

Meta-analysis of reconstruction techniques after low anterior resection for rectal cancer

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Background: Options for reconstruction after low anterior resection (LAR) for rectal cancer include straight or side-to-end coloanal anastomosis (CAA), colonic J pouch and transverse colectomy. This systematic review compared these techniques in terms of function, surgical outcomes and quality of life.

Methods: A systematic literature search (MEDLINE, Embase and the Cochrane Library, from inception of the databases until November 2014) was conducted to identify randomized clinical trials comparing reconstructive techniques after LAR. Random-effects meta-analyses were carried out, and results presented as weighted odds ratios or mean differences with corresponding 95 per cent c.i. A network meta-analysis was conducted for the outcome anastomotic leakage.

Results: The search yielded 965 results; 21 trials comprising data from 1636 patients were included. Colonic J pouch was associated with lower stool frequency and antidiarrhoeal medication use for up to 1 year after surgery compared with straight CAA. Transverse colectomy and side-to-end CAA had similar functional outcomes to the colonic J pouch. No superiority was found for any of the techniques in terms of anastomotic leak rate.

Conclusion: Colonic J pouch and side-to-end CAA or transverse colectomy lead to a better functional outcome than straight CAA for the first year after surgery.

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Introduction

A common problem after low anterior resection (LAR) with a straight coloanal anastomosis (CAA) is a frequent or fragmented stool pattern; this stimulated the introduction of rectal reconstruction methods to improve postoperative function. One option is a colonic reservoir in the shape of a J, in analogy to the ileal J pouch after proctocolectomy¹. A colonic J pouch is not feasible because of anatomical limitations in some patients, in whom a side-to-end CAA can be performed². More recently, transverse colectomy was introduced to reconstitute a neorectal reservoir even in patients with a thick mesocolon or narrow pelvis³. Several trials^{4–7} showed better functional outcomes for the colonic J pouch, and a Cochrane review⁸ from 2008 supported this suggestion. A number of recent randomized clinical trials (RCTs)^{9–13} have addressed this issue, thus extending the evidence for the individual techniques. The purpose of this study was to analyse the overall evidence in order to identify the ideal technique(s).

Methods

This systematic review was conducted according to the recommendations of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines¹⁴. All stages of study selection, data abstraction and quality assessment were carried out independently by two reviewers.

Literature search

A systematic literature search was conducted in the following bibliographic databases: MEDLINE (via PubMed), the Cochrane Library and Embase since inception of the databases until November 2014. No restrictions were applied with regard to language or publication date. In addition, reference lists of studies and relevant former systematic reviews were searched manually and experts in this field were asked for relevant trials. Trial registries

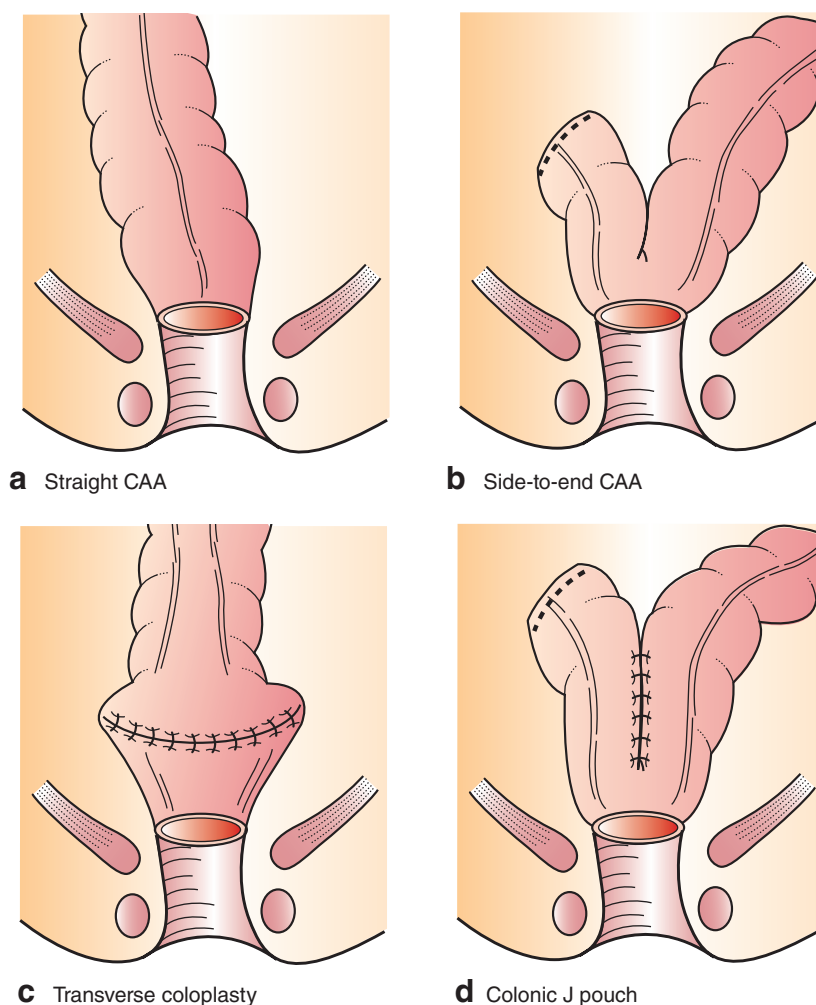


Fig. 1 Illustration of reconstructive techniques: **a** straight coloanal anastomosis (CAA), **b** side-to-end CAA, **c** transverse coloplasty and **d** colonic J pouch

(EU Clinical Trials Register, ClinicalTrials.gov, etc.) were searched for ongoing trials.

