Original article

Outcomes of laparoscopic and open restorative proctocolectomy

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Background: **The literature on laparoscopic restorative proctectomy (RP) and proctocolectomy (RPC) is limited. This study compared clinical outcomes of laparoscopic RP and RPC with those of conventional open surgery at one centre.**

Methods: **Data were analysed from consecutive patients undergoing RPC and RP between November 2006 and November 2011. A standard laparoscopic technique was developed during the first 2 years, performed by two laparoscopic surgeons, with selection of patients who had not previously undergone open colectomy. Study endpoints included postoperative length of stay, 30-day morbidity, readmission, reoperation, pouch function and failure.**

Results: **A total of 207 patients were included; open surgery was performed in 131 (63·3 per cent) and a laparoscopic procedure in 76 (36·7 per cent). There were no significant differences in patient demographics. The conversion rate was 9 per cent (7 of 76). The median (i.q.r.) duration of operation was shorter for open than for laparoscopic procedures: 208 (178–255) *versus* 285 (255–325) min respectively ($P < 0·001$). Laparoscopic RPC had a shorter length of stay: median (i.q.r.) 6 (4–8) *versus* 8 (7–12) days ($P < 0·001$). The rate of minor complications was lower in the laparoscopic group (33 *versus* 50·4 per cent; odds ratio (OR) 0·48, 95 per cent confidence interval 0·27 to 0·87).There were no significant differences in total complications (51 per cent after laparoscopy *versus* 61·5 per cent after open surgery; OR 0·66, 0·37 to 1·17), anastomotic leakage, major morbidity, 30-day readmission, reoperation and stoma closure rates. Pouch failure (including permanent stoma) occurred in 14 (7·7 per cent) of 181 patients. Three patients died, all in the open surgery group.**

Conclusion: **Laparoscopic RPC is feasible with some short-term advantages.**

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Introduction

Laparoscopic colonic resection is associated with improved outcomes: reduced blood loss, postoperative pain, length of hospital stay, morbidity and recovery time, and, in the long term, improved cosmesis, fewer adhesions and hernias[1–6]. Recently, in a multicentre setting, the LAparoscopy and/or FAst track multimodal management *versus* standard care (LAFA) trial[7] found that laparoscopy was the only independent predictive factor associated with reduced morbidity and hospital stay. Laparoscopic rectal surgery has had a slower uptake owing to its complexity.

Laparoscopic restorative proctocolectomy (RPC) was first described in 1992[8] and, in general, few benefits have been reported[9,10]. To date, there has been only one randomized clinical trial[11] which, together with ten non-randomized studies, was included in a Cochrane review[12]. A total of only 253 laparoscopic and 354 conventional open procedures were included. Commenting on the heterogeneity of the data, the authors concluded that laparoscopic RPC is 'safe and feasible but larger trials are needed'[12].

Methods

All consecutive elective restorative proctectomies (RPs) and RPCs, performed by four consultant surgeons, were included from the date of the first laparoscopic RPC at St Mark's Hospital (November 2006) to November 2011. The laparoscopic procedures were performed or supervised by

one of two expert laparoscopic colorectal surgeons, and the open procedures performed or supervised by two expert conventional open surgeons. A comprehensive database existed for the laparoscopic surgery and data for open surgery were retrieved from patients' records. This was cross-checked with administrative databases and theatre records to ensure accuracy. Patients undergoing reoperative pouch surgery were excluded. Those having RP had undergone previous subtotal or total colectomy with end ileostomy or ileorectal anastomoses.

During the early experience of laparoscopic RPC, one of the open pouch surgeons attended the procedure to assist with the development process. Over the first 26 months of development, any patients who had previously undergone open total colectomy were referred selectively to the open surgeons for restorative surgery. All patients referred to the laparoscopic surgeons underwent laparoscopic surgery. The two laparoscopic surgeons had extensive experience before commencing this process and were aided by a high-volume practice with a large operative caseload: jointly over 250 laparoscopic colorectal resections per year including approximately 30 total colectomies.

