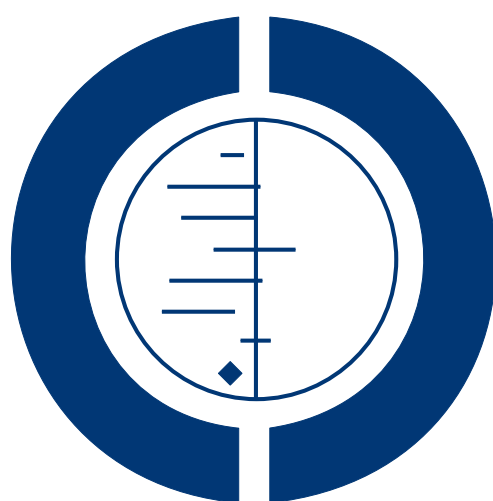


Stapled versus handsewn methods for colorectal anastomosis surgery (Review)

Neutzling CB, Lustosa SAS, Proenca IM, da Silva EMK, Matos D



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[Intervention Review]

Stapled versus handsewn methods for colorectal anastomosis surgery

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ABSTRACT

Background

Previous systematic reviews comparing stapled and handsewn colorectal anastomosis that are available in the medical literature have not shown either technique to be superior. An update of this systematic review was performed to find out if there are any data that properly answer this question.

Objectives

To compare the safety and effectiveness of stapled and handsewn colorectal anastomosis surgery. The following primary hypothesis was tested: the stapled technique is more effective because it decreases the level of complications.

Search methods

A computerized search was performed in the Cochrane Central Register of Controlled Trials (CENTRAL), MEDLINE, EMBASE according to the strategies of the Colorectal Cancer Group of The Cochrane Collaboration. There were no limits upon language, date or other criteria. A revised search strategy was performed for this updated version of the review May 2011.

Selection criteria

All randomised controlled trials (RCTs) in which stapled and handsewn colorectal anastomosis techniques were compared. Participants were adult patients undergoing elective colorectal anastomosis surgery. The interventions were endoluminal circular stapler and handsewn colorectal anastomosis surgery. Outcomes considered were a) mortality; b) overall anastomotic dehiscence; c) clinical anastomotic dehiscence; d) radiological anastomotic dehiscence; e) stricture; f) anastomotic haemorrhage; g) reoperation; h) wound infection; i) anastomosis duration; and j) hospital stay.

Data collection and analysis

Data were independently analysed by the two review authors (CBN, SASL) and cross-checked. The methodological quality of each trial was assessed by the same two authors. After searching the literature for this update, no study was added to those in the previous version of this review. Details of randomizations (generation and concealment), blinding, whether an intention-to-treat analysis was done or

not, and the number of patients lost to follow-up were recorded. The analysis of the risk of bias was updated according to the software Review Manager 5.1. The results of each RCT were summarized on an intention-to-treat basis in 2 x 2 tables for each outcome. External validity was defined by the characteristics of the participants, interventions and the outcomes. The RCTs were stratified according to the level of colorectal anastomosis. The risk difference (RD) method (random-effects model) and number needed to treat (NNT) for dichotomous outcome measures and weighted mean differences (WMD) for continuous outcomes measures, with the corresponding 95% confidence intervals (CI), were presented in this review. Statistical heterogeneity was evaluated using a funnel plot and the Chi² test.

Main results

Of the 1233 patients enrolled in nine identified trials, 622 were treated with staples and 611 with manual suture. The following main results were obtained.

- a) Mortality, result based on 901 patients: RD -0.6%, 95% CI -2.8% to +1.6%.
- b) Overall dehiscence, result based on 1233 patients: RD 0.2%, 95% CI -5.0% to +5.3%.
- c) Clinical anastomotic dehiscence, result based on 1233 patients: RD -1.4%, 95% CI -5.2 to +2.3%.
- d) Radiological anastomotic dehiscence, result based on 825 patients: RD 1.2%, 95% CI -4.8% to +7.3%.
- e) Stricture, result based on 1042 patients: RD 4.6%, 95% CI 1.2% to 8.1%; NNT 17, 95% CI 12 to 31.
- f) Anastomotic haemorrhage, result based on 662 patients: RD 2.7%, 95% CI -0.1% to +5.5%.
- g) Reoperation, result based on 544 patients: RD 3.9%, 95% CI 0.3% to 7.4%.
- h) Wound infection, result based on 567 patients: RD 1.0%, 95% CI -2.2% to +4.3%.
- i) Anastomosis duration, result based on one study (159 patients): WMD -7.6 minutes, 95% CI -12.9 to -2.2 minutes.
- j) Hospital stay, result based on one study (159 patients): WMD 2.0 days, 95% CI -3.27 to +7.2 days.

Authors' conclusions

The evidence found was insufficient to demonstrate any superiority of stapled over handsewn techniques in colorectal anastomosis surgery, regardless of the level of anastomosis. There were no randomised clinical trials comparing these two types of anastomosis in elective conditions in the last decade. The relevance of this research question has possibly lost its strength where elective surgery is concerned. However, in risk situations, such as emergency surgery, trauma and inflammatory bowel disease, new clinical trials are needed.

PLAIN LANGUAGE SUMMARY

The evidence found did not indicate superiority of stapled over handsewn technique in colorectal anastomosis, regardless of the anastomotic level.

The review with nine randomised controlled trials (1233 patients, 622 with stapling and 611 with the handsewing technique) compared the safety and effectiveness of stapled versus handsewn colorectal anastomosis surgery. Meta-analysis was performed using the risk difference and weighted mean difference, with corresponding 95% confidence intervals. Outcome measures were mortality, anastomotic dehiscence, narrowing (stricture), haemorrhage, need for reoperation, wound infection, anastomosis duration (time taken to perform the anastomosis) and hospital stay. No significant statistical differences were found except that stricture was more frequent with stapling ($P < 0.05$) and the time taken to perform the anastomosis was longer with handsewn techniques.

BACKGROUND

Since stapling instruments have been introduced into the current practice of surgery of the digestive tract, by Ravitch and Steichen ([Ravitch 1979](#)), the safety, usability and cost effectiveness of stapling has been questioned.

In colorectal surgery, the advantages of the stapled technique are said to be a lower percentage of complications, such as leaks, better blood supply, reduced tissue manipulation, less edema, uniformity of sutures and shorter hospital stay and operation time ([Korolija 2008](#)). A smaller number of leaks might be a factor in the lower incidence of both tumour recurrence and cancer-specific mortality ([Docherty 1995](#)).

The medical literature concerning the comparison of stapling and handsewn techniques is conflicting. The use of staplers for intra-peritoneal anastomosis has been questioned ([Beart 1991](#)). Systematic reviews have shown that both techniques are effective and the choice of technique may be based on personal preference ([MacRae 1998](#)) and local availability. Prospective and randomised trials have shown different results, shown by no significant inter-group difference found in regard to time for anastomosis construction or occurrence of complications in colorectal anastomosis ([Cajozzo 1990](#)); the routine use of stapling instruments for intra-peritoneal colorectal anastomosis could not be recommended because of a higher incidence of mishaps and strictures, even though the operation took less time to perform and anastomotic leakage occurred less often ([Fingerhut 1994](#)).

Taking into consideration the conflicting data available so far, an update of this systematic review comparing handsewn and stapled colorectal anastomosis surgery is needed.

OBJECTIVES

To compare the relative safety and effectiveness of stapled anastomosis with that of handsewn colorectal anastomosis surgery. The following primary hypothesis was tested: the stapled technique is more effective because it decreases the level of complications.

METHODS

Criteria for considering studies for this review

Types of studies

Randomized controlled trials.

Types of participants

Adults submitted electively to stapled and handsewn colorectal anastomosis. There was no stratification according to underlying disease.

Types of interventions

Endoluminal circular stapler using the models end-to-end anastomosis (EEA), disposable end-to-end anastomosis (DEEA) and intraluminal anastomosis (ILS); no restriction on the material and technique used for handsewn anastomosis surgery.

Types of outcome measures

- a) Specific mortality: number of in-hospital deaths due to anastomotic complications.
- b) Overall anastomotic dehiscence: total number of anastomotic dehiscences.
- c) Clinical anastomotic dehiscence: clinical dehiscence defined as a discharge of faeces from the anastomosis site.
- d) Radiological anastomotic dehiscence: presence of a leak with the control postoperative enema in a patient who had no evidence of clinical anastomotic leak.
- e) Stricture: narrowing in the bowel lumen due to anastomotic healing.
- f) Anastomotic haemorrhage: postoperative bleeding per anus from the anastomotic site.
- g) Reoperation: surgical re-intervention for anastomotic complication.
- h) Wound infection: defined as the presence of infection in the abdominal wound.
- i) Anastomosis duration: time to perform the anastomosis.
- j) Hospital stay: time from operation until discharge from the hospital.

Search methods for identification of studies

All publications describing (or which might describe) stapled versus handsewn colorectal anastomosis were sought through computerised searches of the Cochrane Central Register of Controlled Trials (CENTRAL) (May 2011), MEDLINE (1980 to 2011), EMBASE (1980 to 2011). For the search terms used please see [Appendix 1](#) (MEDLINE), [Appendix 2](#) (EMBASE) and [Appendix 3](#) (CENTRAL).

Data collection and analysis

Locating and selecting studies

Two review authors (CBN and SASL) independently selected the trials which were included in the review. Previous systematic reviews have been reviewed.

Critical appraisal of studies

The methodological quality of each trial was assessed by the same two review authors. Details of the randomizations method, blinding, whether an intention-to-treat analysis was performed, and the number of patients lost to follow-up were recorded. The risk of bias was stratified by CBN and EMKS according to the Cochrane Collaboration criteria (Higgins 2011).

Collecting data

Data were independently extracted by the review authors and cross-checked. The results of each trial were summarized on an intention-to-treat basis in 2 x 2 tables for each outcome. Only trials classified as randomised score A and B have been used in the review. In the analysis, trials of each type of suture (stapled or handsewn) and anatomical anastomotic site (extra or intraperitoneal) were stratified to assess whether there may be important differences between them.

The external validity of the studies has been assessed by analysis of the following.

Participants: category of disease (cancer, inflammatory disease, non-inflammatory disease), male and female, location and duration of study. The calculation of the sample size and the sample representativeness was also analysed.

Interventions: endoluminal circular stapler, models end-to-end anastomosis (EEA), disposable end-to-end anastomosis (DEEA) and intra-luminal anastomosis (ILS); no restriction was made on materials and techniques used for handsewn anastomosis surgery. Outcomes: a) mortality; b) overall anastomotic dehiscence; c) clinical anastomotic dehiscence; d) radiological anastomotic dehiscence; e) stricture; f) anastomotic haemorrhage; g) reoperation; h) wound infection; i) anastomosis duration; j) hospital stay.

Analysing and presenting results

The results of each RCT were summarized on an intention-to-treat basis in 2 x 2 tables for each outcome. External validity was defined by the characteristics of the participants, the interventions and the outcomes. The RCTs have been stratified according to the level of colorectal anastomosis. The risk difference (RD) method (random-effects model) and number needed to treat (NNT) for dichotomous outcome measures and weighted mean difference (WMD) for continuous outcomes measures, with the corresponding 95% confidence intervals (CI), have been presented in this review. Meta-analysis was performed using RevMan 2011.

Statistical heterogeneity in the results of the trials were assessed both by inspection of a graphical presentation (funnel plot: plotting the study weight or sample size [on the 'y' axis] against the odds ratio [on the 'x' axis]) and by calculating a test of heterogeneity (standard χ^2 test on N degrees of freedom, where N equals the number of trials contributing data minus one). Three possible reasons for heterogeneity were pre-specified: (i) that responses differed according to a difference in the quality of the trials; (ii) that responses differed according to sample size; (iii) that responses differed according to clinical heterogeneity. These have been assessed by looking at separate subgroups of trials. Clinical heterogeneity was assessed by the authors of this review (CBN, SASL and DM).

RESULTS

Description of studies

See: [Characteristics of included studies](#); [Characteristics of excluded studies](#).

In summary, nine studies were selected for this systematic review. They were published in English (six trials), French (two trials) and German (one trial). The aim of these studies was to compare stapled anastomosis performed with EEA, DEEA and ILS instruments (622 patients) versus handsewn anastomosis (611 patients); altogether (1231 patients) were submitted to elective operations and two patients were submitted to emergency operations.

The outcome measures analysed in the studies were:

- a) specific mortality (7 studies);
- b) overall anastomotic dehiscence (6 studies);
- c) clinical anastomotic dehiscence (9 studies);
- d) radiological anastomotic dehiscence (6 studies);
- e) stricture (7 studies);
- f) anastomotic haemorrhage (4 studies);
- g) reoperation (3 studies);
- h) wound infection (6 studies);
- i) anastomosis duration (1 study);
- j) hospital stay (1 study).