The search strategy was based on a combination of medical subject heading (MeSH) terms and text words related to reconstruction after LAR. The final MEDLINE search strategy is shown in detail in the supporting information of this article (*Appendix S1*, supporting information). The most recent search in MEDLINE was carried out on 30 November 2014.

Trial selection

Only RCTs comparing at least two reconstruction procedures after LAR (straight CAA, colonic J pouch, side-to-end CAA, transverse coloplasty; *Fig. 1*) in terms of

functional outcome with a follow-up of at least 6 months were included. Age was limited to over 18 years, but no limitations were applied with regard to sex, ethnicity or baseline characteristics of the trial subjects. Titles and abstracts of retrieved references were screened for eligibility. Full texts of the articles were retrieved if one of the reviewers was of the opinion that the eligibility criteria had been fulfilled.

Whenever two or more publications reported on the same population of patients, the results were either combined, if complementary data were reported (such as additional time points), or the study with the more detailed data was used. The authors were contacted for clarification if there were questions remaining.

Outcome measures

All functional outcomes were recorded at three time intervals as described in the Cochrane review by Brown and colleagues⁸: early (within 8 months), intermediate (8–18 months), and late (more than 18 months). Usually, these time points were calculated from the date of stoma closure, if a diverting ileo/colostomy was performed, although a few studies did not refer to this issue in detail. The main outcome in terms of postoperative function was daily stool frequency. Secondary functional outcomes were: incontinence (defined as incontinence to liquids or solids, or complete incontinence), urgency (defined as the inability to defer defaecation by at least 15 min), sensation of incomplete defaecation, and regular use of antidiarrhoeal medication. Anastomotic leakage, anastomotic stricture, mortality and reoperations represented secondary surgical outcomes. Quality of life (QoL) was recorded as a secondary patient-relevant outcome. Baseline comparability of the different treatment groups was evaluated.

Data extraction

A standard paper-based extraction sheet (available on request) was used for data extraction. This was used to record predefined data including a study identifier, essential study data, baseline characteristics of trial subjects, surgical experience and quality features. Finally, the outcome parameters described above were extracted for individual treatment groups at the predefined time points.

Assessment of risk of bias

The methodological quality of included studies was assessed by means of the Cochrane risk of bias tool¹⁵. The following dimensions were evaluated: randomization and allocation concealment (selection bias), blinding (performance and detection bias), incomplete outcome data (attrition bias), selective reporting (reporting bias) and other sources of bias (baseline imbalances, funding bias and sample size bias). For obvious reasons, blinding of surgeons is impossible. Therefore, if patients and outcome assessors were blinded to the individual treatment group, the risk of performance and detection bias was considered low. Sensitivity analyses were conducted by excluding the trials with two or fewer positive judgements of low risk of bias.

Statistical analysis

Mean differences (MDs) pooled by the inverse-variance method together with 95 per cent c.i. were used for

continuous outcomes. If trials reported only medians or ranges, the methods described by Hozo and colleagues¹⁶ were applied to calculate means and standard deviations from the values reported. Odds ratios (ORs) and 95 per cent c.i. were pooled for dichotomous outcomes using the Mantel–Haenszel method. Taking clinical heterogeneity in trial participants and treatments into account, a random-effects model was chosen for the meta-analyses. To guarantee data accuracy, all data entries in the columns of forest plots for each outcome were double-checked individually by the two reviewers. Heterogeneity was explored by means of the I^2 statistic. Sensitivity analyses were conducted for stool frequency and anastomotic leakage, by excluding trials without routine ileostomy and those that used hand-sutured anastomoses respectively, as these factors possibly influence outcome. To investigate publication bias, a funnel plot for the primary endpoint stool frequency and the main surgical outcome anastomotic leakage was evaluated for the different comparisons.

For the surgical outcome anastomotic leakage, a Bayesian random-effects model for network meta-analysis with minimally informative prior distributions was used¹⁷. The resulting 95 per cent credible intervals in Bayesian statistics can be interpreted in a similar way to conventional confidence intervals in frequentist statistics.

Pooled analyses for each outcome were done using RevMan (version 5.2)¹⁸ and R (version 3.0.2, meta-package version 3.1)^{19,20}. The network meta-analysis for anastomotic leakage was carried out using WinBUGS (version 1.4)²¹.

Results

Of 965 abstracts retrieved, 46 full texts were considered for detailed evaluation. Of these, 23 publications reporting data from 21 RCTs met the inclusion criteria. Except for one Italian paper, all reports were published in English. The reasons for exclusion at each stage of the process are shown in Fig. 2. The search of trial registries retrieved four potentially relevant trials (Lauscher/Berlin, Germany, NCT01006577; Zutshi/Cleveland, Ohio, USA, NCT01182116; Nitti/Padua, Italy, NCT01110798; Hamel, Switzerland, NCT00238381). All are currently ongoing or not even started, and no final results are yet available.

