A systematic review and meta-analysis of laparoscopic versus open colectomy with end ileostomy for non-toxic colitis

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ABSTRACT

Background
This review compared short-term outcomes after laparoscopic versus open subtotal colectomy for acute medically refractory colitis.

Methods
A systematic review of the literature was carried out using MEDLINE, Embase and the Cochrane databases. Overall study quality was assessed by the modified Methodological Index for Non-Randomized Studies (MINORS). Meta-analysis was performed for conversion, reoperation, wound infection, ileus, gastrointestinal bleeding, intra-abdominal abscess, postoperative length of stay and mortality.

Results
The search identified nine non-randomized studies: six cohort studies and three case-matched series, comprising 966 patients in total. The pooled conversion rate was 5.5 (95 per cent confidence interval (c.i.) 3.6 to 8.4) per cent in the laparoscopic group. The pooled risk ratio of wound infection was 0.60 (95 per cent c.i. 0.38 to 0.95; P = 0.03) and that of intra-abdominal abscess was 0.27 (0.08 to 0.91; P = 0.04), both in favour of laparoscopic surgery. Pooled risk ratios for other complications showed no significant differences. Length of stay was significantly shorter after laparoscopic subtotal colectomy, with a pooled mean difference of 3.17 (95 per cent c.i. 2.37 to 3.98) days (P < 0.001).

Conclusion
Where the procedure can be completed laparoscopically, there may be short-term benefits over open colectomy for colitis. These results cannot be generalized to critically ill patients in need of an emergency subtotal colectomy.
INTRODUCTION

Ulcerative colitis or Crohn’s disease may present with medically refractory acute severe colitis requiring urgent subtotal colectomy as either an open or laparoscopic procedure. Laparoscopic surgery has better short-term outcomes than open surgery, with reduced morbidity, pain, hospital stay and time to resumption of normal daily activities\textsuperscript{1,2}. Possible long-term advantages of laparoscopic colorectal surgery include less adhesion formation, lower risk of small bowel obstruction, fewer incisional hernias and better preservation of fertility\textsuperscript{3–9}. The aim of this systematic review was to compare short-term outcomes after laparoscopic and open subtotal colectomy with end ileostomy for inflammatory bowel disease (IBD).

METHODS

This systematic review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines\textsuperscript{10}. Inclusion criteria for article selection were: randomized clinical trials, cohort studies (both prospective and retrospective) and case-matched studies comparing open and laparoscopic subtotal colectomy in adult patients with IBD. A subtotal colectomy was defined as a total or subtotal colectomy with end ileostomy, being performed in an acute or subacute setting because of medically refractory disease. The reported intervention and control groups had to contain at least ten patients each. For the purpose of this review, hand-assisted laparoscopic surgery data were analysed as ‘laparoscopic’.

Search strategy

MEDLINE (PubMed), Embase (Ovid) and the Cochrane Database of Systematic Reviews and Central Register of Controlled Trials (Wiley) were searched by a clinical librarian. No restrictions regarding language or publication date were applied and no methodological filter was used. The final search was carried out on 21 June 2012. The keywords and medical subject heading (MeSH) terms used for MEDLINE were: (‘Colitis’[Mesh] OR ‘Crohn Disease’[Mesh] OR ‘Inflammatory Bowel Diseases’[Mesh] OR ibd[tiab] OR crohn* disease[tiab] OR colon inflamm*[tiab] OR inflammatory bowel disease*[tiab] OR ulcerative colitis[tiab] OR colitis ulcerosa[tiab]) AND (‘Colectomy’[Mesh] OR colectom*[tiab] OR ‘Proc-tocolectomy, Restorative’[Mesh] OR proctocolectom*[tiab] OR coloproctectom*[tiab]) AND (‘Laparoscopy’[Mesh] OR laparoscop*[tiab] OR single port[tiab] OR natural orifice specimen extraction[tiab] OR hand-assisted colectom*[tiab]). For Embase the combination of Emtree terms used was: [ulcerative colitis OR Crohn disease OR enteritis OR (ibd or inflammatory bowel disease* or colon inflamm* or inflammatory bowel disease* or
ulentative colitis or colitis ulcerosa).ti,ab OR crohn* disease.ti,ab] AND [colon resection OR intestine resection OR proctocolectomy OR (colectom* or proctocolectom* or coloproctec-
tom*).ti,ab.] AND [exp laparoscopy or endoscopic surgery or (laparoscop* or single port 
or natural orifice specimen extraction or hand-assisted colectom*).ti,ab.]. The keywords 
used for searching the Cochrane database were ‘colectomy’ and ‘laparoscopy’. Two review-
ers independently selected relevant studies based on their titles and abstracts. Full-text 
articles were read by both reviewers. Additionally, the references of relevant studies were 
hand-searched. Authors of relevant conference abstracts were contacted to provide more 
details. Discrepancies were solved by consensus discussion.