Risk of bias in included studies

The process of generation of random numbers was reported in six studies and concealment of allocation was kept until the time of the anastomotic procedure (the surgeon opened the envelope when he found out that both techniques were feasible) in seven studies; in two studies the allocation concealment was not reported. Blinding was not described in any study.

The follow up of the patients was confined to the period within hospital in three studies, for six to 10 months in three studies, for

more than a year in two studies, and was not described in one study.

Intention-to-treat analysis was applied in three studies for all outcome measures; in four studies the stricture anastomotic variable was not described using intention-to-treat analysis; in one study this principle was not used at all; in one study local recurrence was not evaluated according to the intention-to-treat principle.

A sample size calculation was described in three studies. The representativeness of the patients was reported in four studies. The learning curve for surgeons to perform stapled colorectal anastomosis was reported in four studies. Dropouts and withdrawals were reported for all outcome measures in one study, in three studies for stricture only, and were not described in four studies.

From the data available, the risk of bias of each study was stratified according to the risk of bias classification of the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2011).

Effects of interventions

Stapled versus handsewn

See comparison 01.00.00

Of the 1233 patients enrolled (09 trials), 622 were treated with stapled and 611 with handsewn anastomoses. The results of the comparison between patients assigned to stapled anastomosis with the patients assigned to the handsewn procedure are as follows.

a) Specific mortality (as a dichotomous outcome): this result was based on seven studies (901 patients); 2.4% (11 of 453 patients) versus 3.6% (16 of 448 patients); risk difference (random-effects model) -0.6% (95% CI -2.8% to 1.6%).

b) Overall dehiscence (as a dichotomous outcome): this result was based on nine studies (1233 patients); 13.0% (81 of 622 patients) versus 13.4% (82 of 611 patients); risk difference (random-effects model) 0.2% (95% CI -5.0% to 5.3%).

c) Clinical anastomotic dehiscence (as a dichotomous outcome): this result was based on nine studies (1233 patients); 6.3% (39 of 616 patients) versus 7.1% (44 of 617 patients); risk difference (random-effects model) -1.4% (95% CI -5.2% to 2.3%).

d) Radiological anastomotic dehiscence (as a dichotomous outcome): this result was based on six studies (825 patients); 7.8% (33 of 421 patients) versus 7.2% (30 of 414 patients); risk difference (random-effects model) 1.2% (95% CI -4.8% to 7.3%).

e) Stricture (as a dichotomous outcome): this result was based on seven studies (1042 patients); 8% (40 of 500 patients) versus 2% (10 of 496 patients); risk difference (random-effects model) 4.6% (95% CI 1.2% to 8.1%); NNT 17 (95% CI 12 to 31).

f) Anastomotic haemorrhage (as a dichotomous outcome): this result was based on four studies (662 patients); 5.4% (18 of 336 patients) versus 3.1% (10 of 326 patients); risk difference (random-effects model) 2.7% (95% CI -0.1% to 5.5%).

g) Reoperation (as a dichotomous outcome): this result was based on three studies (544 patients); 7.6% (21 of 278 patients) versus 4.1% (11 of 266 patients); risk difference (random-effects model) 3.9% (95% CI 0.3% to 7.4%).

h) Wound infection (as a dichotomous outcome): this result was based on six studies (567 patients), 5.9% (17 of 286) versus 4.3% (12 of 282); risk difference (random-effects model) 1.0% (95% CI -2.2% to 4.3%).

i) Anastomosis duration, time to complete the anastomosis (as a continuous outcome): this result was based on one study (159 patients); average value of -7.6 minutes (95% CI -12.9 to -2.2 minutes).

j) Hospital stay (as a continuous outcome): this result was based on one study (159 patients), average value of 2.0 days (95% CI -3.2 to 7.2 days).

The results were stratified according to level of anastomosis (intra versus extra-peritoneal) and are shown in the graphs.

DISCUSSION

When we performed a search on the available literature comparing manual and stapled suture techniques in colorectal elective surgery in order to update this systematic review we asked ourselves if this was a relevant question and do we have consolidated scientific evidence to sustain our current surgical routine?

The basic premise of this systematic review was that by grouping studies without statistical power but with adequate methodological quality, a sample large enough to detect any possible significant differences could be obtained. This was not observed, given that the majority (7/9) of the variables analysed were not significantly different. Perhaps this fact can be explained by insufficient overall sample sizes for demonstrating the magnitude of possible differences. This reinforces the necessity for periodic updating of this review.

It is possible that the results may in some way have been influenced by aspects of a learning curve related to differences in experience between surgeons participating in the included studies. In addition to this learning curve, another factor related to the results from colorectal anastomoses is the adequate functioning of the instrument used. In this systematic review, some authors (Beart 1991; Fingerhut 1994; McGinn 1985) analysed this aspect together with the experience of the surgeon. It is accepted that these two parameters, failure of instruments and experience of surgeons, should be analysed independently (Matos 1996).

Colorectal anastomoses have their healing progressively compromised the closer they are to the anal margin. In a prospective study of handsewn colorectal anastomosis in 370 patients, an incidence of fistula in supra-peritoneal anastomoses of 0.6% was seen, and

of 7.0% in infra-peritoneal anastomoses (Mann 1996). In a retrospective study of 219 patients submitted to radical anterior resection because of adenocarcinoma of the rectum, there was an incidence of 11%, all in anastomoses situated within 6 cm of the anal margin. The risk of complications is greater for infra-peritoneal, more distal and colorectal anastomoses (Karanjia 1994).

The classification criteria for colorectal anastomoses in relation to position were not uniform in the literature surveyed in this review. Thus, some authors refer to endoscopic measurements for classifying anastomoses (Beart 1991; Fingerhut 1994; Fingerhut 1995; McGinn 1985) while others classify anastomoses as high or low without referring to the criteria adopted (Kracht 1991). In fact, the heterogeneity of measures may lead to misinterpretation of some results in this review.

Various procedures may alter the security of a colorectal anastomosis. Protection colostomy (Mealy 1992), epiploplasty, complementary suturing and the performance or otherwise of an integrity test on the anastomosis (Beart 1991) are procedures frequently used by surgeons, but not in a uniform manner. In this review, the great majority of authors (8/9) used such procedures and this may have influenced the conclusions. Future trials and analyses should stratify for these variables.

The data relating to specific mortality show that clinical dehiscence was responsible for four deaths in the group sutured by stapling, and for two deaths in the handsewn group. The rate of anastomotic dehiscence, evaluated clinically and radiologically, was not significantly different between the two techniques of stapling and handsewing.

In various non-randomised studies, a greater incidence of stenosis has been attributed to the technique of stapling (Docherty 1995; Fain 1975; Heald 1981; Ravitch 1979; Shahinian 1980). In the present systematic review it was observed that the length of follow-up for assessing stenosis varied a lot between the different studies, which made comparison excessively difficult and may have made the overall result imprecise. Actuarial calculations, instead of crude ones, may be more appropriate in this context.

This systematic review has shown that stenosis occurs to a significant extent in patients undergoing stapled colorectal anastomosis, especially in infra-peritoneal anastomoses. This may be considered scientifically relevant in this review. However, the majority of the studies (7/9) considered this complication to be irrelevant from a clinical point of view, given the favourable outcome with conservative treatment in the great majority of cases. No patient in any series had to be re-operated on for anastomotic stenosis. Besides, the data favouring handsewn anastomosis regarding this outcome (stricture) in this review are the result of a single study for infra-peritoneal anastomosis, and so conclusions may be tendentious.

The time taken to perform the anastomosis was significantly shorter in colorectal anastomoses performed with the stapler than

for handsewn anastomoses. A limitation to the analysis of this variable was that only one study (Fingerhut 1995) provided data (average and standard deviation) that could be used for statistical analysis, just as we have seen in the stricture analysis.

The time taken to perform the anastomosis may, when analysed in isolation, have some importance. It may influence the total length of the operative procedure or hospitalisation of the patient. The other variables analysed did not demonstrate any advantage of one technique over the other.

The question of cost, which was not analysed in this review, is related to the length of the operative procedure, length of hospitalisation, price of sutures and the value of devices used, among other factors. This represents a variable of great importance, deserving special attention in studies with that specific objective. We also consider that a more detailed study of costs in this review would become necessary in the event of evidence that the stapling technique was more advantageous. When only the cost of the material used in the anastomosis is taken into consideration, the stapler is more expensive. The cost of an operative procedure, however, must be analysed within a wider context involving not only the monetary value of the materials but also the value resulting from the ease of execution, total time consumed, cost of complications related to the method employed among other factors.

In the literature review we found some studies comparing the stapling technique and manual suture in less ordinary conditions, such as trauma and other emergency situations. One of them was a randomised clinical trial (Catena 2004) and another was a prospective analysis (Demetriades 2002) and both advocate that the method of anastomosis does not affect the incidence of abdominal complications. More randomised clinical data are needed to support these results.

In the same way, a few clinical trials and non-randomised studies speculate that stapled anastomosis may have better outcomes in Crohn disease than manual suture (Resegotti 2005), and there are controversial results concerning the oncological outcome of the stapled anastomosis (Docherty 1995; Lovegrove 2006). These points remain unclear in this updated review of the available data.

The practical conclusion, from this systematic review, is that the evidence found was insufficient to demonstrate superiority of the stapler to handsewn anastomosis, independent of the level of anastomosis. The fact that few studies were found comparing those two techniques for elective colorectal anastomosis means, from our point of view, that the decision about which technique to use depends on clinical circumstances and available resources and is not currently decided for the coloproctological surgeon. However, we think this is still a very relevant question when we concern risk situations, such as trauma, inflammatory bowel disease, obstruction, etc. and a number of randomised trials exist to help answer this question.

AUTHORS' CONCLUSIONS

Implications for practice

The evidence found was insufficient to demonstrate any superiority of stapled over handsewn techniques in colorectal anastomosis surgery, regardless of the level of anastomosis. The choice of which technique is applied depends on the surgeon's personal preferences, clinical circumstances and available resources. There are no randomised clinical trials comparing these two types of anastomosis in elective surgery in the last decade. The relevance of this research question has possibly lost its strength where elective surgery is concerned. However, in risk situations, such as emergency surgery, trauma and inflammatory bowel disease, new clinical trials are needed.

Implications for research

From the results of this systematic review, we propose that the design of future trials should include the following.

- a) Objective: to compare the efficiency of handsewn and stapled supra and infra-peritoneal colorectal anastomosis separately.
- b) Design: Multicentre randomised controlled trial with adequate follow-up and analysis of anastomotic strictures. The intention-to-treat principle should be used with a full description of dropouts and withdrawals.
- d) Participants: consecutive elective patients.
- e) Intervention: anastomotic devices should be standardized. Sur-

gical interventions performed during the learning curve period should not be included.

f) Control group: use standardized techniques of handsewn colorectal anastomosis.

g) Factors influencing safety of anastomosis: take into account, and stratify for, ancillary procedures such as diverting colostomy, air-tightness test, oversewn and omental wrap as major factors influencing the safety of anastomosis.

h) Outcome measures: mortality, overall anastomotic dehiscence, clinical anastomotic dehiscence, radiological anastomotic dehiscence, stricture, anastomotic haemorrhage, reoperation, anastomosis duration and hospital stay.

i) Data analysis: with a sample size of 578 patients in each group, there will be 90% statistical power to detect a 50% reduction (0,1 to 0,05) in the clinical anastomotic dehiscence, with 95% confidence interval.

j) Compare the efficiency of handsewn and stapled colorectal anastomosis surgery in risk situations (emergency procedures for trauma, active inflammatory bowel disease, obstruction and others).

