Laparoscopic colorectal surgery: beyond the short-term effects
Bartels, S.A.L.

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Chapter 5

A systematic review and meta-analysis of laparoscopic versus open subtotal colectomy in patients with inflammatory bowel disease

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ABSTRACT

Aim
Ulcerative colitis and Crohn’s disease can cause an acute severe colitis necessitating surgical treatment. The aim of this review is to compare short term outcomes after laparoscopic and open subtotal colectomy in patients with inflammatory bowel diseases.

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

Results
The search resulted in 9 non-randomised studies: 6 cohorts and 3 case-matched series, comprising 966 patients in total. Pooled conversion rate was 5.5% (95% confidence interval (CI) 3.6 - 8.4) in the laparoscopic group. The pooled risk ratio of wound infection was 0.60 (95% CI 0.38 - 0.95; P=0.03) and of intra-abdominal abscess 0.27 (95% CI 0.08 - 0.91; P=0.04), both in favour of laparoscopic surgery. Pooled risk ratios for the other complications showed no significant differences. Length of stay was significantly shorter after laparoscopic subtotal colectomy with a pooled mean difference of 3.2 days (95 per cent CI 2.4 - 4.0; P<0.001).

Conclusion
Based on presently available non-randomised studies, laparoscopic subtotal colectomy can be regarded as safe and has important short-term benefits over the open procedure in patients with inflammatory bowel diseases.
INTRODUCTION

Both ulcerative colitis (UC) and Crohn’s disease (CD) can cause a medical refractory acute severe colitis requiring surgical treatment. In this (sub)acute setting, a subtotal colectomy with end ileostomy is performed. A subtotal colectomy can be carried out either as an open procedure via a midline incision, or as a laparoscopic procedure, entailing both hand-assisted and straight laparoscopy. Since the introduction of minimally invasive surgery, several multicenter randomized controlled trials (RCTs) have established that laparoscopy is a safe and feasible approach in colorectal surgery. Strong evidence indicates that laparoscopic colorectal surgery is associated with better short-term outcomes compared to open, consisting of reduced morbidity, reduced postoperative pain, shorter hospitalisation, and faster return to bowel function and normal daily activities.1-2 However, almost all large studies were done in patients with colorectal cancer and in an elective setting. In addition to short term benefits, recent studies indicate that possible long term advantages of laparoscopic colorectal surgery include less adhesion formation, less adhesion-related small bowel obstruction, less incisional hernias and a better preservation of fertility.3-7

Current guidelines by the European Crohn’s and Colitis Organisation (ECCO) do not contain a statement regarding the preference for an open or laparoscopic approach for colectomy in patients with inflammatory bowel disease (IBD).8,9 In case of severe colitis, the patients are often exhausted due to prolonged medical treatment, malnutrition, sepsis and rectal blood loss. Furthermore, the colon is potentially more fragile because of the severe inflammation. These factors could make the patient more susceptible for postoperative morbidity in comparison with the elective setting. No systematic review has been published so far on the two surgical approaches for subtotal colectomy in the (sub)acute setting. Therefore, the aim of this systematic review is to compare short term outcomes after laparoscopic and open subtotal colectomy in patients with IBD.

METHODS

This systematic review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines.10 Inclusion criteria for article selection were: RCTs, 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 medical refractory disease. The reported intervention and control groups had to contain at least 10 patients each. For the purpose of this review, both hand-assisted laparoscopic surgery (HALS) and straight laparoscopic subtotal colectomy were analyzed as ‘laparoscopic’.
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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 performed on 21 June 2012. The keywords and MeSH terms used for MEDLINE were:

- 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 ulcerative colitis or colitis ulcerosa).ti,ab OR crohn* disease.ti,ab] AND [colon resection OR intestine resection OR proctocolectomy OR (colectom* or proctocolectom* or coloproctectom*).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 searching the Cochrane Database were ‘colectomy’ and ‘laparoscopy’. Two reviewers (SB and TG) independently selected relevant studies based on their titles and abstracts. Full text articles were read by both reviewers. Additionally, a hand search was performed of the references of relevant studies. 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, operating time, reoperation rate, wound infection, ileus, gastrointestinal bleed, intra-abdominal abscess, length of stay and mortality. These outcomes were selected based on their clinical relevance.