Study characteristics

A total of 1636 patients were randomized. The numbers of patients analysed in the individual comparisons are shown in Table 1. The trial by Fazio and colleagues¹¹ compared

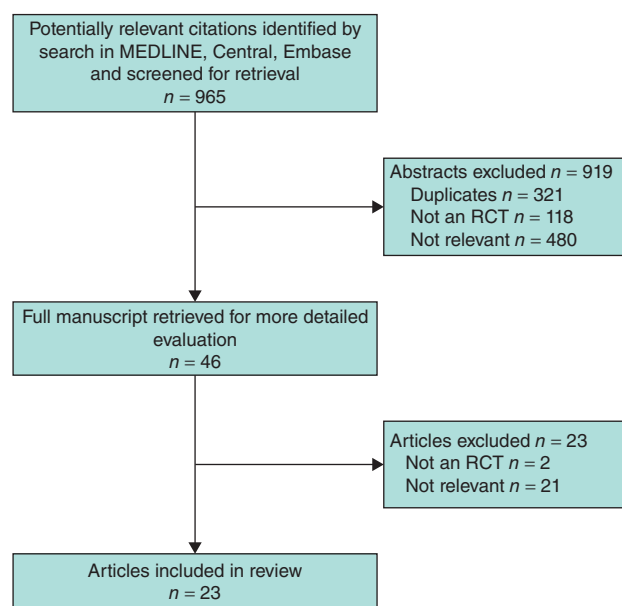


Fig. 2 PRISMA flow chart showing selection of articles for review. RCT, randomized clinical trial

Table 1 Number of patients in the individual comparisons

	Reconstructive technique	No. of patients	References
Comparison 1	Straight CAA	272	4–7, 12, 22–27
	Colonic J pouch	266	
Comparison 2	Side-to-end CAA	191	10, 28–32
	Colonic J pouch	197	
Comparison 3	Transverse colectomy	262	9, 11, 33–35
	Colonic J pouch	270	
Comparison 4	Straight CAA	32	13
	Transverse colectomy	21	
	Colonic J pouch	29	
Comparison 5	Straight CAA	49	11
	Transverse colectomy	47	

CAA, coloanal anastomosis.

either transverse colectomy *versus* colonic J pouch or, if colonic J pouch was not feasible, straight CAA *versus* transverse colectomy. For the purpose of analysis this study was considered as two separate trials: one comparing colonic J pouch *versus* transverse colectomy, and the other straight CAA *versus* transverse colectomy. Further characteristics of the included trials are presented in *Tables S1–S5* (supporting information). Most studies used a circular stapled technique for the colorectal anastomosis; only 11.4 per cent of anastomoses were hand-sutured transanally. In these trials the hand-sutured anastomoses were distributed evenly between the study groups, except in the study by Huber and co-workers²⁸ (2 hand-sutured anastomoses in side-to-end

group and 6 in colonic J pouch group). Only the trial by Jiang *et al.*²⁹ used a totally transabdominal technique for the colorectal anastomosis; usually the stapling device was inserted transanally. Most trials (especially more recent ones)^{4,6,7,9–11,22–25,33,34} carried out protective ileostomy, or in some instances colostomy, but some^{5,12,26,28–31,35} left the decision up to the surgeon on an individual basis. In trials in which ileostomy was not performed routinely, the rates of diverting ileostomy were similar in the randomized groups. An exception to this was the trial by Oya and colleagues²⁶, in which ileostomy was carried out more frequently in patients with a colonic J pouch. In all trials except that by Liang *et al.*¹², who performed laparoscopic hand-assisted LAR with either colonic J pouch or straight CAA, the operations were accomplished via an open approach. Seventeen^{4–7,12,22–26,28–31,33–35} of the 21 trials were undertaken in a single centre; the remaining four^{9–11,13} were multicentre trials, with the number of centres ranging from two to ten.

Baseline clinical and demographic data were similar between the treatment groups; the patients' overall mean age was 60 years and 38 per cent were women. The mean distance of the tumour from the anal verge was 6.8 cm, and neoadjuvant or adjuvant radiotherapy and/or chemotherapy were also distributed equally between comparison groups.

Risk of bias assessment for included studies

Fig. 3 gives an overview of the risk of bias assessment. Random sequence generation and allocation concealment were unclear in eight^{4,13,22,23,29,31,34,35} of 21 trials. The remaining 13 used appropriate randomization methods. In only one trial¹² were patients and all study personnel except the surgeon blinded to the procedure performed. Outcome assessors were blinded in five trials^{5,6,9,12,33}. The risk of attrition bias was low in 11 studies^{4,5,9,13,24–26,29,30,33,34}. Information on withdrawals and losses to follow-up was insufficient in the other ten trials^{6,7,10–12,22,23,28,31,35}. Because none of the trials was preceded by a published protocol, the risk of selective reporting was judged acceptable when the end-points were defined clearly in the methods section of the individual trials. The risk of selective reporting remained unclear in eight trials^{11,13,22,23,25,28,31,33}.