ACKNOWLEDGEMENTS

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* Indicates the major publication for the study

CHARACTERISTICS OF STUDIES

Characteristics of included studies [ordered by study ID]

Beart 1991

Methods	RCT	
Participants	1) Inclusion criteria: any patient requiring an anterior anastomosis 2) Type of disease: malignant=53, prolapse of the rectum=06, diverticulosis=11 3) Exclusion criteria: patients with cancer the rectum within 5 cm of the dentate line were excluded, but those with benign disease in this region were included 4) Type of anastomosis: end-to-end 5) Number of participants: 70, S=35, HS=35 6) Age: 64 (25-88) years, S=62, HS=65 7) Sex: not described 8) Location of study: Mayo Clinic and Mayo Foundation, Rochester, Minnesota, USA 9) Time of study: June 1978 to January 1980	
Interventions	1) Group S (n = 35): stapler, EEA 2) Group HS (n = 35): hand sewn with two layer	
Outcomes	1) wound infection 2) pelvic infection 3) anastomotic dehiscence 4) mortality 5) urinary infection, urinary retention, pneumonitis, phlebitis 6) time of anastomosis 7) duration of hospital stay 8) mishaps	
Notes	1) Sample size: not described 2) Representativity: not described 3) Intention to treat: done 4) Learning curve: after becoming familiar with the EEA stapler in the laboratory and though clinical use in performing 20 rectal anastomosis, they initiated a randomised prospective evaluation of the end-to-end stapler 5) Distance anastomosis and anal verge (cm): S= 9.4, HS=9.8 6) Dukes: not described 7) Factors influencing safety of anastomosis: loop colostomy 8) Others: not described 9) Follow up not described	
Risk of bias		
Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer randomizations sequence

Beart 1991 (Continued)

Allocation concealment (selection bias)	Low risk	At operation, if either anastomosis could be performed
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Not described
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Not described
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not described
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Not described
Selective reporting (reporting bias)	Low risk	All outcomes described

Elhadad 1990

Methods	RCT
Participants	1) Inclusion criteria: elective colorectal resection 2) Type of disease: neoplastic and diverticular disease 3) Exclusion criteria: emergency operator and inflammatory bowel disease 4) Type of anastomosis: end-to-end, end-to-side, side-to end 5) Number of participants: 272 S=139, HS=133 6) Age: not described 7) Sex: 135 men, 136 women 8) Location of study: 26 centres, Aulnay-sous-Bois, France 9) Time of study: not described
Interventions	1) Group S (n=139) stapler: EEA, DEEA and ILS 2) Group HS (n=133) interrupted or not interrupted suture
Outcomes	1) clinical leakage 2) radiological leakage 3) duration of anastomosis 4) duration of operation 5) haemorrhage 6) stricture 7) cost
Notes	11) Sample size: not described 2) Representativity: not described 3) Intention to treat: not described to stricture 4) Learning curve: not described

Elhadad 1990 (Continued)

	5) Distance anastomosis and anal verge(cm): not described 6) Dukes: not described 7) Factors influencing safety of anastomosis: diverting colostomy and omental wrap 8) Others: not described 9) Follow up not described	
<i>Risk of bias</i>		
Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Not described
Allocation concealment (selection bias)	Low risk	At operation, if either anastomosis could be performed
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Not described
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Not described
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not described
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Not described
Selective reporting (reporting bias)	Low risk	All outcomes described

Fingerhut 1994

Methods	RCT
Participants	1) Inclusion criteria: only patients who underwent immediate infra-peritoneal anastomosis after elective left colorectal resection. 2) Type of disease: carcinoma 102, S=46, HS=56; diverticulosis 9, S=7, HS=2; benign tumour 2, S=1, HS=1 3) Exclusion criteria: emergency procedure, colitis, reestablishment of continuity or supra peritoneal anastomosis 4) Anastomosis: end-to-end 57, S=37, HS=20; side-to-end 50, S=11, HS=39; end-to-side 6, S=6, HS=0 5) Number of participants: 113, S=54, HS=59 6) Age: 66.5 (30-87) years 7) Sex: 48 men, 65 women 8) Location of study: 24 different institutions, Bois-Colombe, France

Fingerhut 1994 (Continued)

	9) Time of study: May 1986-October 1988 10) Number of participants: 113 (48 male; 65 female) 11) Age: 67±12 years (range: 30 to 87 years) 12) Location of study: 24 different institutions (Bois-Colombe, France) 13) Time of study: May 1986 - October 1988
Interventions	Group HS (n=59): hand-sewn, one extra mucosal layer, with continuous or interrupted, with 3/0 polyglycolic acid or polyglactin in general
Outcomes	1) duration of anastomosis 2) duration of operation 3) duration of hospital stay 4) mortality 5) clinical leakage 6) radiological leakage 7) wound abscess 8) localized and generalized peritonitis 9) haemorrhage per anum 10) reoperation 11) mishaps 12) extra-abdominal complications 13) strictures
Notes	1) Sample size: the number of patients required was based on the hope of improving the rate of anastomotic failure from 15% to 5% with an a priori gamma risk at 5% according to the pragmatic method of Schwartz et al 2) Representativity: 113 consecutive patients 3) Intention to treat: done, except in stricture 4) Learning curve: all participating surgeons had at least 3 years experience with stapling devices and had accomplished at least 30 anastomoses 5) Distance anastomosis and anal verge cm: 6 (2-13) 6) Dukes carcinoma: 102, S=46, HS=46 A e B: 48, S=17, HS=31 C: 54, S=29, HS=25 Paliativo: 17, S=06, HS=11 7) Factors influencing safety of anastomosis: tested for air-tightness: 52, S=29, HS=23 leakage detected: 02, S=02, HS=0 extra sutures added: 01, S=01, HS=0 doughnuts verified: 49, S=49, HS=0 defect detected: 06 sutures added: 02 reanastomosis: 02 diverting colostomy: 28, S=13, HS=15 omental wrap: 25, S=08, HS=17 8) Others: all patients had mechanical colonic preparation and antibiotic prophylaxis 9) Follow up: 6-10 months
Risk of bias	

Fingerhut 1994 (Continued)

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Adequate: computerized random number tables.
Allocation concealment (selection bias)	Low risk	At operation, if either anastomosis could be performed
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Not described
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Not described
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not described
Incomplete outcome data (attrition bias) All outcomes	Low risk	Withdraws and dropouts: 11 patients (10.8%)
Selective reporting (reporting bias)	Low risk	All outcomes described

Fingerhut 1995

Methods	RCT
Participants	<p>1) Inclusion criteria: only patients who underwent immediate supra-peritoneal anastomosis after elective colorectal resection.</p> <p>2) Type of disease: carcinoma: 92, S=53, HS=39; diverticulosis: 56, S=28, HS=28; benign tumour: 11, S=04, HS=07</p> <p>3) Exclusion criteria: patients who were operated on for an emergency procedure, those with colitis or who had reestablishment of digestive continuity after Hartmann's procedure or patients undergoing ileocolonic, colocolonic, ileorectal or intra-peritoneal anastomosis</p> <p>4) Anastomosis: end-to-end: 82, S=40, HS=42; side-to-end: 72, S=41, HS=31; end-to-side: 05, S=04, HS=01</p> <p>5) Number of participants: 159, S=85, HS=74</p> <p>6) Age: 65.8 (33-99)</p> <p>7) Sex: 88 men, 71 women</p> <p>8) Location of study: 24 centres, Bois-Colombes, France</p> <p>9) Time of study: May 1986-October 1988</p>
Interventions	<p>Group S (n=85): stapler: EEA, DDEA and ILS</p> <p>Group HS (n=74): handsewn (one extra-mucosal layer with continuous or interrupted sutures, preferably using 3/0 polyglycolic acid or polyglactin sutures)</p>

Fingerhut 1995 (Continued)

Outcomes	1) clinical leakage 2) radiological leakage 3) wound abscess 4) deep abscess 5) generalized peritonitis 6) haemorrhage per anus 7) reoperation 8) extra-abdominal complications 9) mortality 10) mishaps 11) duration of anastomosis 12) duration of hospital stay 13) duration of operation	
Notes	1) Sample size: the number of patients required was based on the hope of improving the rate of anastomotic leakage from 12% (found in preceding studies) to 5% with a priori gamma risk set at 5% according to Schwartz's pragmatic method. However a posteriori gamma risk up to 15%. Seventh patients required in each group. 2) Representativity: 159 consecutive patients 3) Intention to treat: done, except in stricture 4) Learning curve: all participating surgeons had at least 3 years of experience with the stapling device and had accomplished at least 30 anastomosis. 5) Distance anastomosis and anal verge (cm): 11(6-20) 6) Dukes carcinoma: 92, S=53 HS=39 A e B: 25, S=13 HS=12 C: 53, S=31 HS=22 palliative: 14, S=09 HS=05 7) Factors influencing safety of anastomosis tested for air tightness: 63, S=47 HS=16 leakage detected: 05, S=04 HS=01 extra sutures added: 05, S=04 HS=01 dognuts verified: 83, S=83 HS=0 defect detected: 04, S=04 HS=0 sutures added: 03, S=03 HS=0 reanastomosis: 03, S=03 HS=0 doughnuts not verified: 02, S=02 HS=0 diverting colostomy: 09, S=04 HS=05 omental wrap: 28, S=14 HS=16 8) Others: all patients had mechanical colonic preparation and antibiotic prophylaxis *a: one leakage (R) occurred even though extra sutures had been added. *b: in 2 sutures were added fist and than judged to be insufficient. *c: all these anastomoses were redone mechanically with one ensuing post-operative leak 9) Follow up: 8 months	
Risk of bias		
Bias	Authors' judgement	Support for judgement

Fingerhut 1995 (Continued)

Random sequence generation (selection bias)	Low risk	Adequate: computerized random number tables.
Allocation concealment (selection bias)	Low risk	At operation, if either anastomosis could be performed
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Not described
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Not described
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not described
Incomplete outcome data (attrition bias) All outcomes	Low risk	Withdraws and dropouts: 5 patients (3.2%)
Selective reporting (reporting bias)	Low risk	All outcomes described

Gonzalez 1987

Methods	RCT
Participants	1) Inclusion criteria: only the elective operations performed in patients with tumours located 5 to 15 cm above the anal verge 2) Type of disease: rectal cancer 3) Exclusion criteria: not described 4) Type of anastomosis: end-to-end 5) Number of participants: 113, S=55 HS=58 6) Age: 59, S=61 HS=58 7) Sex: not described 8) Location of study: Madrid, Spain 9) Time of study: from 1979 to 1985
Interventions	1) Group S (n=55): stapler EEA 2) Group HS (n=58): handsewn
Outcomes	1) general complications 2) infectious complications 3) mortality 4) clinical leakage 5) radiological leakage 6) local recurrence

Gonzalez 1987 (Continued)

Notes	1) Sample size: not described 2) Representativity: consecutive patients 3) Intention to treat: done 4) Learning curve: not described 5) Distance anastomosis and anal verge(cm): S=4.2 HS=3.2 6) Dukes: A=12, S=08 HS=04 B=52, S=23 HS=29 C=41, S=20 HS= 21 D=08, S=04 HS=04 7) Factors influencing safety of anastomosis: not described 8) Others: not described 9) Follow up: 3 years at least	
<i>Risk of bias</i>		
Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Not described
Allocation concealment (selection bias)	Unclear risk	Not described
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Not described
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Not described
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not described
Incomplete outcome data (attrition bias) All outcomes	Low risk	Withdraws and dropouts: none
Selective reporting (reporting bias)	Low risk	All outcomes described

Kracht 1991

Methods	RCT
Participants	1) Inclusion criteria: all patients submitted to elective colorectal resection 2) Type of disease: neoplastic and diverticular disease 3) Exclusion criteria: emergency operation and inflammatory bowel disease 4) Type of anastomosis: end-to-end, end-to-side, side-to-end 5) Number of participants: 268, S=137 HS=131

Kracht 1991 (Continued)

	6) Age: not described 7) Sex: not described 8) Location of study: Bois-Colombes, France 9) Time of study: not described	
Interventions	1) Group S(n=137): stapler EEA, DEEA and ILS 2) Group HS (n=131): interrupted or not interrupted suture	
Outcomes	1) clinical leakage 2) mortality 3) stricture	
Notes	1) Sample size: anastomotic dehiscence: improving the results from 10% to 5%, gamma risk of 5% 2) Representativity: not described 3) Intention to treat: done, except in stricture 4) Learning curve: not described 5) Distance anastomosis and anal verge cm: not described 6) Dukes: not described 7) Factors influencing safety of anastomosis: diverting colostomy and omental wrap 8) Others: mechanical bowel preparation, fibreless diet, antibiotic prophylaxis	
<i>Risk of bias</i>		
Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Generation sequence process not described
Allocation concealment (selection bias)	Unclear risk	Not described
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Not described
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Not described
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not described
Incomplete outcome data (attrition bias) All outcomes	Low risk	Dropout of 09 patients (3.5%)
Selective reporting (reporting bias)	Low risk	All outcomes described

McGinn 1985

Methods	RCT	
Participants	1) Inclusion criteria: low colorectal anastomosis in elective, except in 02 (two) cases, S=01 HS=01 2) Type of disease: carcinoma 107, S=51 HS=56, diverticular disease 10(07/03), endometriosis 01, S=0 HS=01 3) Exclusion criteria: higher anastomosis 4) Anastomosis: end-to-end 5) Number of participants: 118, S=58 HS=60 6) Age: 66.5 (37-85) years 7) Sex: 60 men, 58 women 8) Location of study: South Hamptom General Hospital, United Kingdom 9) from September 1979 to 1984	
Interventions	1) Group S (n=58): stapler EEA and ILS 2) Group HS (n=60): single layer, interrupted extra-mucosal (3.0 braided polyamide)	
Outcomes	1) mishaps 2) clinical leakage 3) radiological leakage 4) wound infection 5) colostomy 6) rectal haemorrhage 7) duration of surgery 8) duration of hospital stay 9) cost 10) mortality	
Notes	1) Sample size: not described 2) Representativity: 118 consecutive patients 3) Intention to treat: it's done 4) Learning curve: senior registrars performed 24 of the 118 operations 5) Distance anastomosis and anal verge (cm): 3.5-5.0 (43, S=22 HS=21) 5.5-8.0 (54, S=26 HS=28); 8.5-11 (21, S=10 HS=11) 6) Dukes: not described 7) Factors influencing safety of anastomosis: hydro pneumatic test, oversewn and colostomies 8) Others: mechanical colonic preparation and antibiotic prophylaxis 9) Follow up: intra-hospital	
Risk of bias		
Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Not described
Allocation concealment (selection bias)	Low risk	At operation, if either anastomosis could be performed