Data extraction and analysis
Data were independently extracted by two reviewers (SB and TG) onto a predefined data sheet which 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 discussion. If original continuous data were not displayed as mean with standard deviation (s.d.), or could not be transformed into a mean with SD, the authors were contacted and requested to provide that data for the purpose of meta-analysis. The methodological quality of the included studies was assessed independently by two reviewers (SB and TG) using the modified Methodological Index for Non-Randomised Studies (MINORS).
Statistical Analysis
To determine if a meta-analysis of the data was appropriate, clinical heterogeneity was assessed by comparing in- and exclusion criteria per study, the outcome parameters studied, the types of laparoscopic surgery, as well as baseline characteristics of the included patients. Methodological heterogeneity was assessed using the MINORS tool. Heterogeneity was tested using the £^2$ test and quantified with an £^2$ (the proportion of total variance explained by heterogeneity). £^2$ > 50% was considered to suggest a marked inconsistency in effect between studies and no meta-analysis was done. If £^2$ was <50%, effect estimates were pooled with the conservative random effect models (REM) to account for possible between-study variance and any clinical heterogeneity. For dichotomous data, a risk ratio (RR) was calculated with a 95% confidence interval (CI). 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 (MD) with 95% CI was calculated based on the inverse variance method. A P value of <0.05 was considered statistically significant. Statistical analysis was done using Review Manager version 5.1 (The Nordic Cochrane Centre, The Cochrane Collaboration 2011) and Comprehensive Meta-Analysis version 2.2.064 (Biostat, Inc., USA 2011).

RESULTS

Figure 1. PRISMA flow chart of search results and article selection
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Study selection, study characteristics and methodological quality

Details of the literature search are shown in Figure 1. The initial search yielded 988 potentially relevant titles. Fifty articles were selected for assessment of inclusion criteria and methodological quality. After assessment of the full text, 41 articles were excluded. The 9 included studies were all non-randomized studies, either cohort studies or case-matched series. Characteristics of the studies are shown in Table 1. The studies were published between 2000 and 2012. Four articles (including all 3 case-matched series) reported on straight laparoscopic colectomy only, all with different extraction sites. 4 articles reported on both HALS and straight laparoscopic colectomy, and 1 article reported on HALS only. The case-matched series were all matched on disease type, sex, BMI, and age. Patient characteristics and reported outcomes are shown in Table 2. A total of 966 patients were included in the 9 studies together; 421 in the laparoscopic group and 545 in the open group. The mean age was comparable between the two groups in 6 studies, but 3 studies reported a significantly different age at baseline. Other baseline data were relatively homogenous; sex did not differ between the groups in any of the 9 studies and a baseline difference in BMI was reported in one of the 7 studies reporting on BMI. Duration of (short-term) follow-up was 30 days in 3 studies, and it was not defined in the remaining studies. Table 3 shows the detailed assessment of methodological quality of the included studies using the modified MINORS. Seven studies were consecutive series and 2 were not; these 2 studies included only patients who also had a completion proctectomy in a second stage. Moreover, data were collected retrospectively in 7 studies, of which 3 studies reported on data that were retrospectively collected from a prospectively maintained database. Assessment of the endpoints was not unbiased (i.e. unblinded) in any of the studies.