Outcome measures
Outcomes considered for this review were conversion rate of laparoscopy, duration of 
operation, reoperation rate, wound infection, ileus, gastrointestinal bleeding, intra-
abdominal abscess, length of stay and mortality. These outcomes were selected based on 
their clinical relevance.

Data extraction and analysis
Data were extracted independently by two reviewers on to a predefined data sheet 
that contained the following items: year of publication, country, study design, inclusion 
period, type of procedure, definition of intervention, characteristics of included patients, 
exclusion criteria, number of patients and predefined outcome measures. Discrepancies 
were resolved by consensus. If original continuous data were not displayed as mean(s.d.), 
or could not be transformed into a mean with s.d., the authors were contacted and 
requested to provide these data for the purpose of meta-analysis. The methodological 
quality of the included studies was assessed independently by two reviewers using the 
modified Methodological Index for Non-Randomized Studies (MINORS)\textsuperscript{11,12}.

Statistical analysis
To determine whether meta-analysis of the data was appropriate, clinical heterogeneity 
was assessed by comparing inclusion and exclusion criteria for each study, the outcome 
parameters studied, the types of laparoscopic surgery, and baseline characteristics of 
the included patients. Methodological heterogeneity was assessed using the MINORS 
tool\textsuperscript{11,12}. Heterogeneity was examined using the $\chi^2$ test and quantified by means of $I^2$ (the 
proportion of total variance explained by heterogeneity). An $I^2$ value of at least 50 per 
cent was considered to suggest a marked inconsistency in effect between studies, and no 
meta-analysis was done. If $I^2$ was less than 50 per cent, effect estimates were pooled using 
conservative random-effects models to account for possible between-study variance and 
any clinical heterogeneity.
For dichotomous data, a risk ratio (RR) was calculated with 95 per cent confidence interval (c.i.). To appreciate clinical relevance, absolute risk differences and number needed to treat (NNT) were added if RRs were significantly different from zero. For continuous data, a mean difference with 95 per cent c.i. was calculated based on the inverse variance method. \( P < 0.050 \) was considered statistically significant. Statistical analysis was done using Review Manager version 5.1 (The Nordic Cochrane Centre, The Cochrane Collaboration, Copenhagen, Denmark) and Comprehensive Meta-Analysis version 2.2.064 (Biostat, Englewood, New Jersey, USA).

RESULTS

Details of the literature search are shown in Figure 1. The nine included studies were non-randomized cohort studies or case-matched series. Characteristics of the studies are shown in Table 1. A total of 966 patients were included in the nine studies, 421 in the laparoscopic group and 545 in the open group. All but two studies comprised consecutive series of patients. The case-matched series were all matched by disease type, sex, body mass index (BMI) and age.

Figure 1 Flow chart showing selection of articles for review. IBD, inflammatory bowel disease.
Table 1 Characteristics of included studies