McGinn 1985 (Continued)

Blinding (performance bias and detection bias) All outcomes	Unclear risk	Not described
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Not described
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not described
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Not described
Selective reporting (reporting bias)	Low risk	All outcomes described

Sarker 1994

Methods	RCT
Participants	1) Inclusion criteria: cancer of the rectum judged to be resectable and located more than 6 cm from the anal verge 2) Type of disease: adenocarcinoma rectum 3) Exclusion criteria: not described 4) Type of anastomosis: end-to-end 5) Number of participants: 60, S=30 HS=30 6) Age: 60 (24-76) years 7) Sex: 49 men, 11 women 8) Location of study: Army Reserch-Referral Hospital New Delhi, India 9) Time of study: from 1984 to 1990
Interventions	Group S (n=30): stapler EEA Group HS (n=30): two layers using 3/0 silk
Outcomes	1) time of anastomosis 2) clinical leak 3) radiological leak 4) wound infection 5) local recurrence
Notes	1) Sample size: not described 2) Representativiy: not described 3) Intention to treat: done, except in local recurrence 4) Learning curve: not described 5) Distance anastomosis and anal verge: 6) Dukes: A=04, S=02 HS=02 B=40, S=19 HS=21

Sarker 1994 (Continued)

	C= 09, S=05 HS=04 D=07, S=04 HS=03 7) Factors influencing safety of anastomosis: hydro pneumatic test 8) Others: bowel preparation, low residue diet and antibiotic 9) Length of follow up: 1 to 7 years	
<i>Risk of bias</i>		
Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Generation sequence process not described
Allocation concealment (selection bias)	Unclear risk	Not described
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Not described
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Not described
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not described
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Not described
Selective reporting (reporting bias)	Low risk	All outcomes described

Thiede 1984

Methods	RCT
Participants	1) Inclusion criteria: elective colorectal resection 2) Type of disease: neoplastic and diverticular disease 3) Exclusion criteria: not described 4) Type of anastomosis: end-to-end 5) Number of participants: 60, S=29 HS=31 6) Age: not described 7) Sex: 30 men, 30 women 8) Location of study: Cristian-Albrechts-Universitat Kiel, Kiel, Germany 9) Time of study: December 1979-January 1982
Interventions	1) Group S (n=29): stapler EEA 2) Group HS (n=31): handsewn with two layer?

Thiede 1984 (Continued)

Outcomes	1) clinical leakage 2) stricture 3) mortality 4) wound infection	
Notes	1) Sample size: not described 2) Representativity: not described 3) Intention to treat: not done 4) Learning curve: not described 5) Distance anastomosis and anal verge: not described 6) Dukes: not described 7) Factors influencing safety of anastomosis: not described 8) Others: not described	
<i>Risk of bias</i>		
Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Adequate: random number table
Allocation concealment (selection bias)	Low risk	At operation, if either anastomosis could be performed
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Not described
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Not described
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not described
Incomplete outcome data (attrition bias) All outcomes	High risk	Withdraws and dropouts: 13 (31.7%)
Selective reporting (reporting bias)	Low risk	All outcomes described

Characteristics of excluded studies *[ordered by study ID]*

Study	Reason for exclusion
Bocassanta 2006	Concerns anorectal anastomosis.
Cajozzo 1990	Inclusion criteria are very wide: right sided anastomoses were included
Catena 2004	Only colorectal anastomoses in emergency patients were included
Choy 2007	Concerns right sided anastomosis (ileocolic anastomosis).
Demetriades 2002	Retrospective study, no randomisation was done.
Didolkar 1985	Inclusion criteria are very wide: right sided anastomoses were included
Everett 1986	The authors selected only colorectal anastomosis over 12 cm above the dentate line
Fukunaga 2007	A novel technique is also included in the comparison.
Ikeuchy 2000	Inclusion criteria were wide: not only colorectal anastomoses included
Korolija 2008	Inclusion criteria are very wide: all anastomosis of gastrointestinal tract were included
Laurent 2005	Concerns ileoanal anastomosis.
Lovegrove 2006	Concerns ileoanal anastomosis.
McLeod 2009	Concerns ileocolic anastomosis.
Nakagoe 2005	Concerns coloanal anastomosis.
Papp 2007	Retrospective analysis, no randomisation was done.
Reiling 1980	Inclusion criteria are very wide: all anastomosis of gastrointestinal tract were included
Resegotti 2005	Concerns ileoanal anastomosis.
Shelygin 2010	The comparison of the types of suture were about the ileostomy closure, not the colorectal anastomosis
West 1991	Colorectal anastomosis in emergency patients were included.
Wrighton 2008	Our inclusion criteria accepts only adults.

DATA AND ANALYSES

Comparison 1. All studies

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 mortality	7	901	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.69 [0.32, 1.49]
1.1 INFRAPERITONEAL ANASTOMOSIS	2	231	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.64 [0.16, 2.67]
1.2 SUPRAPERITONEAL ANASTOMOSIS	2	229	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.78 [0.18, 17.29]
1.3 COLORECTAL ANASTOMOSIS	3	441	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.60 [0.22, 1.61]
2 overall dehiscence	9	1233	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.99 [0.71, 1.40]
2.1 INFRAPERITONEAL ANASTOMOSIS	2	231	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.88 [0.97, 3.63]
2.2 SUPRAPERITONEAL ANASTOMOSIS	3	289	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.03 [0.42, 2.53]
2.3 COLORECTAL ANASTOMOSIS	4	713	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.74 [0.47, 1.15]
3 clinical dehiscence	9	1233	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.80 [0.51, 1.24]
3.1 INFRAPERITONEAL ANASTOMOSIS	3	344	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.74 [0.36, 1.55]
3.2 SUPRAPERITONEAL ANASTOMOSIS	4	448	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.97 [0.34, 2.74]
3.3 COLORECTAL ANASTOMOSIS	3	441	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.79 [0.41, 1.51]
4 radiological dehiscence	6	835	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.10 [0.66, 1.85]
4.1 INFRAPERITONEAL ANASTOMOSIS	2	231	Peto Odds Ratio (Peto, Fixed, 95% CI)	2.04 [0.92, 4.50]
4.2 SUPRAPERITONEAL ANASTOMOSIS	2	219	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.34 [0.50, 3.61]
4.3 COLORECTAL ANASTOMOSIS	2	385	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.38 [0.15, 0.98]
5 stricture	7	996	Peto Odds Ratio (Peto, Fixed, 95% CI)	3.59 [2.02, 6.35]
5.1 INFRAPERITONEAL ANASTOMOSIS	1	102	Peto Odds Ratio (Peto, Fixed, 95% CI)	3.90 [1.06, 14.30]
5.2 SUPRAPERITONEAL ANASTOMOSIS	2	214	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.75 [0.34, 8.92]
5.3 COLORECTAL ANASTOMOSIS	4	680	Peto Odds Ratio (Peto, Fixed, 95% CI)	3.99 [2.00, 7.96]
6 hemorrhage	4	662	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.78 [0.84, 3.81]
6.1 INFRAPERITONEAL ANASTOMOSIS	2	231	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.86 [0.22, 3.31]
6.2 SUPRAPERITONEAL ANASTOMOSIS	1	159	Peto Odds Ratio (Peto, Fixed, 95% CI)	6.82 [1.15, 40.41]
6.3 COLORECTAL ANASTOMOSIS	1	272	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.74 [0.59, 5.09]

7 reoperation	3	544	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.94 [0.95, 3.98]
7.1 INFRAPERITONEAL ANASTOMOSIS	1	113	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.60 [0.48, 5.27]
7.2 SUPRAPERITONEAL ANASTOMOSIS	1	159	Peto Odds Ratio (Peto, Fixed, 95% CI)	6.73 [0.93, 48.93]
7.3 COLORECTAL ANASTOMOSIS	1	272	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.62 [0.59, 4.44]
8 wound infection	6	568	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.43 [0.67, 3.04]
8.1 INFRAPERITONEAL ANASTOMOSIS	2	231	Peto Odds Ratio (Peto, Fixed, 95% CI)	2.43 [0.68, 8.68]
8.2 SUPRAPERITONEAL ANASTOMOSIS	3	289	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.08 [0.40, 2.92]
8.3 COLORECTAL ANASTOMOSIS	1	48	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.0 [0.06, 16.47]
9 anastomosis duration	1	159	Mean Difference (IV, Fixed, 95% CI)	-7.60 [-12.92, -2.28]
9.1 INFRAPERITONEAL ANASTOMOSIS	0	0	Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
9.2 SUPRAPERITONEAL ANASTOMOSIS	1	159	Mean Difference (IV, Fixed, 95% CI)	-7.60 [-12.92, -2.28]
9.3 COLORECTAL ANASTOMOSIS	0	0	Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
10 hospital stay	1	159	Mean Difference (IV, Fixed, 95% CI)	2.0 [-3.27, 7.27]
10.1 INFRAPERITONEAL ANASTOMOSIS	0	0	Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
10.2 SUPRAPERITONEAL ANASTOMOSIS	1	159	Mean Difference (IV, Fixed, 95% CI)	2.0 [-3.27, 7.27]
10.3 COLORECTAL ANASTOMOSIS	0	0	Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]

Comparison 2. Studies with adequate allocation concealment

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 mortality	6	788	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.50 [0.21, 1.20]
1.1 INFRAPERITONEAL ANASTOMOSIS	2	231	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.64 [0.16, 2.67]
1.2 SUPRAPERITONEAL ANASTOMOSIS	2	229	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.78 [0.18, 17.29]
1.3 COLORECTAL ANASTOMOSIS	2	328	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.28 [0.08, 0.99]
2 overall dehiscence	7	1060	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.99 [0.68, 1.43]
2.1 INFRAPERITONEAL ANASTOMOSIS	2	231	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.88 [0.97, 3.63]
2.2 SUPRAPERITONEAL ANASTOMOSIS	2	229	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.26 [0.39, 4.03]
2.3 COLORECTAL ANASTOMOSIS	3	600	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.66 [0.41, 1.08]

3 clinical dehiscence	6	1051	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.71 [0.44, 1.14]
3.1 INFRAPERITONEAL ANASTOMOSIS	3	503	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.56 [0.32, 0.97]
3.2 SUPRAPERITONEAL ANASTOMOSIS	3	501	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.47 [0.59, 3.62]
3.3 COLORECTAL ANASTOMOSIS	1	47	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.13 [0.00, 6.54]
4 radiological dehiscence	4	662	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.03 [0.59, 1.81]
4.1 INFRAPERITONEAL ANASTOMOSIS	2	231	Peto Odds Ratio (Peto, Fixed, 95% CI)	2.04 [0.92, 4.50]
4.2 SUPRAPERITONEAL ANASTOMOSIS	1	159	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.32 [0.37, 4.75]
4.3 COLORECTAL ANASTOMOSIS	1	272	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.27 [0.10, 0.76]
5 stricture	5	826	Peto Odds Ratio (Peto, Fixed, 95% CI)	3.86 [2.03, 7.36]
5.1 INFRAPERITONEAL ANASTOMOSIS	1	102	Peto Odds Ratio (Peto, Fixed, 95% CI)	3.90 [1.06, 14.30]
5.2 SUPRAPERITONEAL ANASTOMOSIS	1	154	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.75 [0.34, 8.92]
5.3 COLORECTAL ANASTOMOSIS	3	570	Peto Odds Ratio (Peto, Fixed, 95% CI)	4.74 [2.06, 10.90]
6 hemorrhage	4	662	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.78 [0.84, 3.81]
6.1 INFRAPERITONEAL ANASTOMOSIS	2	231	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.86 [0.22, 3.31]
6.2 SUPRAPERITONEAL ANASTOMOSIS	1	159	Peto Odds Ratio (Peto, Fixed, 95% CI)	6.82 [1.15, 40.41]
6.3 COLORECTAL ANASTOMOSIS	1	272	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.74 [0.59, 5.09]
7 reoperation	3	544	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.94 [0.95, 3.98]
7.1 INFRAPERITONEAL ANASTOMOSIS	1	113	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.60 [0.48, 5.27]
7.2 SUPRAPERITONEAL ANASTOMOSIS	1	159	Peto Odds Ratio (Peto, Fixed, 95% CI)	6.73 [0.93, 48.93]
7.3 COLORECTAL ANASTOMOSIS	1	272	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.62 [0.59, 4.44]
8 wound infection	5	508	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.21 [0.49, 2.95]
8.1 INFRAPERITONEAL ANASTOMOSIS	2	231	Peto Odds Ratio (Peto, Fixed, 95% CI)	2.43 [0.68, 8.68]
8.2 SUPRAPERITONEAL ANASTOMOSIS	2	229	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.54 [0.13, 2.19]
8.3 COLORECTAL ANASTOMOSIS	1	48	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.0 [0.06, 16.47]
9 anastomosis duration	1	159	Mean Difference (IV, Fixed, 95% CI)	-7.60 [-12.92, -2.28]
9.1 INFRAPERITONEAL ANASTOMOSIS	0	0	Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
9.2 SUPRAPERITONEAL ANASTOMOSIS	1	159	Mean Difference (IV, Fixed, 95% CI)	-7.60 [-12.92, -2.28]
9.3 COLORECTAL ANASTOMOSIS	0	0	Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
10 hospital stay	1	159	Mean Difference (IV, Fixed, 95% CI)	2.0 [-3.27, 7.27]