Most of the reports did not address the experience of the participating surgeons, so the risk of bias was considered unclear^{4,5,9,11–13,22,24,28,30–32,34,35}. In six trials^{6,7,23,25,26,29} a limited number of surgeons were responsible for all interventions, reflecting their status as experts. Supervision by an experienced surgeon was described for the first colonic J pouch in one trial¹⁰. In the study by Ho and colleagues³³

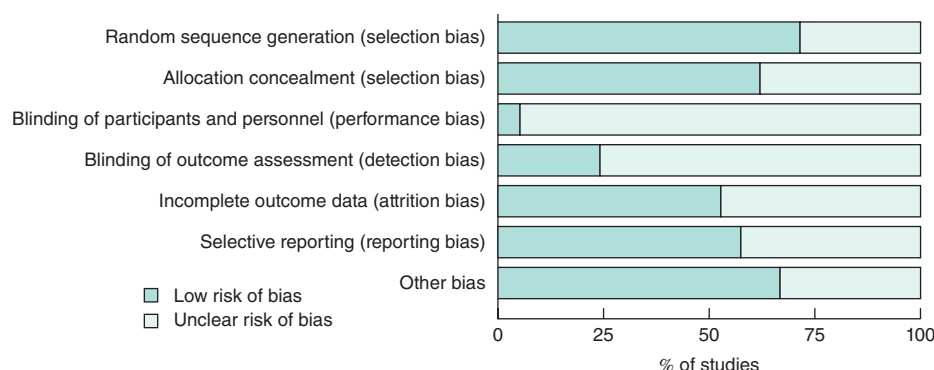


Fig. 3 Overview of risk of bias assessment for all included trials. No trial had a high risk of bias

four surgeons performed the interventions in the trial; all were experienced in the J pouch technique and had carried out at least two transverse colectomies without complications.

Functional outcomes

Straight coloanal anastomosis versus colonic J pouch: early postoperative period (less than 8 months)

The meta-analysis of stool frequency (5 trials^{4,5,12,25,26}) showed a significant result in favour of colonic J pouch (MD 2.85, 95 per cent c.i. 1.09 to 4.61; $P=0.001$, $I^2=93$ per cent), as did the meta-analysis of incomplete defaecation (3 trials; OR 2.32, 1.02 to 5.28; $P=0.044$, $I^2=33$ per cent (Fig. 4). These results were further substantiated in trials that could not be pooled^{6,7,22–24}. Incontinence problems were not significantly different in a meta-analysis of four trials^{6,7,12,26}. Of the trials that could not be pooled, four^{4,5,23,24} reported significantly better continence for the colonic J pouch group, whereas one²⁵ reported no significant difference. Six^{4,6,12,24–26} of eight trials showed no significant difference in urgency, whereas two trials found colonic J pouch significantly superior to straight CAA in ability to defer defaecation by at least 10–15 min⁷ and more than 30 min⁵ respectively. The use of antidiarrhoeal drugs did not differ significantly (OR 3.22, 0.78 to 13.38; $P=0.107$, $I^2=72$ per cent)^{5,6,12,25}.

Straight coloanal anastomosis versus colonic J pouch: intermediate postoperative period (8–18 months)

Stool frequency (MD 1.22, 0.25 to 2.20; $P=0.014$, $I^2=78$ per cent) and use of antidiarrhoeal medication (OR 4.83, 1.74 to 13.40; $P=0.002$, $I^2=1$ per cent) were still significantly less after colonic J pouch surgery (Fig. 4). Of the remaining trials, three^{7,22,23} also reported a significant result in favour of the colonic J pouch group, whereas one trial²⁴ showed no significant difference in stool

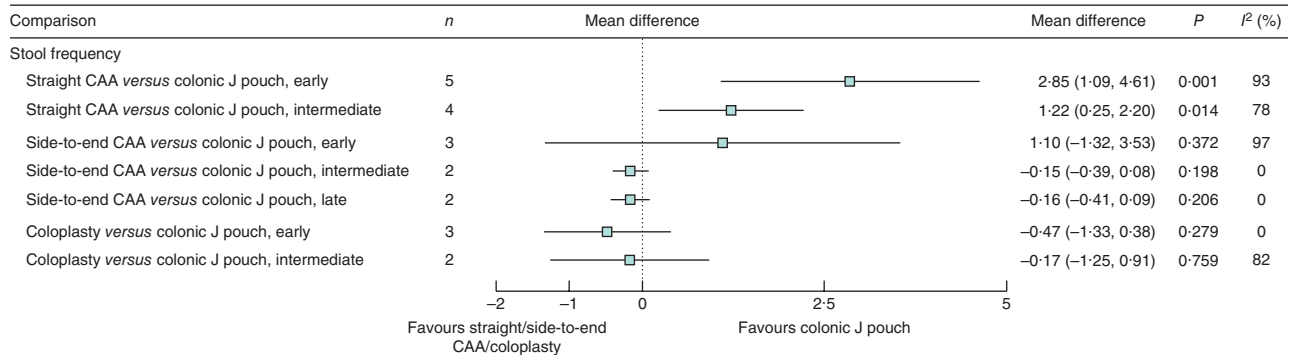
frequency. The meta-analysis for incontinence yielded a non-significant result (Fig. 4)^{7,12,22,25,26}. Two further trials^{5,23} that could not be pooled showed superiority of the colonic J pouch method, whereas one²⁴ showed no difference between colonic J pouch and straight CAA. The results of three trials^{7,12,25} reporting urgency could be summarized in a meta-analysis, which showed no significant difference between techniques (Fig. 4). Of the other four studies, three^{22,24,26} did not show a significant difference and one trial⁵ found a significantly higher rate of urgency in the straight CAA group. The meta-analysis of incomplete defaecation showed no significant difference (Fig. 4)^{5,12,26}.