<table>
<thead>
<tr>
<th>Reference</th>
<th>Year</th>
<th>Country</th>
<th>Study design</th>
<th>Inclusion period</th>
<th>Procedure</th>
<th>Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gu et al.</td>
<td>2012</td>
<td>USA</td>
<td>Cohort</td>
<td>2006–2010</td>
<td>Total colectomy</td>
<td>Straight laparoscopy (151), HALS (26), single-incision laparoscopic surgery (20)</td>
</tr>
<tr>
<td>Bartels et al</td>
<td>2012</td>
<td>The Netherlands</td>
<td>Cohort</td>
<td>1999–2010</td>
<td>Two- or three-stage restorative proctocolectomy</td>
<td>HALS via Pfannenstiel incision (32), straight laparoscopy (4), extraction via stoma site or transrectally</td>
</tr>
<tr>
<td>Telem et al.</td>
<td>2010</td>
<td>USA</td>
<td>Cohort</td>
<td>2002–2007</td>
<td>(Sub)total colectomy, end ileostomy</td>
<td>Straight laparoscopy, extraction via stoma site or Pfannenstiel incision</td>
</tr>
<tr>
<td>Watanabe et al</td>
<td>2009</td>
<td>Japan</td>
<td>Cohort</td>
<td>2000–2004</td>
<td>(Sub)total colectomy, end ileostomy and mucous fistula</td>
<td>HALS, extraction via 7-cm paramedian incision</td>
</tr>
<tr>
<td>Chung et al.</td>
<td>2009</td>
<td>USA</td>
<td>Cohort</td>
<td>2002–2008</td>
<td>Three-stage restorative proctocolectomy</td>
<td>HALS and straight laparoscopy, extraction via hand port, suprapubic or left lower quadrant incision or stoma site</td>
</tr>
<tr>
<td>Ouaïssi et al</td>
<td>2008</td>
<td>France</td>
<td>Case-matched</td>
<td>2000–2006</td>
<td>(Sub)total colectomy, end ileostomy and sigmoidostomy</td>
<td>Straight laparoscopy, extraction via 5-cm incision in right iliac fossa</td>
</tr>
<tr>
<td>Marceau et al.</td>
<td>2007</td>
<td>France</td>
<td>Case-matched</td>
<td>Open: before 1999</td>
<td>(Sub)total colectomy, end ileostomy</td>
<td>Straight laparoscopy, extraction via incision in right iliac fossa</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Laparoscopy: 1999 onwards</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marcello et al.</td>
<td>2001</td>
<td>USA</td>
<td>Case-matched</td>
<td>1997–1999</td>
<td>Total colectomy, end ileostomy and mucous fistula</td>
<td>Straight laparoscopy, extraction via incision in right lower quadrant</td>
</tr>
<tr>
<td>Dunker et al.</td>
<td>2000</td>
<td>The Netherlands</td>
<td>Cohort</td>
<td>1996–1999</td>
<td>(Sub)total colectomy, end ileostomy</td>
<td>HALS (2) or straight laparoscopy (8), extraction via Pfannenstiel incision</td>
</tr>
</tbody>
</table>

HALS, hand-assisted laparoscopic surgery.
Patient characteristics and outcomes reported are shown in Table 2. The mean age was comparable between the two groups in six studies, but three reported a significantly different age at baseline\textsuperscript{4,13,15}. Other baseline data were relatively homogenous; sex did not differ between the groups in any of the nine studies, and a baseline difference in BMI was reported in only one\textsuperscript{9} of the seven that detailed it\textsuperscript{4,13,15–18,20}. Duration of (short-term) follow-up was 30 days in three studies\textsuperscript{4,13,14}, and was not defined in the remaining studies. Two studies included only patients who also had a completion proctectomy in a second stage\textsuperscript{4,16}. Data were collected retrospectively in seven studies\textsuperscript{4,13-16,18,19}. Assessment of the endpoints was not unbiased (unblinded) in any of the studies.

### Table 2 Patient and study characteristics

<table>
<thead>
<tr>
<th>Reference</th>
<th>Diagnosis</th>
<th>Exclusion criteria</th>
<th>No. of patients</th>
<th>Mean age (years)</th>
<th>Relevant endpoints</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gu et al.\textsuperscript{13}</td>
<td>UC</td>
<td>Megacolon, perforation, massive haemorrhage</td>
<td>197</td>
<td>39</td>
<td>C, OT, M, R, WI, I, LOS</td>
</tr>
<tr>
<td>Bartels et al.\textsuperscript{4}</td>
<td>UC</td>
<td>No subsequent IPAA</td>
<td>36</td>
<td>33</td>
<td>C, M, R</td>
</tr>
<tr>
<td>Telem et al.\textsuperscript{14}</td>
<td>UC</td>
<td>Toxic megacolon, dysplasia, neoplasm</td>
<td>29</td>
<td>40</td>
<td>C, OT, M, R, WI, I, GIB, LOS</td>
</tr>
<tr>
<td>Watanabe et al.\textsuperscript{15}</td>
<td>UC</td>
<td>Toxic megacolon, perforation, shock</td>
<td>30</td>
<td>32</td>
<td>C, OT, M, R, WI, I, GIB, A, LOS</td>
</tr>
<tr>
<td>Chung et al.\textsuperscript{16}</td>
<td>UC</td>
<td>No subsequent IPAA, perforation</td>
<td>37</td>
<td>38</td>
<td>C, OT, M, R, WI, I, GIB, A, LOS</td>
</tr>
<tr>
<td>Ouaïssi et al.\textsuperscript{17}</td>
<td>UC, CD</td>
<td>Toxic dilatation, perforation, peritonitis, haemorrhage</td>
<td>23</td>
<td>41</td>
<td>C, OT, M, R, WI, I, A, LOS</td>
</tr>
<tr>
<td>Marceau et al.\textsuperscript{18}</td>
<td>UC, CD, IBD</td>
<td>Toxic megacolon, perforation, peritonitis</td>
<td>40</td>
<td>41</td>
<td>C, OT, M, R, WI, I, GIB, LOS</td>
</tr>
<tr>
<td>Marcello et al.\textsuperscript{19}</td>
<td>UC, CD</td>
<td>At least one sign of toxicity (heart rate, temperature, peritonitis, etc.)</td>
<td>19</td>
<td>32*</td>
<td>C, OT, WI, I, GIB, LOS</td>
</tr>
</tbody>
</table>

