be associated with less risk of infertility,^{39,40} but this still needs further evaluation.

4. Quality of life

The quality of life in UC is dependent on a range of different factors like symptom burden [remission or active disease], comorbidity, and gender.⁴¹ Health-related quality of life has been compared between UC patients in remission on anti-tumour necrosis factor [anti-TNF] therapy and patients reconstructed with IPAA after proctocolectomy. No differences were found regarding health-related quality of life or disability, despite a significantly higher stool frequency and need of anti-diarrhoeal medication in patients with IPAA.⁴² Similarly, in FAP patients IPAA and IRA had an equal outcome regarding quality of life, despite a better function in IRA.²⁸ In the report by Moreira *et al.*, IRA in UC was associated with fewer bowel movements and less night-time seepage but increased urgencies compared with IPAA. Regardless of this, no difference in quality of life was found between the groups apart from some dietary and work restrictions in IRA.²⁷

5. Medication, cancer risk, and surveillance

Patients with UC reconstructed with IRA have a high need of anti-inflammatory medication, ranging from 60–91%^{9,16,19,27} [Table 1]. Due to both the anti-inflammatory effect and a possible cancer-preventing effect, topical 5-aminosalicylic acid [5-ASA] medication is often proposed [Box 1].^{9,16,43,44} The experience of using

Table 1. Advantages and disadvantages of reconstructive methods after colectomy for ulcerative colitis.

Surgical method	Advantages	Disadvantages
Ileostomy	Seldom need of revision Controlled emptying from stoma bag Preservation of fertility	Negative impact on body image Negative impact on sexual function Uncontrolled emptying into stoma bag
Ileorectal anastomosis	Less complicated procedure Transanal defaecation Less frequent bowel movements Continence No [or postponed] pelvic surgery Preservation of fertility	Proctitis Need for anti-inflammatory medication Urgencies Need of surveillance Cancer risk
Ileal pouch anal anastomosis	Transanal defaecation No remaining disease [apart from rectal cuff in stapled anastomoses]	Complicated procedure More frequent bowel movements Impaired continence [especially night] Urgency Pouchitis Impaired sexual function and fecundability
Kock's continent ileostomy	Controlled emptying of stoma Patient controlling bowel rather than bowel controlling patient	Need for revisions Pouchitis Complicated procedure [few centres worldwide with contemporary experience]

Box 1. Maintenance therapy and surveillance algorithm for reconstruction with ileorectal anastomosis in ulcerative colitis**Medical therapy**

Maintenance therapy is recommended with topical mesalamine 1000 mg twice daily

Surveillance

Surveillance is recommended using flexible endoscopy and multiple random biopsies [including any suspicious area]:

Early onset of the disease [< 20 years of age] and < 10 years' duration	Yearly interval
Early onset of the disease and > 10 years' duration:	Twice yearly
All others	Yearly interval

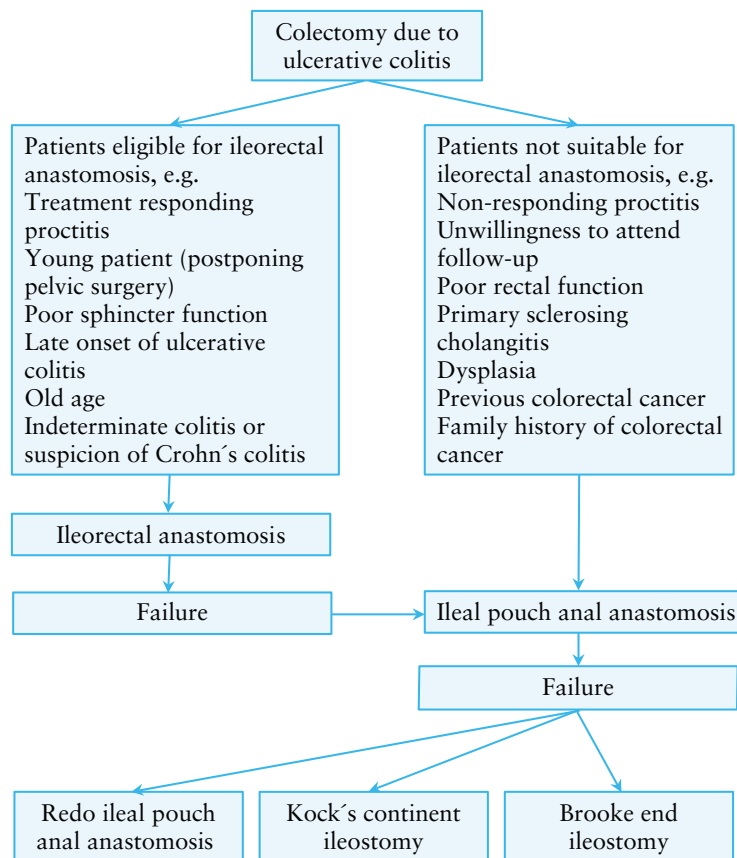


Figure 3. Possible reconstructive algorithm after colectomy in ulcerative colitis.