Definitions of outcome measures

Conversion was defined as an unplanned laparotomy or extension of the initial extraction site, any unplanned incision or a planned incision longer than 6 cm for specimen extraction, a midline incision, or no definition was given. Operating time was defined as operating room time, time from skin incision to wound closure, or no definition was provided. Reoperation rate was defined as a reoperation within 30 days after the index operation, or no definition was given. A definition of wound infection was provided only by Gu et al.: signs of infection or purulent drainage, requiring deliberate opening of the wound or antibiotic treatment, and a culture being positive. Gu et al. defined ileus as absence of adequate bowel function on postoperative day 5, or the need to insert a nasogastric tube because of abdominal distension, nausea or emesis after having started a liquid diet, in the absence of a mechanical obstruction (imaging studies or operation). In the other included studies reporting on ileus, no clear definition was given. Gastrointestinal bleed and intra-abdominal abscess were not defined in any of the studies reporting on these outcomes.
<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>’06 - ’10</td>
<td>Total colectomy</td>
<td>Straight laparoscopy (n=151), HALS (n=26), single incision laparoscopic surgery (n=20)</td>
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<td>Bartels et al.</td>
<td>2012</td>
<td>Netherlands</td>
<td>Cohort</td>
<td>Jan ’99 - Apr ’10</td>
<td>2- or 3 stage restorative proctocolectomy</td>
<td>HALS (n=32) via Pfannenstiel incision or straight laparoscopy (n=4) extraction via stoma site or transrectally</td>
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<tr>
<td>Telem et al.</td>
<td>2010</td>
<td>USA</td>
<td>Cohort</td>
<td>Jan ’02 - Dec ’07</td>
<td>(Sub)total colectomy, end ileostomy</td>
<td>Straight laparoscopy, extraction via stoma site or Pfannenstiel incision</td>
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<td>Watanabe et al.</td>
<td>2009</td>
<td>Japan</td>
<td>Cohort</td>
<td>Jan ’00 - Dec ’04</td>
<td>(Sub)total colectomy, end ileostomy &amp; mucous fistula</td>
<td>HALS, extraction via 7 cm paramedian incision</td>
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<td>Chung et al.</td>
<td>2009</td>
<td>USA</td>
<td>Cohort</td>
<td>Jun ’02 - Mar ’08</td>
<td>3 stage restorative proctocolectomy</td>
<td>HALS and straight laparoscopy, extraction via hand port, suprapubic or left lower quadrant incision or stoma site</td>
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<td>Ouaïssi et al.</td>
<td>2008</td>
<td>France</td>
<td>Case-matched</td>
<td>’00 - ’06</td>
<td>(Sub)total colectomy, end ileostomy and sigmoidostomy</td>
<td>Straight laparoscopy, extraction via 5 cm incision right iliac fossa</td>
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<td>Marceau et al.</td>
<td>2007</td>
<td>France</td>
<td>Case-matched</td>
<td>Open &lt; ’99 Laparoscopy ≥ ’99</td>
<td>(Sub)total colectomy, end ileostomy</td>
<td>Straight laparoscopy, extraction via incision right iliac fossa</td>
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<tr>
<td>Marcello et al.</td>
<td>2001</td>
<td>USA</td>
<td>Case-matched</td>
<td>Jan ’97 - Dec ’99</td>
<td>Total colectomy, end ileostomy &amp; mucous fistula</td>
<td>Straight laparoscopy, extraction via incision right lower quadrant</td>
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<tr>
<td>Dunker et al.</td>
<td>2000</td>
<td>Netherlands</td>
<td>Cohort</td>
<td>Mar ’96 - Oct ’99</td>
<td>(Sub)total colectomy, end ileostomy</td>
<td>HALS (n=2) or straight laparoscopy (n=8) extraction via Pfannenstiel incision</td>
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<table>
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<tr>
<th>Author</th>
<th>Patients</th>
<th>Exclusion criteria</th>
<th>No. of patients</th>
<th>Mean age</th>
<th>Relevant endpoints</th>
<th>Short term follow-up</th>
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<tr>
<td>Gu et al.</td>
<td>UC</td>
<td>- Megacolon</td>
<td>197</td>
<td>39</td>
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<td></td>
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<td>- Perforation</td>
<td>215</td>
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<td>- Massive haemorrhage</td>
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<tr>
<td>Bartels et al.</td>
<td>UC</td>
<td>- No subsequent IPAA</td>
<td>36</td>
<td>33</td>
<td>Conversion, mortality, reoperation</td>
<td>30 days</td>
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<td>Telem et al.</td>
<td>UC</td>
<td>- Toxic megacolon</td>
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<td>40</td>
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<td>- Dysplasia or neoplasm</td>
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<td>UC</td>
<td>- Toxic megacolon</td>
<td>30</td>
<td>32</td>
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<td>- Perforation</td>
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<td>42 a</td>
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<td>- Shock stage</td>
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<td>- Advanced colon cancer</td>
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<td>Chung et al.</td>
<td>UC</td>
<td>- No subsequent IPAA</td>
<td>37</td>
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<td></td>
<td>- Perforation</td>
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<td>38</td>
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<td>Ouaïssi et al.</td>
<td>UC, CD</td>
<td>- Toxic dilatation</td>
<td>23</td>
<td>41</td>
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<td>- Massive haemorrhage</td>
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<td>Marceau et al.</td>
<td>UC, CD, IBD-U</td>
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<td>- Peritonitis</td>
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<td>Marcello et al.</td>
<td>UC, CD</td>
<td>- Fulminant disease: ≥ 2 of:</td>
<td>19</td>
<td>32 d</td>
<td>Conversion, operating time, wound infection, ileus, GI bleed, length of stay</td>
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<td>* Temperature &gt; 38 °C</td>
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<td>* Peritoneal signs</td>
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<td>* WBC count &gt; 1.000/ml</td>
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<tr>
<td>Dunker et al.</td>
<td>UC, CD</td>
<td>ND</td>
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<td>ND</td>
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<td>32</td>
<td>37</td>
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</table>