Postoperative morbidity and mortality data were recorded according to the Dindo–Demartines–Clavien classification[13], which grades complications into five categories: I–II (minor), III–IV (major morbidity) and V (death). The International Study Group of Rectal Cancer recommendations[14] were used to subdivide anastomotic leakage into one of three categories; category C leakage requires laparotomy, category B requires active therapeutic intervention without laparotomy, and category A does not require intervention. 'Pouch problems' included pouchitis, other dysfunction and cuffitis, whereas 'pouch failure' indicated the requirement for pouch excision or permanent pouch diversion with a stoma.

All data were collected up to and including the most recent clinic appointment. All patients followed the same routine preoperative and postoperative management regimen, within an established enhanced recovery programme[15].

Study outcomes

The following clinical outcomes were assessed: complications, anastomotic leakage, postoperative hospital stay, reoperation, readmission and death within 30 days. Time to ileostomy closure, pouch problems and pouch failure, duration of operation and trainee involvement in surgery were also analysed. All results for laparoscopic surgery, including patients requiring conversion to open surgery, were analysed on an intention-to-treat basis.

Surgical technique

Open operation

All procedures were performed as described previously, with all but one incorporating a standard J pouch formation[16]. The exception was an S pouch in one patient to create extra length and permit safe anastomosis. The bowel was diverted with a loop ileostomy in all but one patient, in whom the small bowel was not sufficiently mobile to allow an ileostomy to be fashioned and a one-stage procedure without diversion was carried out.

Laparoscopic operation

Proctocolectomy or proctectomy was performed entirely laparoscopically, including all vascular ligations. A transverse suprapubic (Pfannenstiel) incision was used in the first five procedures to transect the rectum, create the ileal pouch and perform the pouch–anal anastomosis. This was the initial approach chosen as the available literature promoted it, and it allowed the open surgeons to contribute to pouch construction and placement in the pelvis. Mesenteric lengthening procedures proved difficult through the Pfannenstiel incision; the incision was far longer than a periumbilical incision and rectal transection through a Pfannenstiel incision was difficult compared with the laparoscopic technique used for rectal surgery. The transverse incision was abandoned following a twisted pouch anastomosis that occurred when this initial approach was used. Thereafter, a 4–5-cm longitudinal periumbilical incision was used for both colonic and rectal specimen extraction and pouch formation, including lengthening procedures. After the first five procedures, laparoscopic stapled rectal transection was performed via a right suprapubic 12-mm incision in the sagittal plane. The ileal pouch–anal anastomosis was constructed with a circular stapler. Conversion, including hand-assisted surgery, was defined as the inability to complete the dissection, vascular ligation and rectal transection laparoscopically, requiring more than the normal 4–5-cm periumbilical incision. As with open surgery, all patients received a diverting loop ileostomy.

Follow-up and stoma closure

Following both laparoscopic and open techniques the pouch was checked after surgery using a Gastrografin® (Bracco Diagnostics, Monroe Township, New Jersey, USA) pouchogram at 4–8 weeks. The ileostomy was closed around 3 months after surgery.

Statistical analysis

A non-normal data distribution was assumed, and median (i.q.r.) values are presented unless indicated otherwise.

Table 1 Patient characteristics

	Open ($n = 131$)	Laparoscopic ($n = 76$)	Total ($n = 207$)	P†
Age (years)*	38 (14–72)	34 (14–65)	37 (14–72)	0·391‡
Sex ratio (M : F)	83 : 48	45 : 31	128 : 79	0·549
BMI (kg/m^2)*	24·2 (16·9–33·6)	24·8 (17·3–37·0)	24·5 (16·9–37·0)	0·402‡
ASA grade				0·352
I	33 (38)	41 (54)	74 (45·7)	
III	49 (57)	35 (46)	84 (51·9)	
III	4 (5)	0 (0)	4 (2·5)	
Unknown	45	0	45	
Procedure				0·140§
RP	76 (58·0)	36 (47)	112 (54·1)	
RPC	55 (42·0)	40 (53)	95 (45·9)	
Previous abdominal surgery				0·124
Yes	82 (62·6)	39 (51)	121 (58·5)	
No	49 (37·4)	37 (49)	86 (41·5)	
Diagnosis				0·464
UC	86 (65·6)	51 (67)	137 (66·2)	
UC + cancer	6 (4·6)	12 (16)	18 (8·7)	
UC + dysplasia	5 (3·8)	1 (1)	6 (2·9)	
FAP	25 (19·1)	10 (13)	35 (16·9)	
FAP + cancer	8 (6·1)	2 (3)	10 (4·8)	
Multiple colorectal cancers alone	1 (0·8)	0 (0)	1 (0·5)	