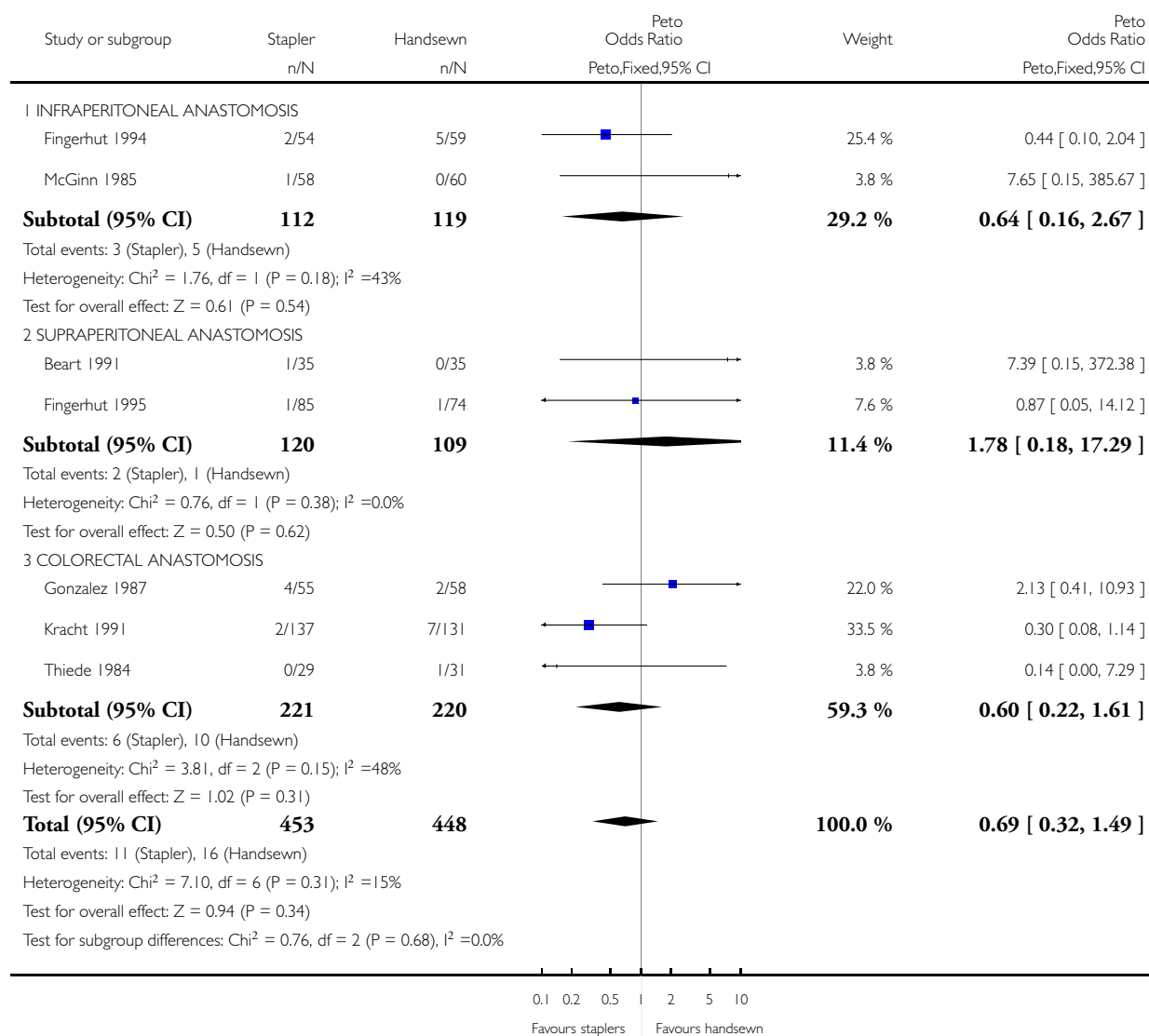
10.1 INFRAPERITONEAL ANASTOMOSIS	0	0	Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
10.2 SUPRAPERITONEAL ANASTOMOSIS	1	159	Mean Difference (IV, Fixed, 95% CI)	2.0 [-3.27, 7.27]
10.3 COLORECTAL ANASTOMOSIS	0	0	Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]

Analysis 1.1. Comparison 1 All studies, Outcome 1 mortality.

Review: Stapled versus handsewn methods for colorectal anastomosis surgery

Comparison: 1 All studies

Outcome: 1 mortality

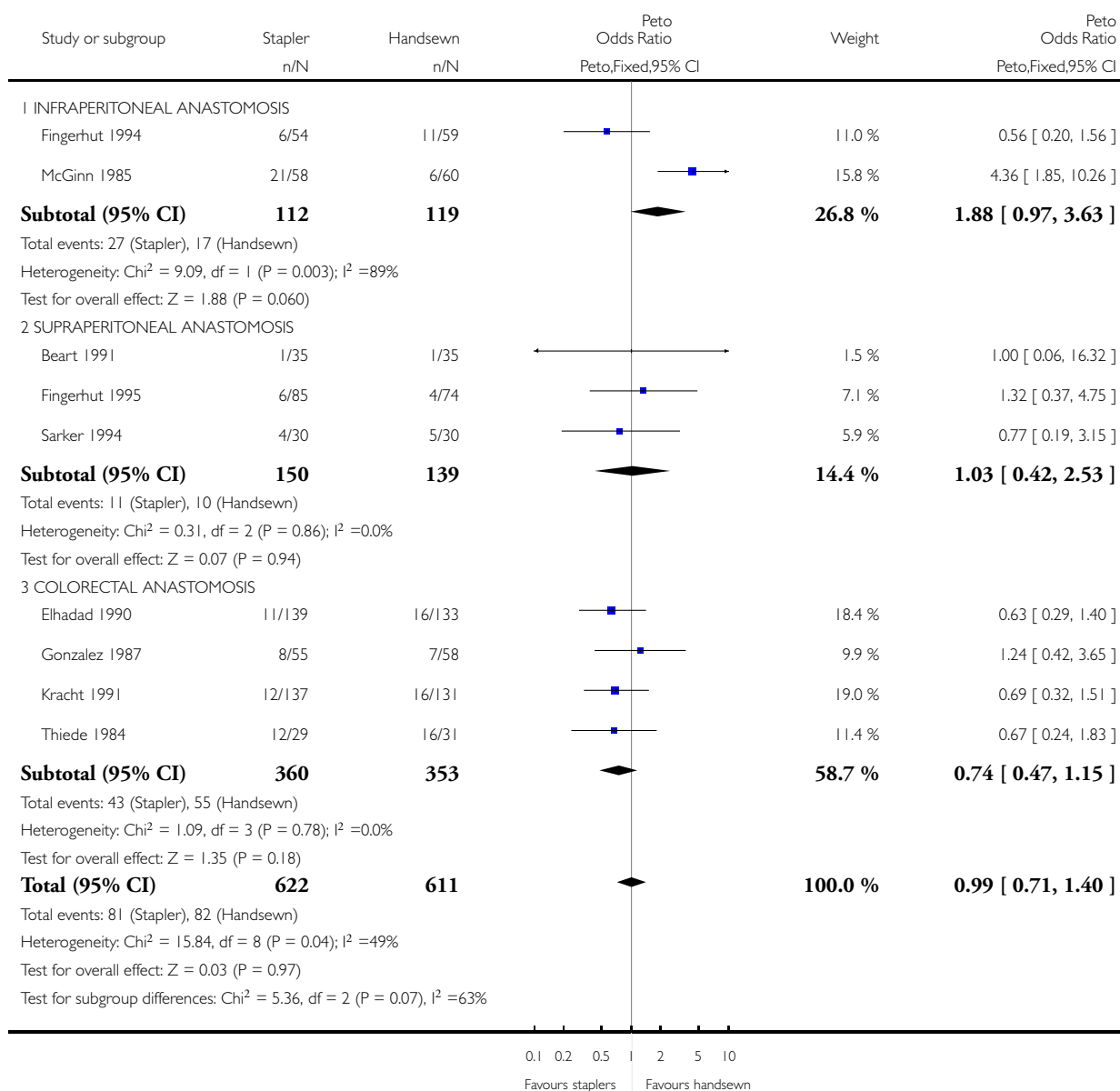


Analysis 1.2. Comparison 1 All studies, Outcome 2 overall dehiscence.

Review: Stapled versus handsewn methods for colorectal anastomosis surgery

Comparison: 1 All studies

Outcome: 2 overall dehiscence

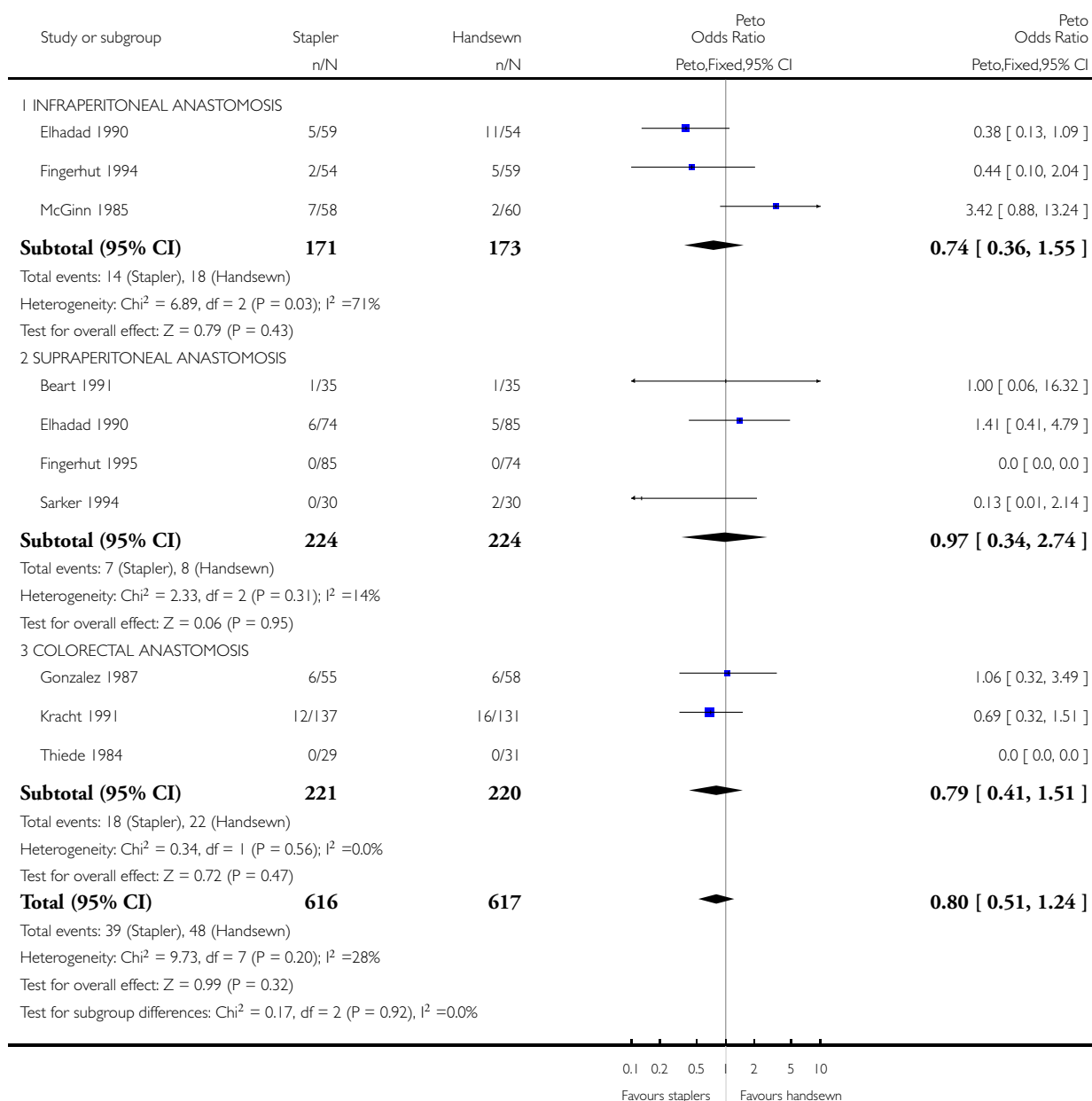


Analysis I.3. Comparison I All studies, Outcome 3 clinical dehiscence.