UC: Ulcerative colitis. IPAA: Ileal-pouch anal anastomosis. GI: Gastrointestinal. CD: Crohn’s disease. IBD-U: Unclassified inflammatory bowel disease. HR: Heart rate. WBC: White blood cell. ND: no data/not clearly defined. (a) Significantly different. (b) Follow-up period equals hospital stay. (c) Mortality was defined as death occurring in-hospital or within 30 days. (d) Age presented in median. * Only highest Clavien Dindo complication for each patient is presented.
<table>
<thead>
<tr>
<th>Study</th>
<th>Consecutive series</th>
<th>Prospective data collection</th>
<th>Unbiased assessment of endpoint</th>
<th>Sufficiently long follow-up period</th>
<th>Loss to follow-up &lt; 5%</th>
<th>Adequate control group</th>
<th>Contemporary groups</th>
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<td>Gu et al.</td>
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<td>−</td>
<td>−</td>
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<td>+</td>
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<td>Telem et al.</td>
<td>+</td>
<td>−</td>
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<td>+</td>
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<td>Watanabe et al.</td>
<td>+</td>
<td>± e</td>
<td>−</td>
<td>+</td>
<td>+</td>
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<td>− b</td>
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<td>+ f</td>
<td>±</td>
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<td>Marceau et al.</td>
<td>+ f</td>
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<td>+ f</td>
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<td>+</td>
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<td>+</td>
<td>+</td>
<td>+</td>
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<td>+</td>
</tr>
</tbody>
</table>

(+) Adequate. (±) Unclear (−) Inadequate. Items were scored ‘adequate’ if condition was satisfied, ‘unclear’ if information regarding item was not reported and ‘inadequate’ if condition was not satisfied. (a) Baseline equivalence was checked for sex, age and BMI. (b) Significant different in age. (c) Significant difference in BMI. (d) No data available on BMI. (e) Data was retrospectively collected from a prospective database. (f) Only laparoscopic patients were consecutive (case-matched).
Length of stay was defined as total postoperative stay\(^5\,\,^4\,\,^6\,\,^57\), hospital stay including rehospitalisation for complications\(^5\,\,^8\), the overall length of stay\(^4\,\,^6\) or no definition was given.\(^5\,\,^5\,\,^9\,\,^61\) Mortality was defined as death within 30 days after the index operation\(^5\,\,^5\,\,^4\,\,^55\), and/ or those occurring in the hospital\(^5\,\,^6\,\,^9\), or no definition was given.\(^5\,\,^6\,\,^7\)

Outcomes and meta-analysis

The authors of 6 studies were contacted for original continuous data reported in mean and standard deviation for the purpose of meta-analysis.\(^5\,\,^5\,\,^6\,\,^6\,\,^0\,\,^51\) However, only data for 2 studies were provided by the authors.\(^5\,\,^4\,\,^56\)