immunomodulators and/or biologicals in UC patients with IRA is limited. In most units undertaking IRA for UC in Sweden, the algorithm so far has been proctectomy and IPAA in those developing intractable proctitis despite the use of topical 5-ASA.

The risk of rectal cancer was one of the reasons why IRA was abandoned after colectomy for UC⁴⁵ and the risk of developing rectal cancer needs to be kept in mind [Tables 1 and 2]. However, in several of the reports on IRA in UC, no patients developed rectal cancer within 10 years of diagnosis^{9,17,18,27,45} and rectal cancer is also existent in IPAA, although to a lesser extent.^{9,46} The major problem with rectal cancer in IRA has been poor selection of patients [dysplasia or even colon cancer at time of reconstruction] or insufficient surveillance.⁹ There are no guidelines regarding surveillance, but annual flexible endoscopy with multiple biopsies is recommended.^{9,27} Accordingly, patients with severe dysplasia, history of colonic cancer, or unwillingness to attend surveillance are not suitable candidates for IRA [Figure 3].^{9,17,18,27}

6. Surgical risks and failure?

Reconstruction with an IRA is a limited procedure in comparison with an IPAA, and in a recent Swedish report, was shown as a shorter operating time and less blood loss [Table 1]. After both procedures the risk of postoperative complications was quite high but there was a significant advantage of IRA compared with IPAA at 23.8 % and 39.9 % risk, respectively; and this was also found regarding more severe complications [Clavien-Dindo \geq 3].⁹ Furthermore, most patients with an IPAA will have the construction protected by a proximal loop ileostomy, so they will need a second operation taking down the ileostomy. This procedure although relatively minor also has its complications.^{9,47}

The need for diversion with a stoma after restorative colectomy, with or without proctectomy or excision of the rectum/pouch in the case of IRA or IPAA, respectively, is considered a failure. The failure rate for IRA was 24.1 % after 10 years in the latest study by Andersson *et al.*⁹ but seems to be around 16 % at 5 years^{18,48} and 31

% at 10 years.^{48,49} The failure rate for IPAA is partly dependent on the experience of the team involved in the care of the UC patient^{10,12} and was approximately 1 % per year in the UK between 1996 and 2008.¹⁰ In other reports the failure rate was 6–9 % after 5 years and 13–19 % after 10 years.^{9,14}

A possible advantage with the IRA, if it fails or dysplasia develops, is the chance of doing a proctectomy with a secondary IPAA [Figure 1]. About 36–70 % of the failed IRAs in UC received an IPAA later on in life.^{9,27} There is, however, limited knowledge regarding the functional outcomes after a secondary IPAA in UC, but in FAP the functional outcome was no worse after a secondary IPAA compared with a primary.⁵⁰ There is of course the possibility to perform a redo of an IPAA, but so far the success rates are far from excellent, especially when performed for septic complications, and with a poorer function compared with primary IPAA.^{49,51}

A comparison of the outcome of IRA in FAP is not completely comparable with the outcome of IRA in UC. A meta-analysis comparing IPAA in UC and FAP showed the risk for pouchitis to be higher in UC as well as a small increased stool frequency but with otherwise comparable outcomes in function and failure as among those with FAP.⁵²

7. Discussion

Despite the pharmaceutical revolution in inflammatory bowel disease, colectomy is still a quite frequent procedure in the lifelong perspective of patients with ulcerative colitis.