*Values are median. †Only the complication with the highest Clavien–Dindo grade was reported for each patient. UC, ulcerative colitis; C, conversion; OT, operating time; M, mortality; R, reoperation; WI, wound infection; I, ileus; LOS, length of stay; IPAA, ileal pouch–anal anastomosis; GIB, gastrointestinal bleed; A, abscess; CD, Crohn’s disease; IBD, inflammatory bowel disease (unclassified). ‡Significantly different versus laparoscopy group.
Definitions of outcome measures
Conversion was defined as an unplanned laparotomy or extension of the initial extraction site\textsuperscript{4,13,16}, any unplanned incision or a planned incision longer than 6 cm for specimen extraction\textsuperscript{17}, a midline incision\textsuperscript{18}, or no definition was given\textsuperscript{14,15,19,20}. Duration of operation was defined as operating room time\textsuperscript{16,19}, time from skin incision to wound closure\textsuperscript{19}, or no definition was provided\textsuperscript{14,15,17,18,20}. Reoperation was defined as a further operation within 30 days after the index operation\textsuperscript{4,13,14} or no definition was given\textsuperscript{15–18,20}. A definition of wound infection was provided only by Gu and colleagues\textsuperscript{13}: signs of infection or purulent drainage, requiring deliberate opening of the wound or antibiotic treatment, and a positive culture. They defined ileus as absence of adequate bowel function on day 5 after surgery, or the need to insert a nasogastric tube because of abdominal distension, nausea or emesis after starting a liquid diet, in the absence of mechanical obstruction (imaging studies or operation)\textsuperscript{13}. No clear definition was given in the other included studies reporting on ileus\textsuperscript{14–19}. Gastrointestinal bleeding and intra-abdominal abscess were not defined in any of the studies that reported on these outcomes\textsuperscript{14–19}. Length of stay was defined as total postoperative stay\textsuperscript{13,15,16}, hospital stay including readmission for complications\textsuperscript{17}, overall length of stay\textsuperscript{19}, or no definition was given\textsuperscript{14,18,20}. Mortality was defined as death within 30 days after the index operation\textsuperscript{4,13,14}, and/ or death occurring in hospital\textsuperscript{17,18}, or no definition was given\textsuperscript{15,16,20}.

Outcomes and meta-analysis
The authors of six studies were contacted for original continuous data reported as mean(s.d.) for the purpose of meta-analysis\textsuperscript{13–15,19–21}. However, only data for two studies were provided by the authors\textsuperscript{13,15}.

All nine studies reported a conversion rate and were included in the meta-analysis. The pooled conversion rate was 5.5 (95 per cent c.i. 3.6 to 8.4) per cent for the laparoscopic group comprising 421 patients. No meta-analysis was done for operating time; the definitions differed or were unclear in most of the included studies and there was considerable statistical heterogeneity ($I^2 = 71$ per cent). The reoperation rate was reported in eight studies comprising 918 patients; only the study by Marcello and co-workers\textsuperscript{19} did not report on reoperations. The pooled RR for reoperation was 0.83 (95 per cent c.i. 0.51 to 1.34; $P = 0.44$, $I^2 = 0$ per cent) in favour of laparoscopic resection.