Values in parentheses are percentages unless indicated otherwise; *values are median (range). BMI, body mass index; ASA, American Society of Anesthesiologists; RP, restorative proctectomy; RPC, restorative proctocolectomy; UC, ulcerative colitis; FAP, familial adenomatous polyposis. †χ^2 test, except ‡Mann–Whitney U test and §Fisher's exact test.

Table 2 Patient characteristics in relation to procedure

	Open			Laparoscopic			
	RP ($n = 76$)	RPC ($n = 55$)	Total ($n = 131$)	RP ($n = 36$)	RPC ($n = 40$)	Total ($n = 76$)	P†
Age (years)*	37 (14–68)	39 (15–72)	38 (14–72)	34 (14–65)	35 (14–63)	34 (14–65)	0·391‡
Sex ratio (M : F)	46 : 30	37 : 18	83 : 48	21 : 15	24 : 16	45 : 31	0·549
BMI (kg/m^2)*	24·0 (17·9–32·0)	24·2 (16·9–33·0)	24·2 (16·9–33·6)	24·9 (19·0–34·0)	24·5 (17·3–37·0)	24·8 (17·3–37·0)	0·402‡
ASA grade							0·352
I	19 (39)	14 (38)	33 (38)	19 (53)	22 (55)	41 (54)	
II	29 (59)	20 (54)	49 (57)	17 (47)	18 (45)	35 (46)	
III	1 (2)	3 (8)	4 (5)	0 (0)	0 (0)	0 (0)	
Unknown	27	18	45	0	0	0	
Previous abdominal surgery	76 (100)	6 (11)	82 (62·6)	36 (100)	3 (8)	39 (51)	0·124

Values in parentheses are percentages unless indicated otherwise; *values are median (range). RP, restorative proctectomy; RPC, restorative proctocolectomy; BMI, body mass index; ASA, American Society of Anesthesiologists. †χ^2 test, except ‡Mann–Whitney U test (comparison of RP overall *versus* RPC overall).

Continuous data were assessed using Mann–Whitney and Kruskal–Wallis tests. Categorical analyses were with χ^2 test and Fisher's exact test, as appropriate. Odds ratios (ORs) were calculated with 95 per cent confidence intervals (c.i.). Pouch failure between groups was assessed using survival analyses with Kaplan–Meier methods, and the log rank test was used to assess differences between groups. SPSS® version 14.0 (IBM, Armonk, New York, USA) was used for analyses.

Results

In total, 207 patients underwent RPC or RP between November 2006 and November 2011; 131 procedures (63·3 per cent) were open and 76 (36·7 per cent) laparoscopic. Two-thirds (82 patients) in the open group had undergone abdominal surgery previously, compared with one-half (39 patients) in the laparoscopic group. There were no significant differences in demographic and clinical characteristics between the two groups (*Table 1*). The open

Table 3 Outcomes following open and laparoscopic procedures

	Open ($n = 131$)	Laparoscopic ($n = 76$)	Total ($n = 207$)	Odds ratio*	P§
30-day readmission	16 (12·2)	13 (17)	29 (14·0)	1·48 (0·67, 3·28)	
30-day reoperation	10 (7·6)	10 (13)	20 (9·7)	2·05 (0·79, 5·31)	
Ileostomy closure ($n = 203$)†					
6 months	80 of 127 (63·0)	50 of 76 (66)	130 of 203 (64·0)		0·772
1 year	110 of 127 (86·6)	71 of 76 (93)	181 of 203 (89·2)		0·173
Pouch problems ($n = 181$)‡	14 of 106 (13·2)	8 of 75 (11)	22 of 181 (12·2)		0·198
Pouch failure ($n = 181$)‡	12 of 106 (11·3)	2 of 75 (3)	14 of 181 (7·7)		0·172