As medications have different advantages and disadvantages, so have surgical reconstructive methods after a colectomy. The use of ileorectal anastomosis in FAP has been well characterised, but the use in UC has been less described. Despite the lack of complete knowledge, recent data have shown the IRA, in combination with topical treatment and surveillance, to be a safe procedure in UC and with a functional outcome and failure rate well in line with the IPAA. In parts of the world the IRA has been just as common as the IPAA. Of 994 UC patients going through colectomy in Sweden during the period 2000–10, the reconstructive method was IRA in 478 cases [48.0%], IPAA in 497 cases [50.0%] and the remaining 19 patients were reconstructed with a continent ileostomy.⁵³ A randomised controlled trial in Sweden, randomising between IRA and IPAA as primary reconstruction in eligible patients after colectomy for UC, was not able to enrol patients due to strong patient opinions after receiving information from surgeons regarding the possible advantages and disadvantages of the two procedures. In Sweden the use of IRA has mainly been offered to patients with a distensible rectum and good response to topical 5-ASA therapy after subtotal colectomy and without a history of colorectal cancer or high grade dysplasia.⁹ Further, patients with primary sclerosing cholangitis or a family history of colorectal cancer are less suitable for IRA,^{9,44} due to increased risk of cancer and, in the former case, poor function as well.⁵⁴

In contrast, young patients could have a favourable outcome with IRA, possibly as a temporary solution, with regard to fecundity and sexual function. Further, patients with a late onset in life of the disease, and/or a short history of colitis, could be suitable candidates for IRA as well.

The use of IRA in ulcerative colitis is safe and has an acceptable outcome regarding function and risk of failure. It can in selected cases be used as a permanent solution and in other cases as a temporary solution, resorting to proctectomy and IPAA later in life. With

the use of ileorectal anastomosis as a complement to the continent ileostomy and the ileal pouch anal anastomosis, we can increase the choices for ulcerative colitis patients who have been colectomised – and our patients should be introduced to the different choices, their advantages as well as their limitations.

Conflict of Interest

The authors declare no conflict of interest.

Acknowledgements

The authors contributed equally to the manuscript

References

- Aratari A, Papi C, Clemente V, *et al.* Colectomy rate in acute severe ulcerative colitis in the infliximab era. *Dig Liver Dis* 2008;**40**:821–6.
- Kaplan GG, Seow CH, Ghosh S, *et al.* Decreasing colectomy rates for ulcerative colitis: a population-based time trend study. *Am J Gastroenterol* 2012;**107**:1879–87.
- Reich KM, Chang HJ, Rezaie A, *et al.* The incidence rate of colectomy for medically refractory ulcerative colitis has declined in parallel with increasing anti-TNF use: a time-trend study. *Aliment Pharmacol Ther* 2014;**40**:629–38.
- Aylett SO. Conservative surgery in the treatment of ulcerative colitis. *Br Med J* 1953;**2**:1348–51.
- Kock NG. Intra-abdominal “reservoir” in patients with permanent ileostomy. Preliminary observations on a procedure resulting in fecal “continence” in five ileostomy patients. *Arch Surg* 1969;**99**:223–31.
- Parks AG, Nicholls RJ. Proctocolectomy without ileostomy for ulcerative colitis. *Br Med J* 1978;**2**:85–8.
- McGuire BB, Brannigan AE, O’Connell PR. Ileal pouch-anal anastomosis. *Br J Surg* 2007;**94**:812–23.
- McLaughlin SD, Clark SK, Tekkis PP, *et al.* Review article: restorative proctocolectomy, indications, management of complications and follow-up a guide for gastroenterologists. *Aliment Pharmacol Ther* 2008;**27**:895–909.
- Andersson P, Norblad R, Söderholm JD, Myrelid P. Ileorectal anastomosis in comparison with ileal pouch anal anastomosis in reconstructive surgery for ulcerative colitis a single institution experience. *J Crohns Colitis* 2014;**8**:582–9.
- Burns EM, Bottle A, Aylin P, *et al.* Volume analysis of outcome following restorative proctocolectomy. *Br J Surg* 2011;**98**:408–17.
- Hahnloser D, Pemberton JH, Wolff BG, *et al.* Results at up to 20 years after ileal pouch–anal anastomosis for chronic ulcerative colitis. *Br J Surg* 2007;**94**:333–40.
- Kennedy ED, Rothwell DM, Cohen Z, McLeod RS. Increased experience and surgical technique lead to improved outcome after ileal pouch-anal anastomosis: a population-based study. *Dis Colon Rectum* 2006;**49**:958–65.
- Huetting WE, Buskens E, van der Tweel I, Gooszen HG, van Laarhoven CJ. Results and complications after ileal pouch anal anastomosis: a meta-analysis of 43 observational studies comprising 9,317 patients. *Dig Surg* 2005;**22**:69–79.
- Tulchinsky H, Hawley PR, Nicholls J. Long-term failure after restorative proctocolectomy for ulcerative colitis. *Ann Surg* 2003;**238**:229–34.
- MacRae HM, McLeod RS, Cohen Z, O’Connor BI, Ton EN. Risk factors for pelvic pouch failure. *Dis Colon Rectum* 1997;**40**:257–62.
- Börjesson L, Lundstam U, Öresland T, Brevinge H, Hultén L. The place for colectomy and ileorectal anastomosis: a valid surgical option for ulcerative colitis? *Tech Coloproctol* 2006;**10**:237–41; discussion 241.
- Mann CV. Total colectomy and ileorectal anastomosis for ulcerative colitis. *World J Surg* 1988;**12**:155–9.
- Pastore RL, Wolff BG, Hodge D. Total abdominal colectomy and ileorectal anastomosis for inflammatory bowel disease. *Dis Colon Rectum* 1997;**40**:1455–64.