Seven studies comprising 824 patients were included in the meta-analysis of wound infection and ileus; only the studies by Bartels and colleagues\textsuperscript{4} and Dunker et al.\textsuperscript{20} did not report on either complication. Figure 2 shows the results of meta-analysis for wound infection. The pooled RR for wound infection was 0.60 (0.38 to 0.95; $P = 0.03$, $I^2 = 0$ per cent), indicating a significant difference in favour of the laparoscopic group. This was equal to a risk difference of 6 (95 per cent c.i. 2 to 9) per cent, and a NNT of 19 (95 per cent c.i. 11 to 70). The pooled RR for ileus was 0.83 (0.43 to 1.61; $P = 0.58$, $I^2 = 40$ per cent). Postoperative
gastrointestinal bleeding was mentioned in five studies comprising 367 patients. The pooled RR for a postoperative gastrointestinal bleed was 1.03 (0.25 to 4.24; \( P = 0.97 \), \( I^2 = 1 \) per cent).

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Laparoscopy</th>
<th>Open</th>
<th>Risk Ratio</th>
<th>Risk Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Events</td>
<td>Total</td>
<td>Weight</td>
<td>M-H, Random, 95% CI</td>
</tr>
<tr>
<td>Chung 2009</td>
<td>1</td>
<td>37</td>
<td>2</td>
<td>3.7%</td>
</tr>
<tr>
<td>Gu 2012</td>
<td>17</td>
<td>197</td>
<td>32</td>
<td>67.6%</td>
</tr>
<tr>
<td>Marceau 2007</td>
<td>0</td>
<td>40</td>
<td>3</td>
<td>2.4%</td>
</tr>
<tr>
<td>Marcello 2000</td>
<td>2</td>
<td>19</td>
<td>3</td>
<td>7.3%</td>
</tr>
<tr>
<td>Ouassi 2008</td>
<td>1</td>
<td>23</td>
<td>2</td>
<td>3.8%</td>
</tr>
<tr>
<td>Telem 2010</td>
<td>0</td>
<td>29</td>
<td>8</td>
<td>61</td>
</tr>
<tr>
<td>Watanabe 2009</td>
<td>4</td>
<td>30</td>
<td>4</td>
<td>30</td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>375</td>
<td>449</td>
<td>100.0%</td>
<td>0.60 [0.38, 0.95]</td>
</tr>
<tr>
<td>Total events</td>
<td>25</td>
<td>54</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heterogeneity: ( T_{au}^2 = 0.00 ); ( \chi^2 = 3.08, df = 6 ) ( P = 0.80 ); ( I^2 = 0 ) per cent</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test for overall effect: ( Z = 2.20 ) ( P = 0.03 )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 2 Forest plot showing wound infection rate after laparoscopic versus open surgery. A Mantel–Haensel random-effects model was used for meta-analysis. Risk differences are shown with 95 per cent confidence intervals.

*Figure 3* shows the results of meta-analysis for intra-abdominal abscess. Three studies, comprising 186 patients, reported on intra-abdominal abscess. The pooled RR for developing an intra-abdominal abscess was 0.27 (0.08 to 0.91; \( P = 0.04 \), \( I^2 = 0 \) per cent), a significant difference in favour of laparoscopic resection. This was equal to a risk difference of 9.1 (1.6 to 16.8) per cent and a NNT of 11 (6 to 63).

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Laparoscopy</th>
<th>Open</th>
<th>Risk Ratio</th>
<th>Risk Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Events</td>
<td>Total</td>
<td>Weight</td>
<td>M-H, Random, 95% CI</td>
</tr>
<tr>
<td>Chung 2009</td>
<td>1</td>
<td>37</td>
<td>5</td>
<td>44</td>
</tr>
<tr>
<td>Ouassi 2008</td>
<td>1</td>
<td>23</td>
<td>3</td>
<td>22</td>
</tr>
<tr>
<td>Watanabe 2009</td>
<td>1</td>
<td>30</td>
<td>4</td>
<td>30</td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>90</td>
<td>96</td>
<td>100.0%</td>
<td>0.27 [0.08, 0.91]</td>
</tr>
<tr>
<td>Total events</td>
<td>3</td>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heterogeneity: ( T_{au}^2 = 0.00 ); ( \chi^2 = 0.04, df = 2 ) ( P = 0.98 ); ( I^2 = 0 ) per cent</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test for overall effect: ( Z = 2.10 ) ( P = 0.04 )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 3 Forest plot showing rate of intra-abdominal abscess after laparoscopic versus open surgery. A Mantel–Haensel random-effects model was used for meta-analysis. Risk ratios are shown with 95 per cent confidence intervals.