Straight coloanal anastomosis versus colonic J pouch: late postoperative period (more than 18 months)

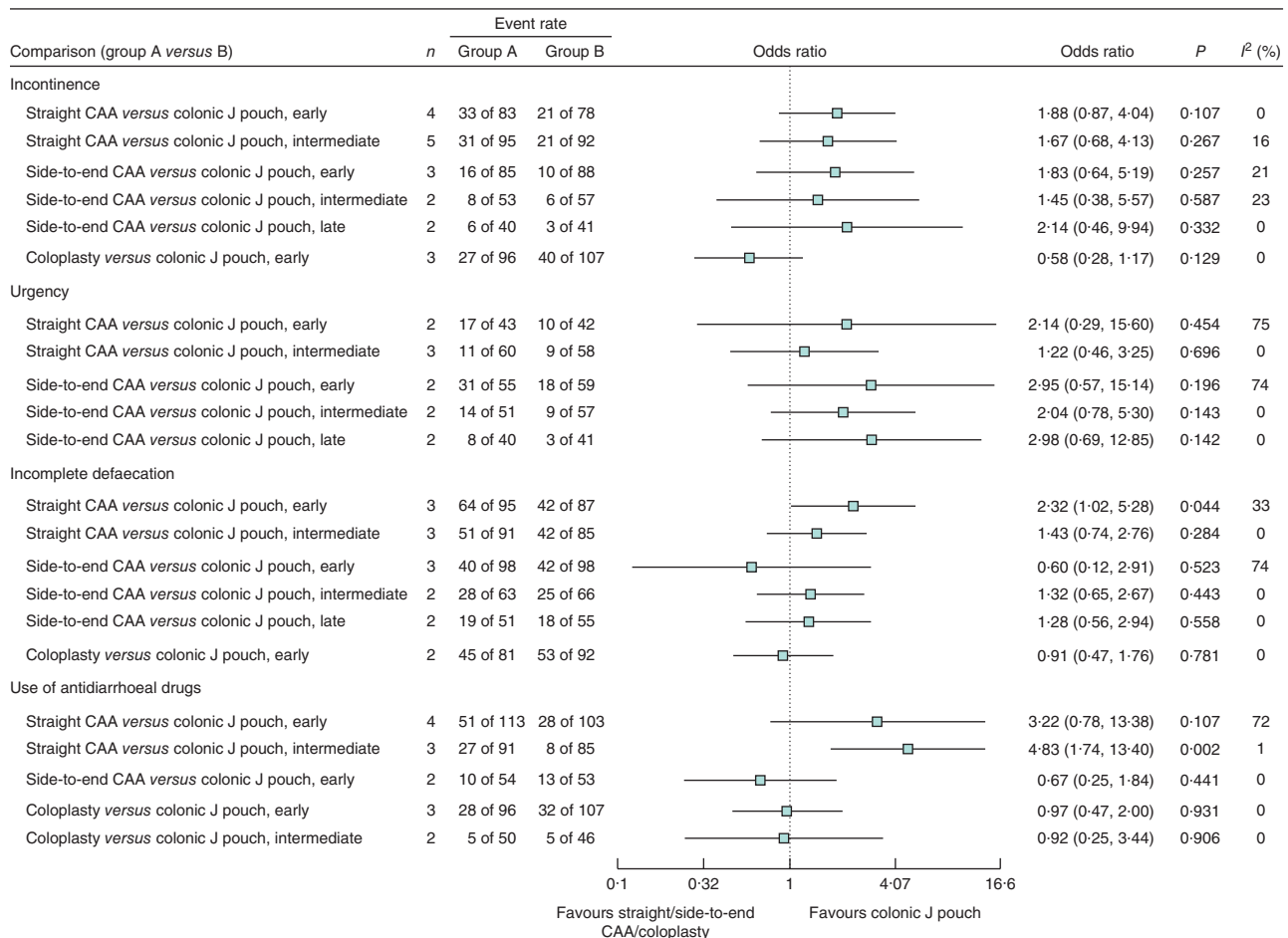
Ho *et al.*⁶ showed no significant differences persisting between the groups in any of the functional outcome measures. In contrast, Lazorthes and colleagues⁷ still showed a significant difference in stool frequency after 2 years, but no differences in terms of incontinence or urgency.

Side-to-end coloanal anastomosis versus colonic J pouch

None of the meta-analyses for functional endpoints showed a significant result for either side-to-end CAA or colonic J pouch at any time point (early, intermediate or late)^{28–31} (Fig. 4). The trial by Doeksen and co-workers¹⁰, which could not be included in the meta-analyses because the authors reported functional outcome only by means of a summary score on the COloREctal Functional Outcome scale, showed superiority of colonic J pouch over side-to-end CAA in terms of stool frequency and incontinence 4 and 12 months after stoma closure; however, these advantages were already present at baseline. Prete and colleagues³¹ also showed a significant reduction in stool frequency for the colonic J pouch group, persisting up to 36 months, but this trial featured severe sources of bias



a Stool frequency



b Other functional endpoints

Fig. 4 Summary of results of meta-analysis for **a** stool frequency (main endpoint) and **b** other functional endpoints. Pooled effect estimates are shown with 95 per cent c.i. *n*, Number of randomized trials included; CAA, coloanal anastomosis

in all dimensions. The trial by Machado *et al.*^{30,32}, which could not be included in the meta-analysis of incontinence, showed no significant difference between the groups in their measure of incontinence at any time point. In terms of urgency, both trials^{28,30} that could not be pooled also showed no significant difference. Data on the use of antidiarrhoeal medication were reported in two trials for the intermediate and late period, and showed similar use between the study groups^{29,32}.