19. Gallone L, Olmi L, Marchetti V. Use of topical rectal therapy to preserve the rectum in surgery of ulcerative colitis. *World J Surg* 1980;4:609–13.
20. Øresland T, Fasth S, Nordgren S, Hultén L. The clinical and functional outcome after restorative proctocolectomy. A prospective study in 100 patients. *Int J Colorectal Dis* 1989;4:50–6.
21. Øresland T, Fasth S, Nordgren S, Åkervall S, Hultén L. Pouch size: the important functional determinant after restorative proctocolectomy. *Br J Surg* 1990;77:265–9.
22. Elton C, Makin G, Hitos K, Cohen CR. Mortality, morbidity and functional outcome after ileorectal anastomosis. *Br J Surg* 2003;90:59–65.
23. da Luz Moreira A, Lavery IC. Ileorectal anastomosis and proctocolectomy with end ileostomy for ulcerative colitis. *Clin Colon Rectal Surg* 2010;23:269–73.
24. de Zeeuw S, Ahmed Ali U, Donders RA, et al. Update of complications and functional outcome of the ileo-pouch anal anastomosis: overview of evidence and meta-analysis of 96 observational studies. *Int J Colorectal Dis* 2012;27:843–53.
25. Gunther K, Braunrieder G, Bittorf BR, Hohenberger W, Matzel KE. Patients with familial adenomatous polyposis experience better bowel function and quality of life after ileorectal anastomosis than after ileoanal pouch. *Colorectal Dis* 2003;5:38–44.
26. Parc R, Legrand M, Frileux P, Tiret E, Ratelle R. Comparative clinical results of ileal-pouch anal anastomosis and ileorectal anastomosis in ulcerative colitis. *Hepatogastroenterology* 1989;36:235–9.
27. da Luz Moreira A, Kiran RP, Lavery I. Clinical outcomes of ileorectal anastomosis for ulcerative colitis. *Br J Surg* 2010;97:65–9.
28. Ko CY, Rusin LC, Schoetz DJ Jr, et al. Does better functional result equate with better quality of life? Implications for surgical treatment in familial adenomatous polyposis. *Dis Colon Rectum* 2000;43:829–35; discussion 835–7.
29. Andrews L, Mireskandari S, Jessen J, et al. Impact of familial adenomatous polyposis on young adults: quality of life outcomes. *Dis Colon Rectum* 2007;50:1306–15.
30. van Balkom KA, Beld MP, Visschers RG, van Gemert WG, Breukink SO. Long-term results after restorative proctocolectomy with ileal pouch-anal anastomosis at a young age. *Dis Colon Rectum* 2012;55:939–47.
31. Ogilvie JW Jr, Goetz L, Baxter NN, et al. Female sexual dysfunction after ileal pouch-anal anastomosis. *Br J Surg* 2008;95:887–92.
32. Larson DW, Davies MM, Dozois EJ, et al. Sexual function, body image, and quality of life after laparoscopic and open ileal pouch-anal anastomosis. *Dis Colon Rectum* 2008;51:392–6.
33. Koivusalo A, Pakarinen MP, Natunen J, et al. Sexual functions in adulthood after restorative proctocolectomy for paediatric onset ulcerative colitis. *Pediatr Surg Int* 2009;25:881–4.
34. Berndtsson I, Øresland T, Hultén L. Sexuality in patients with ulcerative colitis before and after restorative proctocolectomy: a prospective study. *Scand J Gastroenterol* 2004;39:374–9.
35. Olsen KO, Juul S, Bulow S, et al. Female fecundity before and after operation for familial adenomatous polyposis. *Br J Surg* 2003;90:227–31.
36. Ording Olsen K, Juul S, Berndtsson I, Øresland T, Laurberg S. Ulcerative colitis: female fecundity before diagnosis, during disease, and after surgery compared with a population sample. *Gastroenterology* 2002;122:15–9.