Review: Stapled versus handsewn methods for colorectal anastomosis surgery

Comparison: I All studies

Outcome: 3 clinical dehiscence

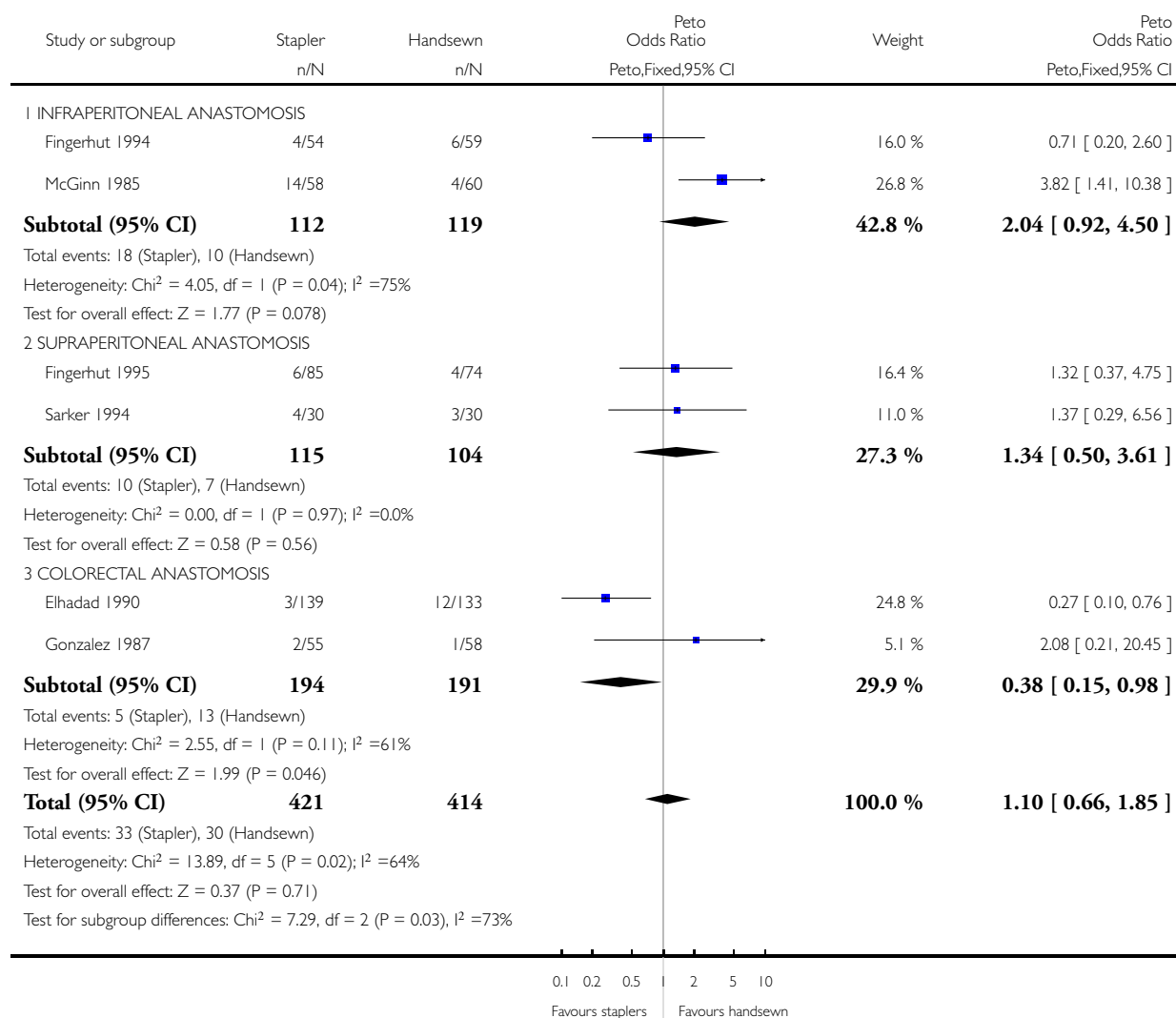


Analysis 1.4. Comparison 1 All studies, Outcome 4 radiological dehiscence.

Review: Stapled versus handsewn methods for colorectal anastomosis surgery

Comparison: 1 All studies

Outcome: 4 radiological dehiscence

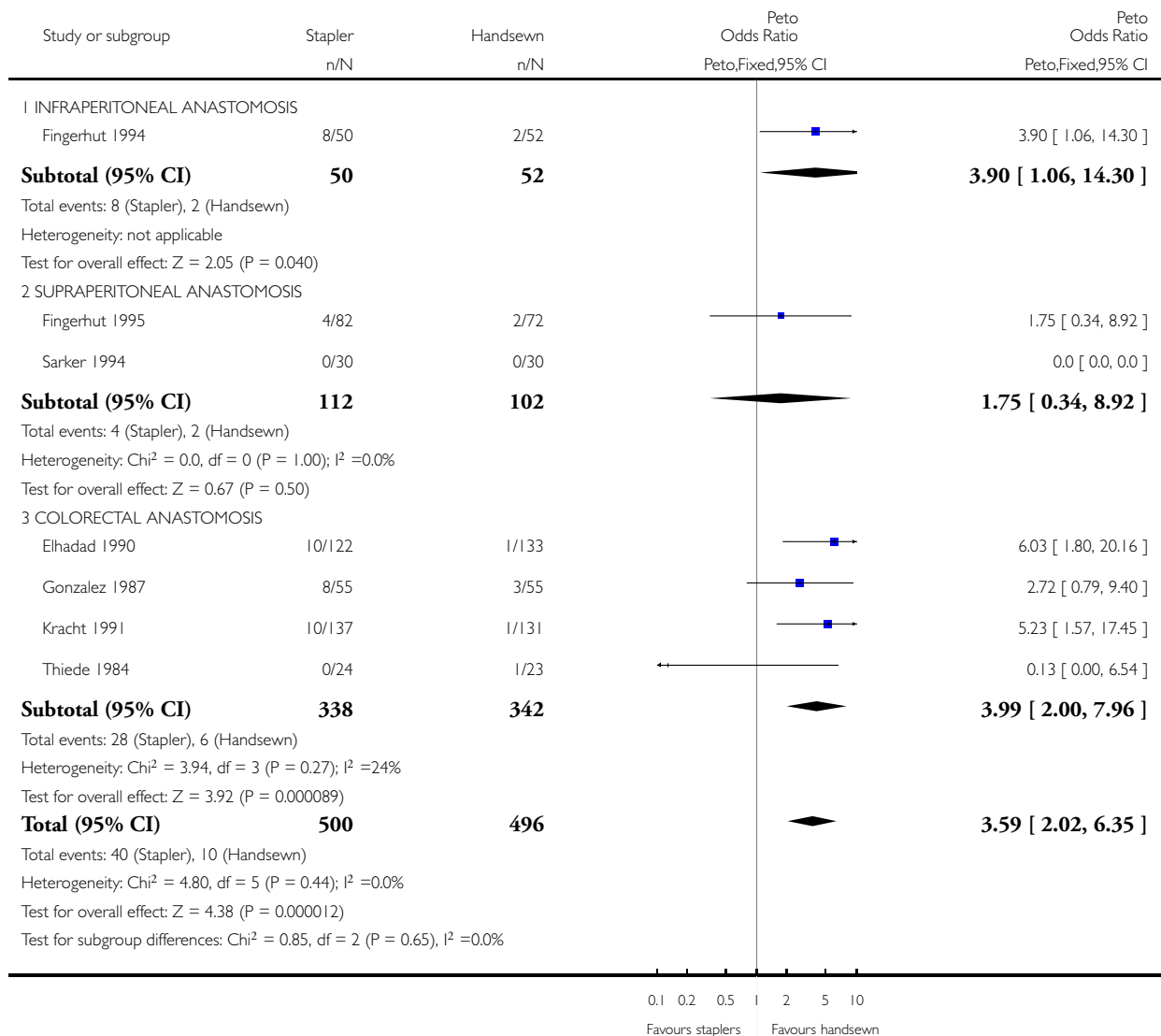


Analysis 1.5. Comparison 1 All studies, Outcome 5 stricture.

Review: Stapled versus handsewn methods for colorectal anastomosis surgery

Comparison: 1 All studies

Outcome: 5 stricture

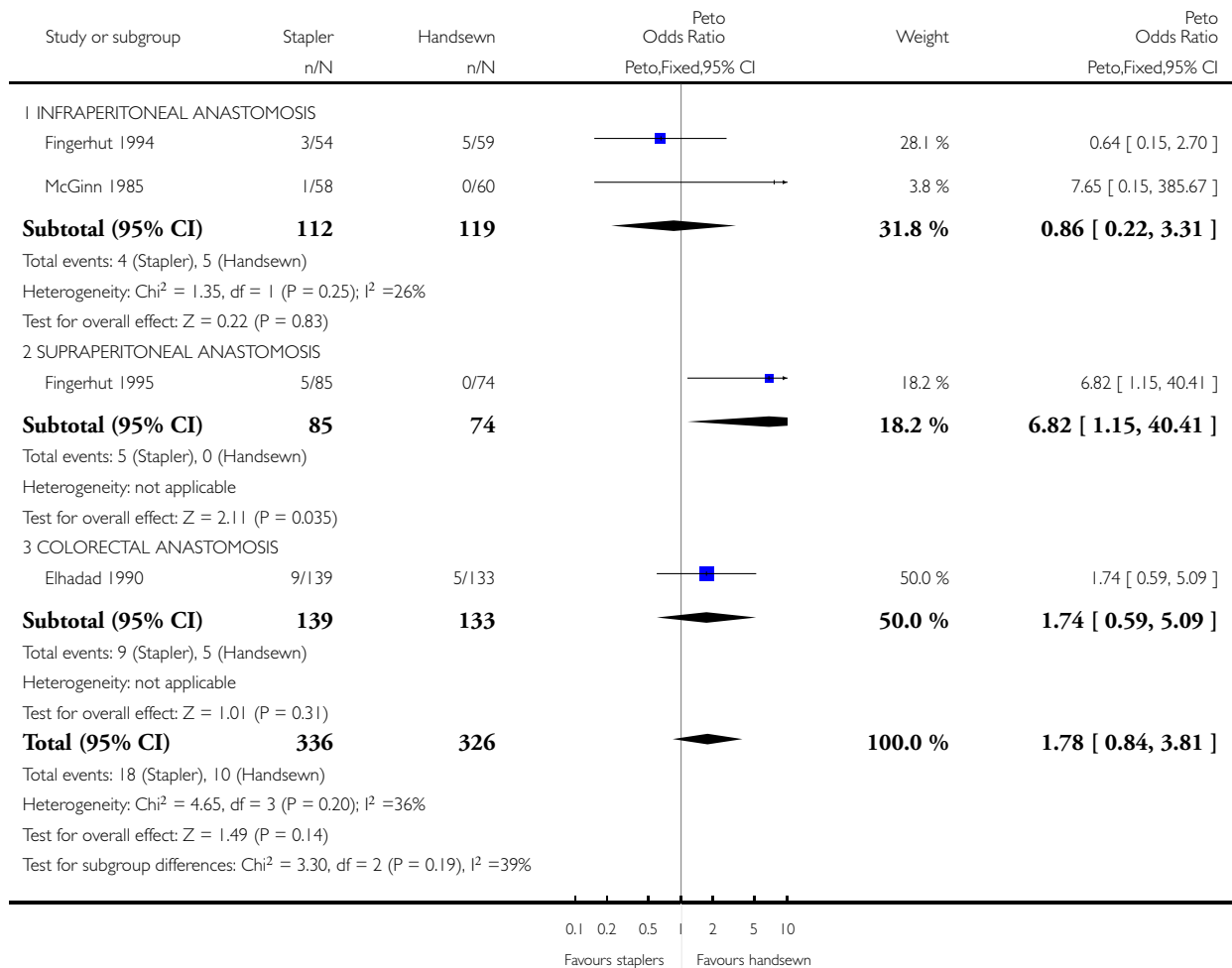


Analysis 1.6. Comparison 1 All studies, Outcome 6 hemorrhage.