Eight studies reported on the length of stay after colectomy, but data from only six of these, comprising 758 patients, were available for meta-analysis. Marcello et al. did not provide mean(s.d.) values; the data of Watanabe and colleagues were excluded as a very extended hospital stay was reported, probably due to the organization of the healthcare system in Japan. *Figure 4* shows the results of meta-analysis for length of stay. The pooled mean difference was 3.17 (95 per cent c.i. 2.37 to 3.98) days (\( P < 0.001 \), \( I^2 = 0 \) per cent), significantly favouring laparoscopic surgery.

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Eight studies, comprising 918 patients, reported on mortality; a total of one of 402 patients in the laparoscopic group died and three of 516 patients in the open group. Marcello and colleagues\textsuperscript{19} did not report clearly on mortality and their results were therefore not included in the meta-analysis. Watanabe and co-workers\textsuperscript{15} reported on one patient who died from intracranial thrombosis and cerebral bleeding 4 days after surgery. The other three postoperative deaths occurred in the largest study, but no details were given\textsuperscript{13}. The pooled RR for death was 0.46 (0.07 to 3.07; $P = 0.42$, $I^2 = 0$ per cent).

**DISCUSSION**

A favourable effect of laparoscopy was observed in terms of the risk of superficial and deep surgical-site infection as well as a shorter hospital stay. There were no significant differences in rates of reoperation, ileus, gastrointestinal bleeding or mortality.

The findings of this systematic review are consistent with those of the Cochrane systematic review of outcomes in colorectal cancer\textsuperscript{1}, except the latter did not show a difference in intra-abdominal abscess and ileus was less likely after laparoscopic resection. Elective colorectal cancer surgery differs from (sub)acute surgery for colitis with regard to the presence of an anastomosis, pre-existing inflammation and physical condition of the patient. The defence mechanisms against abscess formation may be further deteriorated by open surgery in an already compromised patient with IBD.

Laparoscopic subtotal colectomy can be technically more difficult than the open procedure. The included studies report on data collected between 1996 and 2010; in this interval, laparoscopic techniques were already used intensively in different colorectal procedures, and many surgeons already performed laparoscopic surgery for colorectal cancer\textsuperscript{21–24}. To what extent a learning curve for the laparoscopic procedure has influenced the outcomes of the included studies is difficult to determine.
One of the potential pitfalls in the present study is the degree of patient and procedure heterogeneity. Even though Crohn’s disease and ulcerative colitis have a distinctly different aetiology, both can cause severe colitis. Potential differences in postoperative outcomes for patients with Crohn’s disease and ulcerative colitis are to be anticipated in the long term. Differences in short-term postoperative outcomes are not expected, and so both groups were analysed together in this systematic review, as in other studies.

A recent meta-analysis showed no difference in complications or duration of operation between hand-assisted and straight laparoscopic surgery; only an obviously lower conversion rate was observed in hand-assisted procedures. As done previously in large reviews of laparoscopic colorectal cancer surgery, hand-assisted laparoscopy was analysed together with straight laparoscopic surgery.

The most important limitation of this systematic review is that no randomized trials have been carried out at present; therefore, the results are prone to selection bias. Patients undergoing laparoscopic colectomy are most likely to be operated on by an experienced laparoscopic surgeon, in contrast to those having an open procedure, which can be performed by any qualified surgeon. Almost all included studies had strict criteria to exclude severely ill patients, thereby limiting the external validity of this review; the present results cannot be generalized to critically ill patients in need of an emergency subtotal colectomy.

The methodological quality of the studies was average. Not all studies clearly defined their outcome measures, thereby increasing heterogeneity, and none included a blinded assessment of the endpoints, which could have led to expectation bias.

Despite these limitations, meta-analysis was found to be appropriate for the outcomes conversion rate, reoperation rate, wound infection, ileus, gastrointestinal bleeding, intra-abdominal abscess, length of stay and mortality. With the expected long-term benefits of the approach, such as fewer incisional hernias and adhesions, laparoscopic (sub)acute colectomy can be regarded as ideal in centres with experienced surgeons.
REFERENCES


16. Chung TP, Fleshman JW, Birnbaum EH, Hunt SR, Dietz DW, Read TE et al. Laparoscopic vs. open total abdominal colectomy for severe colitis: impact on recovery and subsequent