37. Rajaratnam SG, Eglinton TW, Hider P, Fearnhead NS. Impact of ileal pouch-anal anastomosis on female fertility: meta-analysis and systematic review. *Int J Colorectal Dis* 2011;26:1365–74.
38. Øresland T, Palmblad S, Ellstrom M, et al. Gynaecological and sexual function related to anatomical changes in the female pelvis after restorative proctocolectomy. *Int J Colorectal Dis* 1994;9:77–81.
39. Beyer-Berjot L, Maggiori L, Birnbaum D, et al. A total laparoscopic approach reduces the infertility rate after ileal pouch-anal anastomosis: a 2-center study. *Ann Surg* 2013;258:275–82.
40. Bartels SA, D'Hoore A, Cuesta MA, et al. Significantly increased pregnancy rates after laparoscopic restorative proctocolectomy: a cross-sectional study. *Ann Surg* 2012;256:1045–8.
41. Hjortswang H, Jarnerot G, Curman B, et al. The influence of demographic and disease-related factors on health-related quality of life in patients with ulcerative colitis. *Eur J Gastroenterol Hepatol* 2003;15:1011–20.
42. Meijs S, Gardenbroek TJ, Sprangers MA, et al. Health-related quality of life and disability in patients with ulcerative colitis and proctocolectomy with ileoanal pouch versus treatment with anti-TNF agents. *J Crohns Colitis* 2014;8:686–92.
43. Pinczowski D, Ekobom A, Baron J, Yuen J, Adami HO. Risk factors for colorectal cancer in patients with ulcerative colitis: a case-control study. *Gastroenterology* 1994;107:117–20.
44. Bernstein CN, Eaden J, Steinhart AH, Munkholm P, Gordon PH. Cancer prevention in inflammatory bowel disease and the chemoprophylactic potential of 5-aminosalicylic acid. *Inflamm Bowel Dis* 2002;8:356–61.
45. Baker WN, Glass RE, Ritchie JK, Aylett SO. Cancer of the rectum following colectomy and ileorectal anastomosis for ulcerative colitis. *Br J Surg* 1978;65:862–8.
46. Alessandrini L, Kohn A, Capaldi M, et al. Adenocarcinoma below stapled ileoanal anastomosis after restorative proctocolectomy for ulcerative colitis. *Updates Surg* 2012;64:149–52.
47. Löffler T, Rossion I, Goossen K, et al. Hand suture versus stapler for closure of loop ileostomy a systematic review and meta-analysis of randomized controlled trials. *Langenbecks Arch Surg* 2015;400:193205.
48. Lepistö A, Järvinen HJ. Fate of the rectum after colectomy with ileorectal anastomosis in ulcerative colitis. *Scand J Surg* 2005;94:40–2.
49. Tekkis PP, Heriot AG, Smith JJ, et al. Long-term results of abdominal salvage surgery following restorative proctocolectomy. *Br J Surg* 2006;93:231–7.
50. Bulow S, Hojen H, Buntzen S, et al. Primary and secondary restorative proctocolectomy for familial adenomatous polyposis: complications and long-term bowel function. *Colorectal Dis* 2013;15:436–41.
51. Tulchinsky H, Cohen CR, Nicholls RJ. Salvage surgery after restorative proctocolectomy. *Br J Surg* 2003;90:909–21.
52. Lovegrove RE, Tilney HS, Heriot AG, et al. A comparison of adverse events and functional outcomes after restorative proctocolectomy for familial adenomatous polyposis and ulcerative colitis. *Dis Colon Rectum* 2006;49:1293–306.
53. Nordenvall C, Myrelid P, Ekobom A, et al. Probability, rate and timing of reconstructive surgery following colectomy for inflammatory bowel disease in Sweden: A population-based cohort study. *Colorectal Dis* 2015, Apr 17. doi: 10.1111/codi.12978. [Epub ahead of print.]
54. Block M, Jörgensen KK, Øresland T, et al. Colectomy for patients with ulcerative colitis and primary sclerosing cholangitis what next? *J Crohns Colitis* 2014;8:421–30.