Review: Stapled versus handsewn methods for colorectal anastomosis surgery

Comparison: 1 All studies

Outcome: 6 hemorrhage

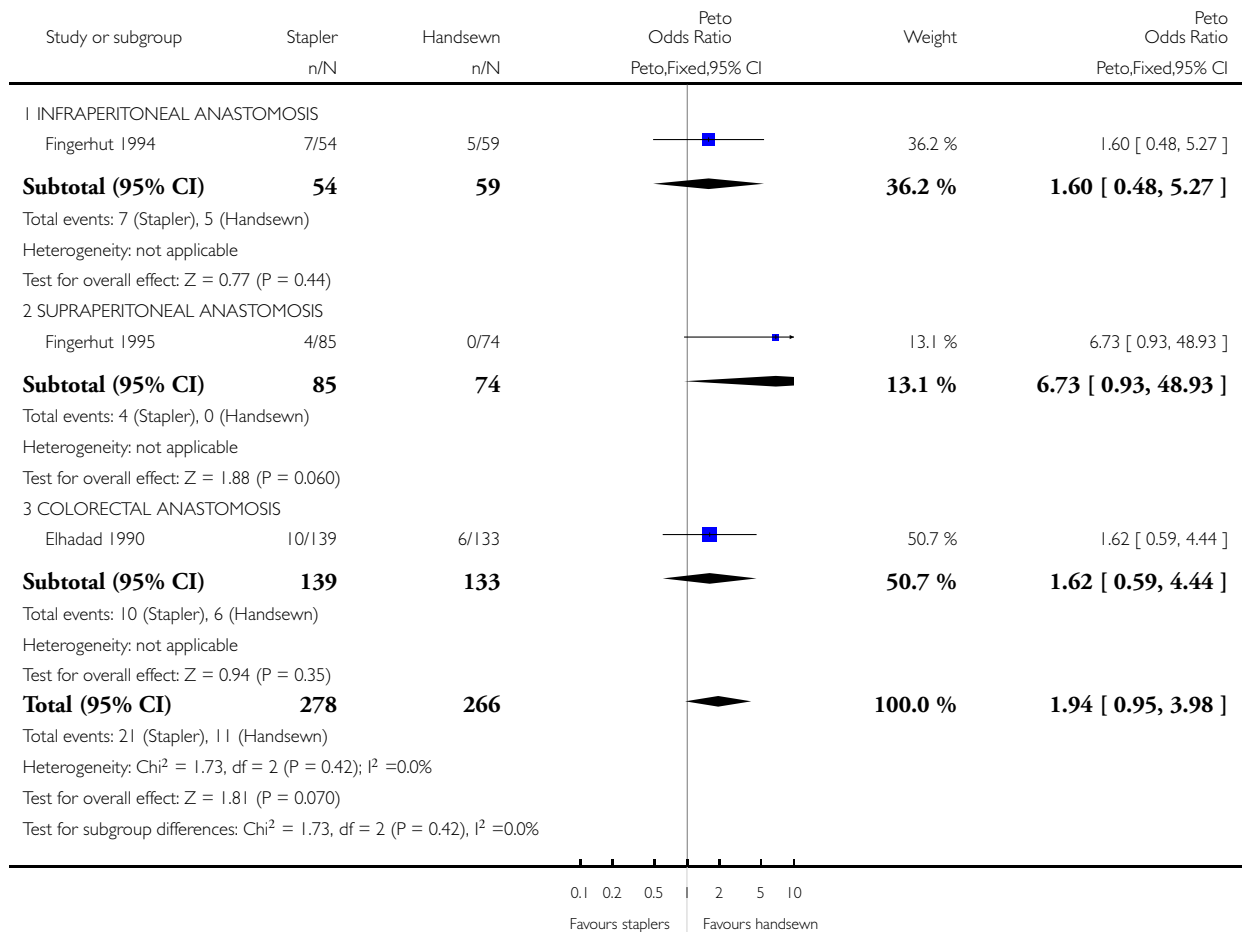


Analysis 1.7. Comparison 1 All studies, Outcome 7 reoperation.

Review: Stapled versus handsewn methods for colorectal anastomosis surgery

Comparison: 1 All studies

Outcome: 7 reoperation

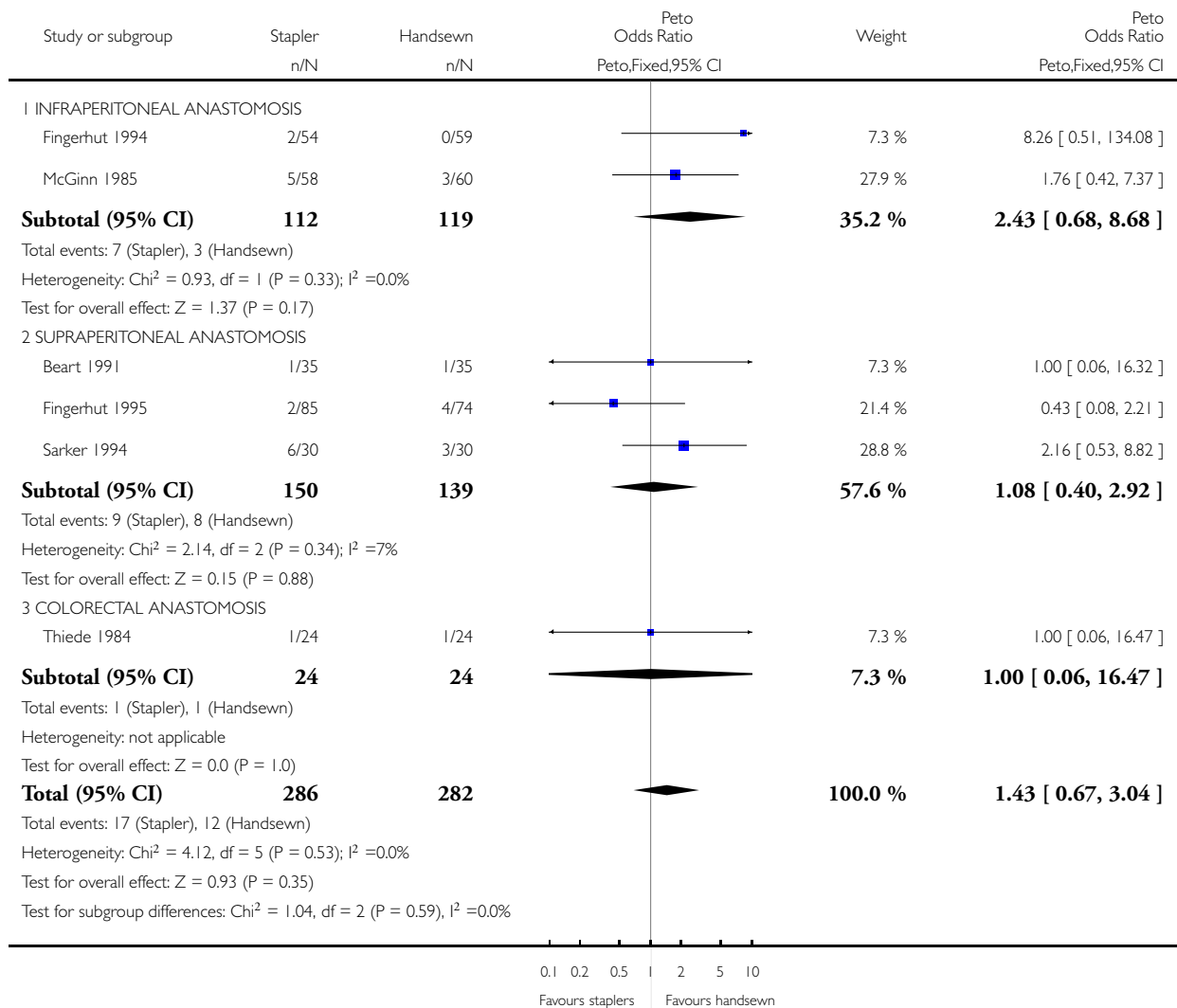


Analysis 1.8. Comparison 1 All studies, Outcome 8 wound infection.

Review: Stapled versus handsewn methods for colorectal anastomosis surgery

Comparison: 1 All studies

Outcome: 8 wound infection

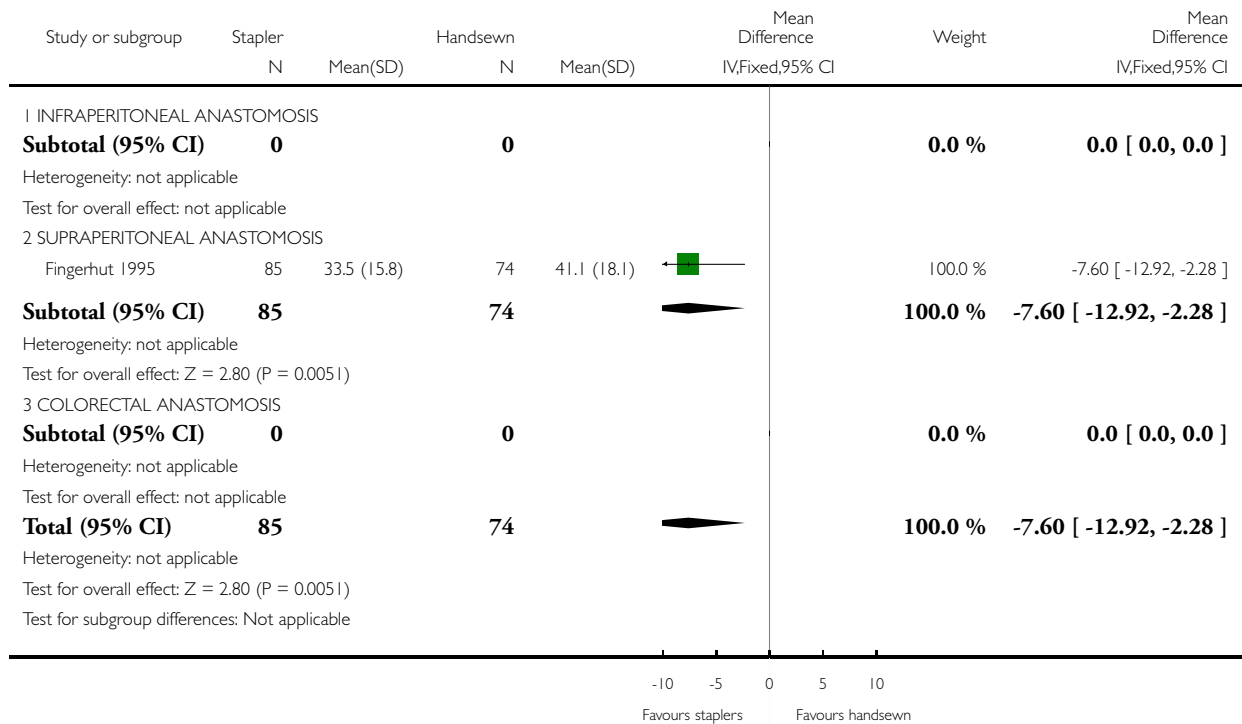


Analysis 1.9. Comparison 1 All studies, Outcome 9 anastomosis duration.

Review: Stapled versus handsewn methods for colorectal anastomosis surgery

Comparison: 1 All studies

Outcome: 9 anastomosis duration

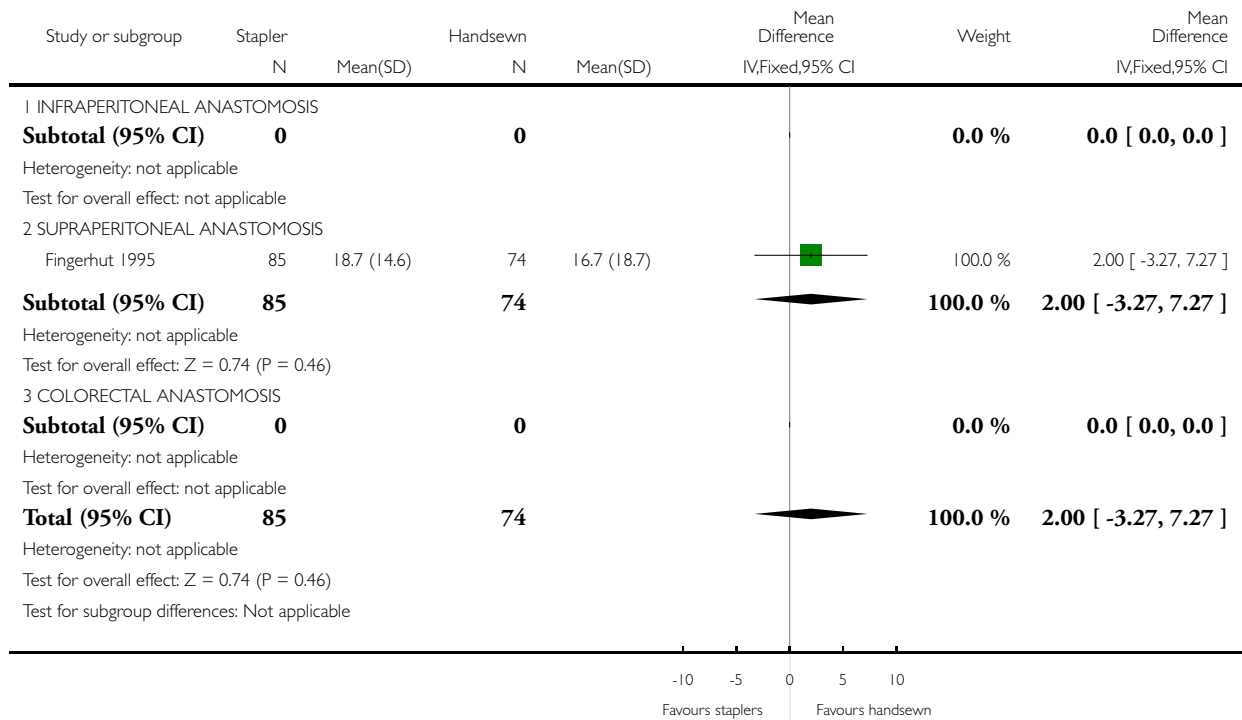


Analysis 1.10. Comparison 1 All studies, Outcome 10 hospital stay.