Figure 2. Forest plot of wound infection

Figure 3. Forest plot of intra-abdominal abscess

Figure 4. Forest plot of length of stay

All 9 studies reported a conversion rate and were included in the meta-analysis. Pooled conversion rate was 5.5% (95% CI 3.6 - 8.4) for the laparoscopic group comprising 421 patients. No meta-
analysis was done for operating time; the definitions of operating time differed or were unclear in most of the included studies and there was a large statistical heterogeneity ($I^2=71\%$). The reoperation rate was reported in 8 studies comprising 918 patients; only the study by Marcello et al.\textsuperscript{60} did not report on reoperations. The pooled risk ratio for reoperation was 0.83 (95\% CI: 0.51 - 1.34; $P=0.44$, $I^2=0\%$) in favour of laparoscopic resection. Seven studies comprising 824 patients could be included for meta-analysis on wound infection and ileus; only the studies by Bartels et al.\textsuperscript{5} and Dunker et al.\textsuperscript{61} did not report on either complication. Figure 2 shows the meta-analysis for wound infection. The pooled risk ratio of wound infection was 0.60 (95\% CI: 0.38 - 0.95; $P=0.03$, $I^2=0\%$); a significant difference in favour of the laparoscopic group. This was equal to a risk difference of 5.4\% (95\% CI: 1.4 to 9.3\%), and a NNT of 19 (95\% CI: 11 to 70). The pooled risk ratio for ileus was 0.83 (95\% CI: 0.43 - 1.61; $P=0.58$, $I^2=40\%$). Postoperative gastrointestinal bleed was mentioned in 5 studies comprising 367 patients.\textsuperscript{55-59} The pooled risk ratio of a postoperative gastrointestinal bleed was 1.03 (95\% CI: 0.25 - 4.24, $P=0.97$, $I^2=1\%$). Figure 3 shows the meta-analysis for intra-abdominal abscess. Three studies, comprising 186 patients, reported on intra-abdominal abscess.\textsuperscript{56-58} The pooled risk ratio of having an intra-abdominal abscess was 0.27 (95\% CI: 0.08 - 0.91; $P=0.04$, $I^2=0\%$), a significant difference in favour of laparoscopic resection. This was equal to a risk difference of 9.1\% (95\% CI: 1.6 to 16.8\%), and a NNT of 11 (95\% CI: 6 to 63).

Eight studies reported on the length of stay after colectomy, but for only 6 studies, comprising 758 patients, data were available for meta-analysis.\textsuperscript{54,55,57-59,61} Marcello et al. did not provide the outcome in mean and standard deviation\textsuperscript{60} and the data of Watanabe et al. were excluded since they reported a very extended hospital stay, which is likely due to the organisation of the health care system in Japan.\textsuperscript{56} Figure 4 shows the meta-analysis for length of stay. The pooled mean difference in length of stay was 3.17 days (95\% CI: 2.37 - 3.98; $P<0.001$, $I^2=0\%$), a significant difference in favour of laparoscopic surgery. Eight studies, comprising 918 patients, reported on mortality. In the 8 studies reporting on mortality, 1 of 402 patients in the laparoscopic group died and 3 of 516 patients in the open group. Marcello et al.\textsuperscript{62} did not clearly report on mortality and their results were therefore not entered in the meta-analysis. Watanabe et al. reported on one patient that died due to intracranial thrombosis and cerebral bleeding 4 days after surgery.\textsuperscript{56} The other 3 postoperative deaths occurred in the largest study, however no details were given.\textsuperscript{54} The pooled risk ratio for mortality was 0.46 (95\% CI: 0.07 - 3.07, $P=0.42$, $I^2=0\%$).

**DISCUSSION**

This systematic review was done to compare short-term outcomes for laparoscopic and open subtotal colectomy in patients with IBD. A significantly favourable effect of laparoscopy was observed as to the risk of wound infection and the development of intra-abdominal abscesses.
Also, a 3 day shorter hospital stay was observed after laparoscopic subtotal colectomy. No significant differences in number of reoperations, ileus, gastrointestinal bleed or mortality were observed between open and laparoscopic (sub) acute colectomy.

Previous studies have already shown that a larger incision has a larger risk of wound infection.\textsuperscript{1} Also quicker recovery after laparoscopy has been demonstrated in several previous studies on colorectal cancer surgery, which is mainly contributed to a reduction in surgical stress response.\textsuperscript{1,63,64} The findings of this systematic review are fairly consistent with those of the Cochrane systematic review in colorectal cancer patients: lower wound infection rate and shorter hospital stay after laparoscopic surgery.\textsuperscript{1} Furthermore, analysing 7350 colorectal cancer patients registered in the Dutch Surgical Colorectal Audit similarly revealed a significantly lower overall complication rate and a significantly shorter length of stay.\textsuperscript{2} However, the Cochrane review did not show a difference in development of intra-abdominal abscesses in over 1600 patients included and it did show a decrease in patients with postoperative ileus after laparoscopic resection.\textsuperscript{1} 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 IBD patient. Differences in ileus based on surgical technique may not become apparent in IBD patients who are already prone for postoperative ileus because of the intraabdominal infection.