Transverse coloplasty versus colonic J pouch

All of the meta-analyses (stool frequency, incontinence, incomplete defaecation and antidiarrhoeal drug use) showed similar results for the intervention groups, no significant difference at all time points (early, intermediate, late)^{33–35} (Fig. 4). The results for urgency for the early period could be described only qualitatively because of differing definitions and outcome measures. No significant difference was shown in four trials^{9,11,34,35}, whereas Ho and colleagues³³ reported a significantly better stool deferral time for transverse coloplasty, which represents an inverse measure of urgency. Furthermore, Fürst and co-workers³⁵ found no significant difference for any type of incontinence in the early postoperative period. The result of the meta-analysis of incomplete defaecation was confirmed by the other two trials^{34,35}, which had similar rates of incomplete defaecation between transverse coloplasty and colonic J pouch in the early period. At the intermediate time point, all trials showed similar results for transverse coloplasty and colonic J pouch with regard to incontinence, sensation of incomplete defaecation and urgency parameters in a qualitative assessment. Fazio *et al.*¹¹ demonstrated that patients with a colonic J pouch had a significantly lower stool frequency per day at all time points, and a significantly better result with regard to the mean Faecal Incontinence Severity Index (FISI) score in the early and late periods. The results of this trial, however, could not be pooled because the number of patients evaluated at the different time points was unclear. Furthermore, the measures of variability presented in the report meant that the data were not suitable for meta-analysis. In contrast, the most recent trial, by Biondo and colleagues⁹, showed similar stool frequency in the two groups, and no differences in any other functional parameters up to 3 years after stoma closure, except for nocturnal bowel movements, which were less frequent in the transverse coloplasty group.

Other trials

Among patients who were ineligible for a colonic J pouch in the trial by Fazio *et al.*¹¹, there were no significant

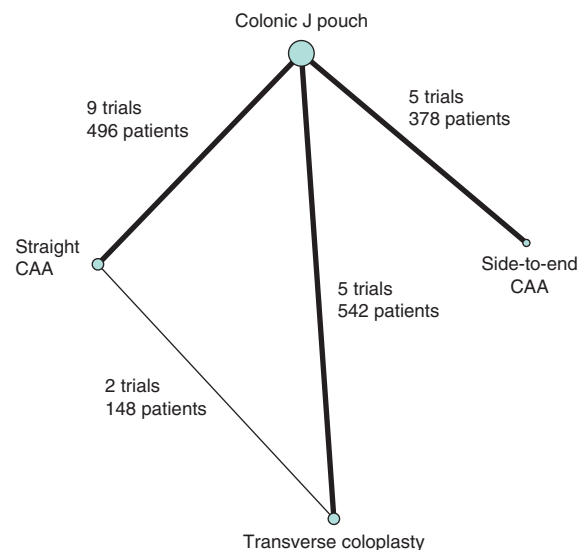


Fig. 5 Network geometry graphic. Circles represent the different reconstruction methods, and lines the direct comparisons between methods in the included randomized trials; circle size is proportional to the number of randomized patients treated by the corresponding method, and line thickness proportional to the number of randomized patients in comparisons between methods

differences in bowel function outcomes between straight CAA and transverse coloplasty at any time point. However, the FISI score at 4 months was lower for the transverse coloplasty group, with borderline significance ($P=0.05$). Stratilatovas and colleagues¹³ reported only an overall anal function score, demonstrating similar functional outcome for all three reconstruction procedures up to 24 months. Because of insufficient reporting, this trial has strong potential sources of bias.

Surgical outcome

Network meta-analysis and pairwise comparisons of anastomotic leakage

The network graphic is presented in Fig. 5, and the results of the network meta-analysis are summarized in Table 2. The overall ORs for side-to-end CAA *versus* colonic J pouch and straight CAA *versus* transverse coloplasty were 1.04 (95 per cent credible interval 0.38 to 2.25) and 1.14 (0.39 to 2.61) respectively. The overall ORs for transverse coloplasty and straight CAA compared separately with colonic J pouch and side-to-end CAA were all greater than 2. The ranking reflects these results, with colonic J pouch and side-to-end CAA higher than transverse coloplasty and straight CAA (colonic J pouch: 1.60, 95 per cent credible interval 1 to 3; side-to-end CAA: 1.58, 1 to 4; transverse coloplasty: 3.39, 2 to 4; straight CAA: 3.43,

Table 2 Odds ratios and ranking positions calculated by network meta-analysis for the surgical outcome anastomotic leakage

	Odds ratio
Side-to-end CAA <i>versus</i> colonic J pouch	1.04 (0.38, 2.25)
Transverse colectomy <i>versus</i> colonic J pouch	2.45 (1.00, 5.22)
Straight CAA <i>versus</i> colonic J pouch	2.49 (1.03, 5.17)
Transverse colectomy <i>versus</i> side-to-end CAA	2.91 (0.73, 8.23)
Straight CAA <i>versus</i> side-to-end CAA	2.94 (0.75, 8.17)
Straight CAA <i>versus</i> transverse colectomy	1.14 (0.39, 2.61)

Values in parentheses are 95 per cent credible intervals. Ranking positions (95 per cent credible intervals): colonic J pouch, 1.60 (1, 3); side-to-end coloanal anastomosis (CAA), 1.58 (1, 4); transverse colectomy, 3.39 (2, 4); straight CAA, 3.43 (2, 4). A Bayesian random-effects model with minimally informative prior distributions for trial baselines and treatment effects was used.