Values in parentheses are percentages unless indicated otherwise; *values in parentheses are 95 per cent confidence intervals. †One patient had no stoma and three died. ‡Twelve patients have not yet had ileostomy closure scheduled or have declined closure, two had ileostomies refashioned after closure owing to problems at the ileostomy anastomotic site, one was discharged before closure, three died and eight were lost to follow-up. §χ^2 test.

and laparoscopic groups had a similar proportion of RPs (76 of 131 *versus* 36 of 76) and RPCs (55 of 131 *versus* 40 of 76). There were no significant differences in demographic and clinical characteristics between patients who had RP and those who had RPC (*Table 2*).

In the laparoscopic group, seven (9 per cent) of the 76 procedures were converted: six to open surgery and one to a hand-assisted procedure. The median incision length for converted procedures was 19 (range 10–25) cm. The reasons for conversion were: dense adhesions (4), narrow pelvis impeding pouch descent (1), revision of the pouch owing to a Meckel's diverticulum (1) and technical difficulties with the pouch–anal anastomosis (1). In the first five procedures, when a transverse suprapubic incision was used to extract the specimen and fashion the pouch, the median incision length was 12 (i.q.r. 10–14) cm. Following this, a small periumbilical incision was adopted, and median wound length decreased to 5 (4–6) cm.

Supervised trainees performed one-half of the pouch operations, and were trained on significantly more open than laparoscopic procedures (80 of 131 *versus* 19 of 76). The median (i.q.r.) duration of operation was significantly shorter for open than laparoscopic surgery: 208 (178–255) *versus* 285 (255–325) min ($P < 0·001$).

Clinical outcomes

Postoperative length of stay was significantly shorter following laparoscopic surgery: median (i.q.r.) 6 (4–8) days *versus* 8 (7–12) days for open surgery ($P < 0·001$). The total complication rate was lower after laparoscopic surgery (51 *versus* 61·5 per cent; OR 0·66, 95 per cent c.i. 0·37 to 1·17), although this was not statistically significant. Overall reoperation and readmission rates were similar (*Table 3*). Minor complications were significantly reduced in the laparoscopic group (33 *versus* 50·4 per cent; OR 0·48, 0·27 to 0·87). In contrast, there was no significant difference in major complications (16 *versus* 11·5 per cent for laparoscopic and open procedures respectively; OR 1·45, 0·64 to 3·29). Major complications after laparoscopic surgery included: drainage (radiological or transanal) of a pelvic abscess (8); laparotomy for obstruction, leak or pouch torsion (3); and pneumonia requiring ventilation (1). Major complications after open surgery included: drainage of a pelvic abscess (3); laparotomy or surgery for bleeding, leak, peritonitis, testicular necrosis and lower limb compartment syndrome (5); and bleeding, sepsis or renal failure requiring intensive care admission (3). There were three deaths among 131 patients in the open group, from cardiac arrest, respiratory failure and stroke.

Anastomotic leakage occurred in 20 (9·7 per cent) of 207 patients, with no significant difference between open and laparoscopic groups (OR 1·12, 0·45 to 2·99) (*Table 4*). Only four patients (1·9 per cent) had a category C leak requiring a laparotomy, three (2·3 per cent) in the open group and one (1 per cent) in the laparoscopic group. All other anastomotic leaks were treated using antibiotics, radiological drainage, transanal drainage under anaesthetic via the suture line, or were non-clinical leaks (such as leakage on follow-up Gastrografin® pouchogram before stoma closure in asymptomatic patients). Separation of the patients into those undergoing RPC and those undergoing RP did not change any of the above comparisons.