Laparoscopic subtotal colectomy is technically more difficult than the open procedure; for example it requires several changes in surgical exposure during the procedure. With the development of vessel sealing devices and the application of hand-assisted surgery the procedure has become less demanding. Nevertheless, advanced laparoscopic skills and case selection are essential to minimize the risk of technique related complications. Furthermore, there are different techniques to take care of the rectum after subtotal colectomy. The rectum can be closed or a sigmoidostomy or mucous fistula can be performed. In three studies included in this review, a sigmoidostomy or mucous fistula was performed.\textsuperscript{56,58,60} This difference in technique can potentially lead to differences in (pelvic) septic complications, however case numbers were to small to detect significant differences between these groups.

**Strength and limitations of the study**
To date, this is the first systematic review of patients with IBD in which open and laparoscopic colectomy are compared. The pooled results of this study showed differences which were not clear in the individual studies. Studies included in this review reported on a well defined population of patients with IBD in need for a subtotal colectomy. Even though CD and UC have a distinctly different
etiology, both diseases can cause severe colitis.\textsuperscript{65} Potential differences in postoperative outcomes for patients with CD or UC are to be expected in the long-term. Differences are not expected in the short-term postoperative outcomes; therefore both groups were included in this systematic review.\textsuperscript{66,67} The included studies report on data collected between 1996 and 2010. In this period, laparoscopic techniques were already intensively used in different colorectal procedures, and most colorectal surgeons already went through a learning curve performing laparoscopic surgery on colorectal cancer patients.\textsuperscript{68-71} To what extent a learning curve for the laparoscopic procedure has influenced the outcomes of the included studies is difficult to determine.

A recent meta-analysis showed no difference in complications or operating time when comparing hand-assisted to straight laparoscopic surgery; only an obviously lower conversion rate was observed in hand-assisted cases.\textsuperscript{72} As was done previously in the large reviews on laparoscopic colorectal cancer surgery, hand-assisted laparoscopy was analyzed together with straight laparoscopic surgery.\textsuperscript{1} Several studies have shown that the introduction of enhanced recovery after surgery (ERAS) programs has decreased hospital stay in both open and laparoscopic colorectal surgery.\textsuperscript{73} Recent studies show that laparoscopy is an independent determinant of faster recovery, despite the use of ERAS programs.\textsuperscript{74-76} However, none of the included studies mentioned the use of an ERAS program, so it could not be determined if this influenced the length of stay.

The most important limitation of this systematic review is that no RCTs have been performed at present; therefore our results are prone to selection bias. Patients undergoing laparoscopic colectomy are most likely operated by an experienced laparoscopic (IBD) surgeon, in contrast to the open procedure, which can be performed by any qualified (gastrointestinal) surgeon. This could possibly increase the real effect of laparoscopy. Almost all included studies had strict criteria to exclude severely ill patients, thereby limiting the external validity of this review; our results can not be generalized to critically ill patients in need of an emergency subtotal colectomy. But hypothetically, critically ill patients will benefit in particular from the decreased surgical stress response of a laparoscopic approach. Moreover, the methodological quality of the studies was average. Not all studies clearly defined their outcome measures, thereby increasing heterogeneity, and none of the studies had a blinded assessment of the endpoints, which could also lead to an expectation bias.

Despite the aforementioned remarks to the limitations of this study, meta-analysis was found appropriate for the outcomes conversion rate, reoperation rate, wound infection, ileus, gastrointestinal bleed, intra-abdominal abscess, length of stay and mortality. This meta-analysis showed important favourable results for the laparoscopic approach. It shows that laparoscopy in patients in need for a subacute colectomy is as safe as the open procedure and has the advantages
of a lower risk of wound infection and intra-abdominal abscess and a shorter hospital stay. With the expected long term benefits of the laparoscopic approach, such as less incisional hernias and adhesions\textsuperscript{4,7,77}, laparoscopic (sub)acute colectomy can be regarded as the surgical approach of choice in centres with experienced laparoscopic surgeons.
REFERENCES


Laparoscopic versus open subtotal colectomy for IBD