2 to 4) (Table 2). A sensitivity analysis excluding the trial by Ho and co-workers³³, which may have been biased by a potential learning curve, showed an approximation in the ranking of transverse colectomy towards side-to-end CAA and colonic J pouch. In summary, the risk of anastomotic leakage did not differ substantially between side-to-end CAA, colonic J pouch, transverse colectomy and straight CAA, and the 95 per cent credible intervals for transverse colectomy *versus* side-to-end CAA and straight CAA *versus* side-to-end CAA are wide. An inverse relationship cannot be excluded.

The results of the pairwise comparisons were in accordance with the results of the network meta-analysis and did not show any significant differences (Fig. 6).

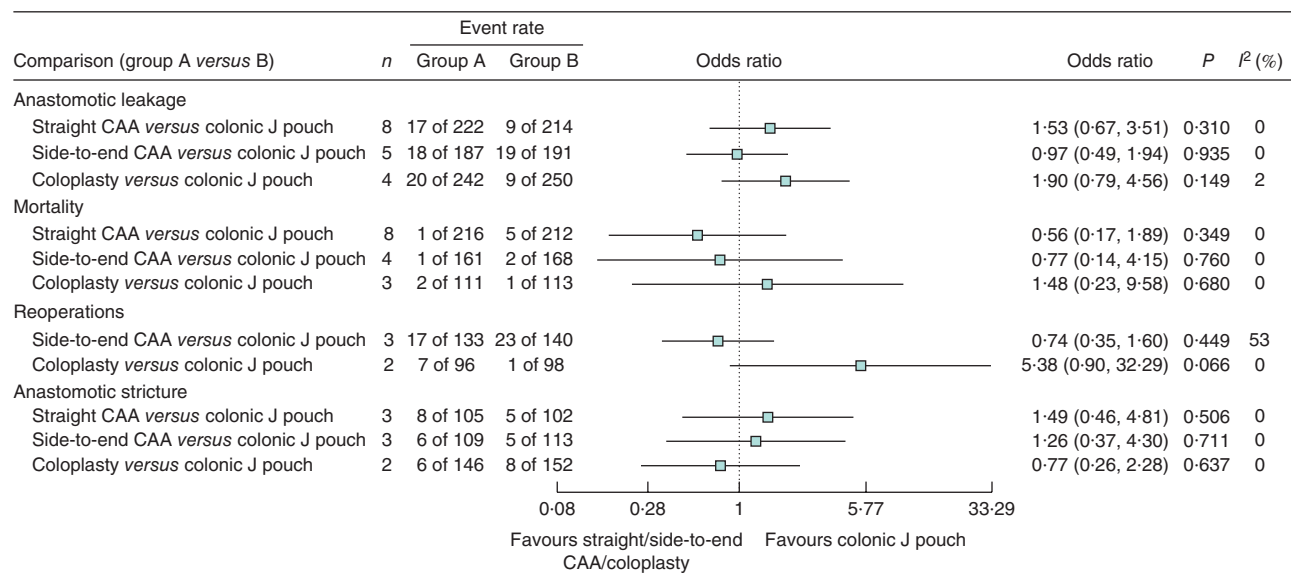
Pairwise comparisons of other surgical outcomes

No significant differences were found in the meta-analyses of postoperative/30-day mortality, anastomotic stricture and reoperations in any of the comparisons: straight CAA *versus* colonic J pouch, side-to-end CAA *versus* colonic J pouch and transverse colectomy *versus* colonic J pouch (Fig. 6).

Quality of life

Four trials provided QoL data for straight CAA *versus* colonic J pouch. Hallböök and co-workers, in a second report²⁷ on the same trial population, found no significant differences between groups in the mean Nottingham Health Profile score. Sailer *et al.*²⁴ reported a significantly better result in the domain 'global health status/QoL' of the European Organization for Research and Treatment of Cancer (EORTC) QLQ-C30 questionnaire at 3, 6 and 12 months after ileostomy closure in the colonic J pouch group. Fürst and colleagues⁴ found no significant differences in EORTC QLQ-C30 questionnaire results up to 6 months after surgery. There was significant superiority in all dimensions of the Fecal Incontinence Quality of Life (FIQL) score at 3 and 12 months (except 'embarrassment' at 12 months) after ileostomy closure for the colonic J pouch group in the trial by Park *et al.*²³.

Only Doeksen and colleagues¹⁰ compared QoL following side-to-end CAA *versus* colonic J pouch. The EORTC QLQ-CR38 and Short Form 36 (SF-36®; QualityMetric,

**Fig. 6** Summary of results of meta-analysis for surgical endpoints. Pooled effect estimates are shown with 95 per cent c.i. n, Number of randomized trials included; CAA, coloanal anastomosis

Lincoln, Rhode Island, USA) questionnaires showed no significant differences between the two groups at any time point.