Table 4 Anastomotic leakage[14]

Grade	Open ($n = 131$)	Laparoscopic ($n = 76$)	Total ($n = 207$)
A	1 (0·8)	1 (1)	2 (1·0)
B	8 (6·1)	6 (8)	14 (6·8)
C	3 (2·3)	1 (1)	4 (1·9)
Total	12 (9·2)	8 (11)	20 (9·7)

Values in parentheses are percentages. Grade A, requiring no active therapeutic intervention; grade B, requiring active therapeutic intervention but can be managed without relaparotomy; grade C, requiring relaparotomy.

Stoma closure rates did not differ between the groups (*Table 3*). A total of 181 patients have been followed to date after ileostomy closure; of the remaining 26 patients, 12 have not yet had ileostomy closure scheduled or have declined closure, two had ileostomies refashioned following closure owing to problems at the ileostomy anastomotic site, one was discharged before stoma closure, three died and eight were lost to follow-up. None of these 26 patients has a permanent ileostomy because of a pouch problem. At the most recent follow-up, pouch failure had occurred in 14 (7·7 per cent) of 181 patients, 12 (11·3 per cent) of 106 in the open group but only two (3 per cent) of 75 in the laparoscopic group (*Table 3*). The apparent advantage in terms of pouch survival for laparoscopic surgery was not statistically significant ($P = 0{\cdot}172$) when corrected for follow-up of 36 and 21 months per patient in the open and laparoscopic groups respectively. At most recent follow-up, 22 (12·2 per cent) of 181 patients had pouch problems, with no significant difference between groups (OR 0·58, 0·25 to 1·35).

Discussion

After a structured development period, this centre has used a totally laparoscopic approach to RPC involving a small incision, rather than a hybrid procedure involving a hand port or a relatively large incision. The data have shown the technique to be feasible, safe and advantageous compared with conventional open surgery in expert hands, with a reduction in the rate of minor complications and hospital stay. The technique enables a patient to benefit fully from a minimal access approach, because all dissection, as well as rectal transection and pouch–anal anastomosis, are performed laparoscopically. The periumbilical incision used to remove the specimen and fashion the pouch retracts into the umbilicus over time, producing an excellent cosmetic result.

The results of this study differ from published series of laparoscopic RPC as nearly all previous studies[9,17,18] either included small numbers of patients, or almost exclusively used a hand-assisted approach or transverse lower abdominal incision. A recent publication[19] has stated that a transverse suprapubic incision is the only way the operation can be done owing to the technical difficulty of undertaking appropriately low rectal transection. In the present series, the authors were able to undertake rectal transection within 1–2 cm of the dentate line by introducing the transecting stapler via a right suprapubic 12-mm port, avoiding the transverse lower abdominal incision. An umbilical incision allows mesenteric lengthening procedures to be undertaken more easily and the decreased incision size reduces the incidence of incisional hernia[10,20]. During this work there was a focus on standardization of technique so that the operation was as efficient, safe and reproducible as possible. This was reflected by the year-on-year reduction in duration of operation, despite the increasing involvement of trainees. The median duration of operation in the final year was only 260 min, which compares favourably with reports of 5–8 h[21–23].

Pouch problems and failure are key outcomes when evaluating RPC and there is a paucity of data relating to this. The trends towards reductions in pouch problems and dysfunction following laparoscopic surgery were not significant. They could be explained by the longer follow-up of patients in the open group and the relatively high rate of pouch failure after open surgery in this study[24]. There were no significant differences between groups, and pouch failure requires reassessment after longer follow-up. Analysis within a randomized trial would be optimal; however, this is unlikely to occur owing to increasing difficulties in recruiting patients to such studies.

Despite this study being non-randomized, with potential for selection bias, its strengths are prospective data collection, involvement of surgeons experienced in pouch surgery, the development of a standard laparoscopic technique and avoidance of hybrid procedures involving large incisions. The reduction in hospital stay and complications associated with laparoscopic pouch surgery in this study, along with the expected decrease in adhesions, incisional hernias and impaired fertility[6,25], strengthen the argument for surgeons with appropriate training and local infrastructure to use laparoscopy for RPC.

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