Ho *et al.*³³ found no significant differences between transverse colectomy and colonic J pouch in the FIQL scale at 12 months after surgery. Fazio and colleagues¹¹ reported no significant differences between transverse colectomy and colonic J pouch in responses to the SF-36® questionnaire up to 2 years after surgery. Similarly, the comparison of straight CAA and transverse colectomy showed no differences in this trial up to 2 years.

Sensitivity analyses and funnel plots

Sensitivity analyses, excluding trials with unequal distribution of hand-sutured anastomosis, protective ileostomy/colostomy or high risk of bias, did not show any relevant changes in the overall effects of any of the meta-analyses (data not shown).

No formal tests for funnel plot asymmetry were conducted. However, some asymmetry in the funnel plots for stool frequency and anastomotic leakage cannot be ruled out. Therefore, a potential publication bias has to be considered when interpreting the meta-analyses.

Discussion

This study showed the superiority of colonic J pouch over straight CAA in functional outcomes for 1 year after surgery. The functional outcomes of side-to-end CAA and transverse colectomy were comparable to those of colonic J pouch. Therefore, the superiority of side-to-end CAA and transverse colectomy over straight CAA is assumed by indirect comparison, but the evidence is not sufficient for a final conclusion to be drawn. Overall, long-term data are sparse and so the quantitative analyses were not able to show superiority of any of the reconstruction techniques persisting for more than 1 year. Surgical outcomes (mortality, reoperations, anastomotic leakage and anastomotic stricture) did not differ significantly between any of the reconstructive techniques. Equally, the network meta-analysis for anastomotic leakage did not show a substantial advantage for any of the techniques.

With regard to the comparison of side-to-end CAA *versus* colonic J pouch, the most recent trial by Doeksen and colleagues¹⁰ showed significantly better stool frequency and incontinence for colonic J pouch. However, these differences were already present at baseline. Consequently, the authors stated that functional superiority of the colonic J pouch 'should be interpreted with caution, as it reflects the results of only 40 per cent of the patients randomized' owing to high complication and drop-out rates. They concluded that the trial 'does not support the preferred

use of the colonic J pouch, but justifies the choice of the side-to-end CAA'.

For transverse colectomy *versus* colonic J pouch, the results of the largest trial by Fazio and co-workers¹¹ could not be included in the pooled analyses because of incomplete outcome data reporting. These authors reported superiority of colonic J pouch over transverse colectomy. Even though this trial had the largest individual sample size, its shortcomings in reporting and the potential sources of bias have to be borne in mind when considering the results.

A possible factor that might influence the functional results is neoadjuvant radio/chemotherapy³⁶. Therefore, the distribution of neoadjuvant therapy in the individual comparison groups was analysed, showing equal rates. For quantification of this potential effect, individual patient data would be necessary, which were not available for the trials analysed here.

Some authors raised concerns about the safety of transverse colectomy in comparison with colonic J pouch³³, mainly because of a higher rate of anastomotic leakage after transverse colectomy. Ho and colleagues³³ reported a significantly higher anastomotic leakage rate of 16 per cent for transverse colectomy compared with 0 per cent in the colonic J pouch group. The latter rate may have been achieved by chance, because the rates reported in the literature are usually between 2 and 7 per cent, as confirmed by the other trials analysed^{4,22,24,28,30,31}. Furthermore, all leaks in the transverse colectomy group were located at the same site (anterior, just distal to the colectomy). This might be explained by an initial learning curve for the surgical technique, with the colectomy being too close to the coloanal anastomosis and thus compromising perfusion of the anterior neorectal wall. An RCT by Ulrich and colleagues³⁷ showed comparable leak rates of 8 per cent in 76 patients randomized to transverse colectomy and 73 patients randomized to colonic J pouch. This trial was not included in the present systematic review because it did not report functional outcomes. Nevertheless, the pooled analyses (Table 2, Fig. 6) showed similar leakage rates after transverse colectomy compared with the other reconstruction techniques. The other safety endpoints (anastomotic stricture, mortality and reoperations) did not show any differences between transverse colectomy and colonic J pouch. These results are in line with previous meta-analytical results^{8,38} and should finally eliminate the safety concerns about transverse colectomy.

Future research should focus on the evaluation of side-to-end CAA, transverse colectomy and colonic J pouch in trials with well defined and validated endpoints, and sufficient follow-up.

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Supporting information

Additional supporting information may be found in the online version of this article:

Appendix S1 MEDLINE search strategy (Word document)

Table S1 Baseline data for patients included in randomized clinical trials of straight coloanal anastomosis *versus* colonic J pouch (comparison 1) (Word document)

Table S2 Baseline data for patients included in randomized clinical trials of side-to-end coloanal anastomosis *versus* colonic J pouch (comparison 2) (Word document)

Table S3 Baseline data for patients included in randomized clinical trials of transverse coloplasty *versus* colonic J pouch (comparison 3) (Word document)

Table S4 Baseline data for patients included in randomized clinical trials of straight coloanal anastomosis *versus* transverse coloplasty *versus* colonic J pouch (comparison 4) (Word document)

Table S5 Baseline data for patients included in randomized clinical trials of straight coloanal anastomosis *versus* transverse coloplasty (comparison 5) (Word document)