Review: Stapled versus handsewn methods for colorectal anastomosis surgery

Comparison: 1 All studies

Outcome: 10 hospital stay

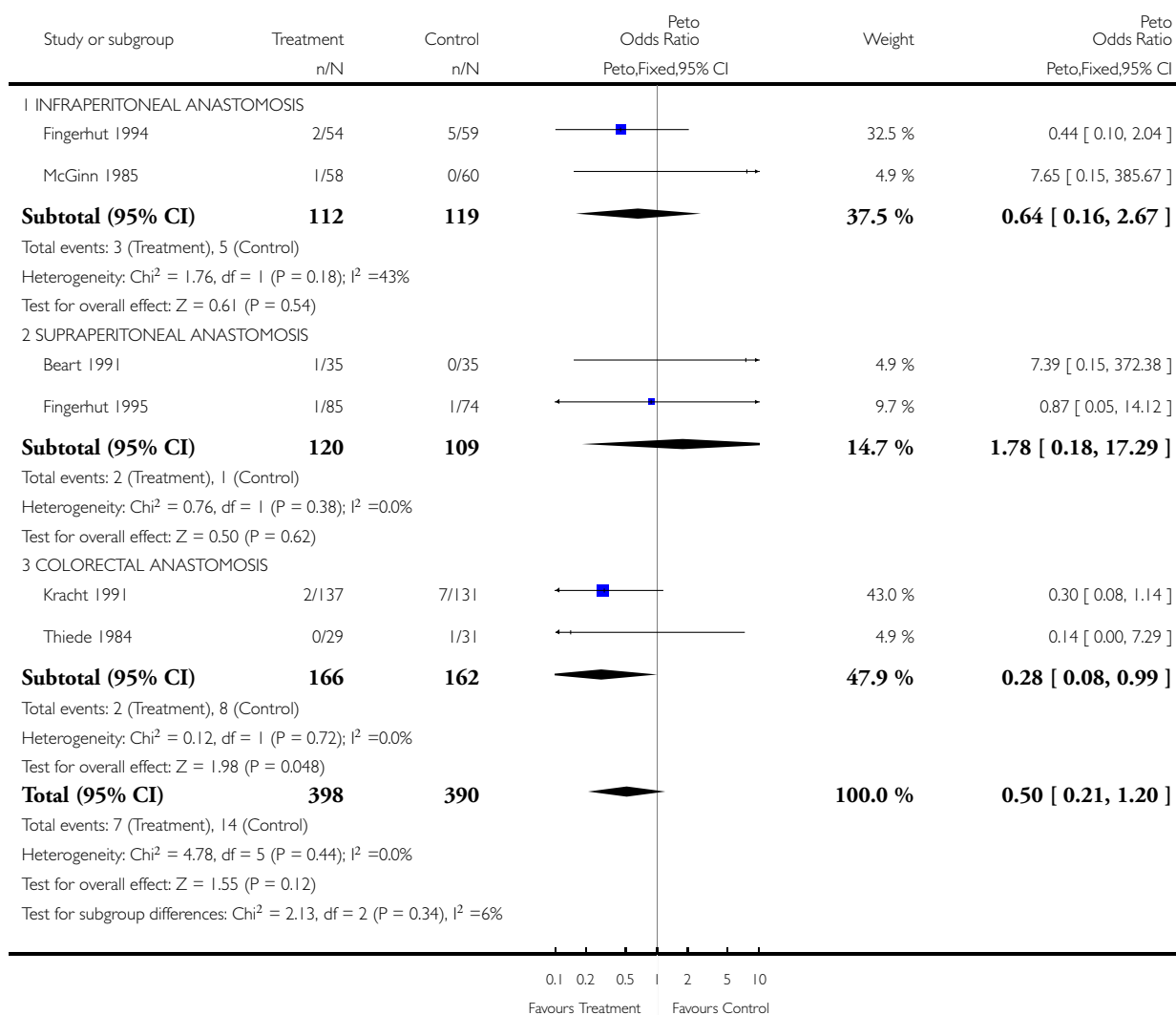


Analysis 2.1. Comparison 2 Studies with adequate allocation concealment, Outcome 1 mortality.

Review: Stapled versus handsewn methods for colorectal anastomosis surgery

Comparison: 2 Studies with adequate allocation concealment

Outcome: 1 mortality

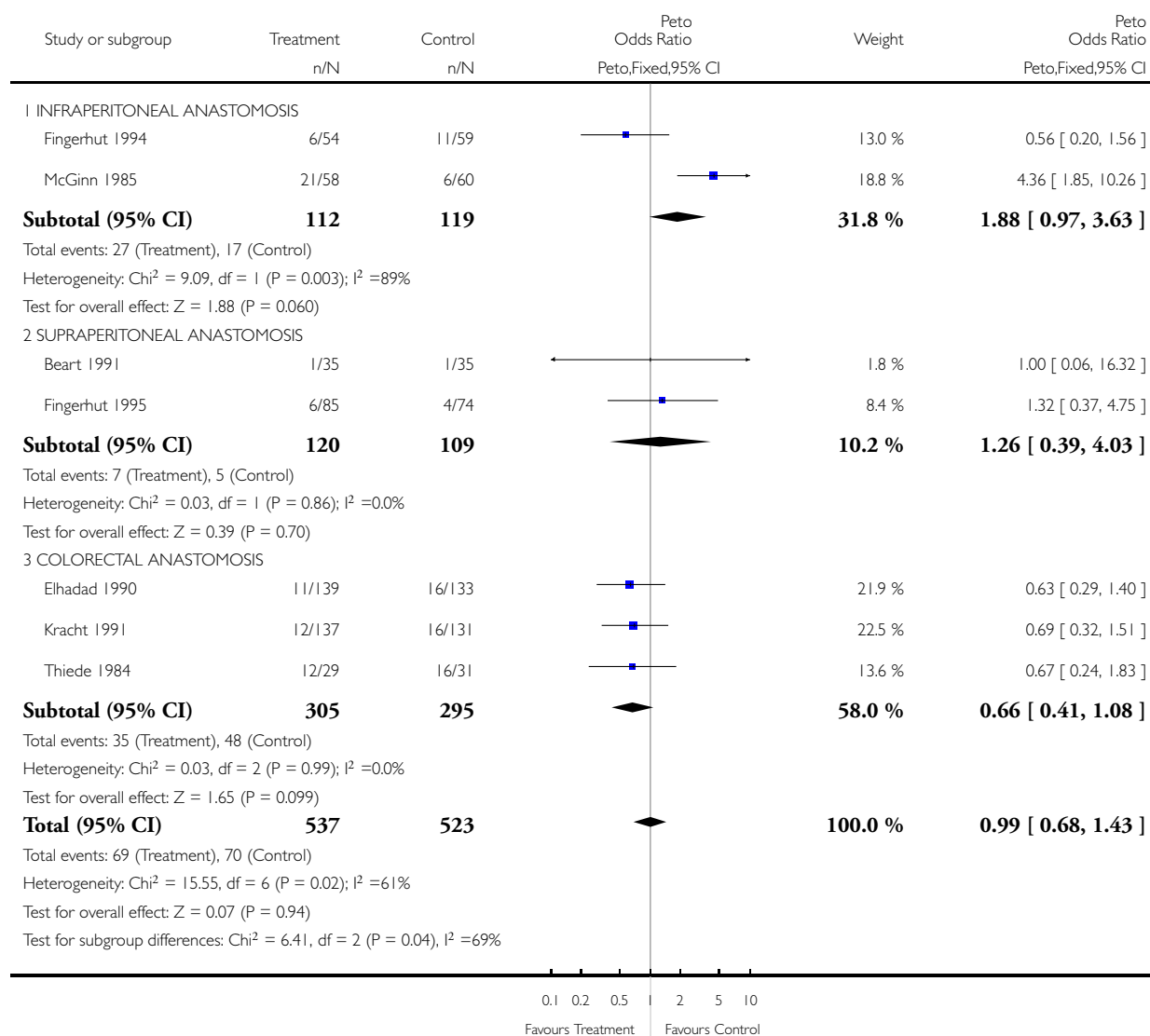


Analysis 2.2. Comparison 2 Studies with adequate allocation concealment, Outcome 2 overall dehiscence.

Review: Stapled versus handsewn methods for colorectal anastomosis surgery

Comparison: 2 Studies with adequate allocation concealment

Outcome: 2 overall dehiscence

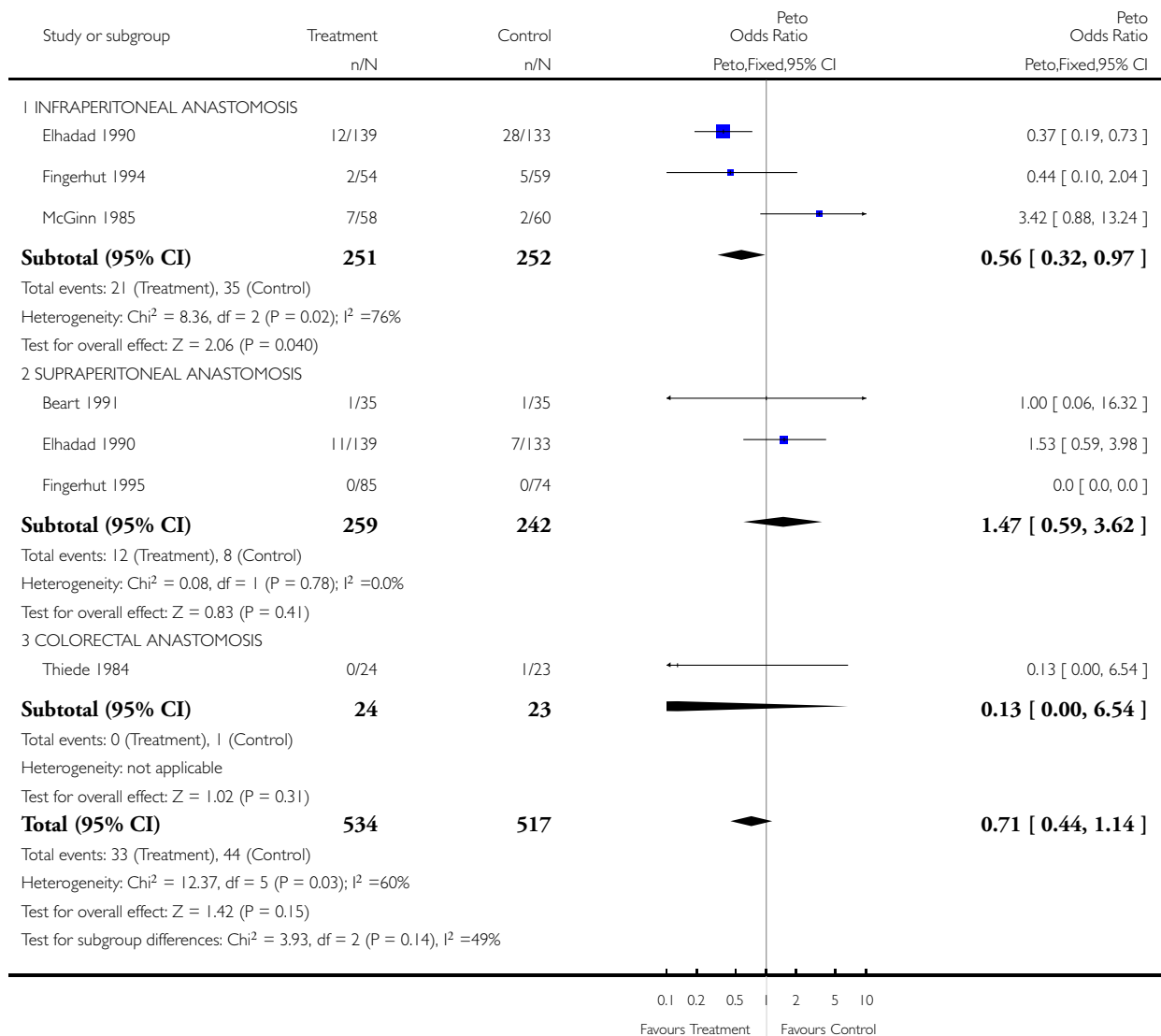


Analysis 2.3. Comparison 2 Studies with adequate allocation concealment, Outcome 3 clinical dehiscence.

Review: Stapled versus handsewn methods for colorectal anastomosis surgery

Comparison: 2 Studies with adequate allocation concealment

Outcome: 3 clinical dehiscence

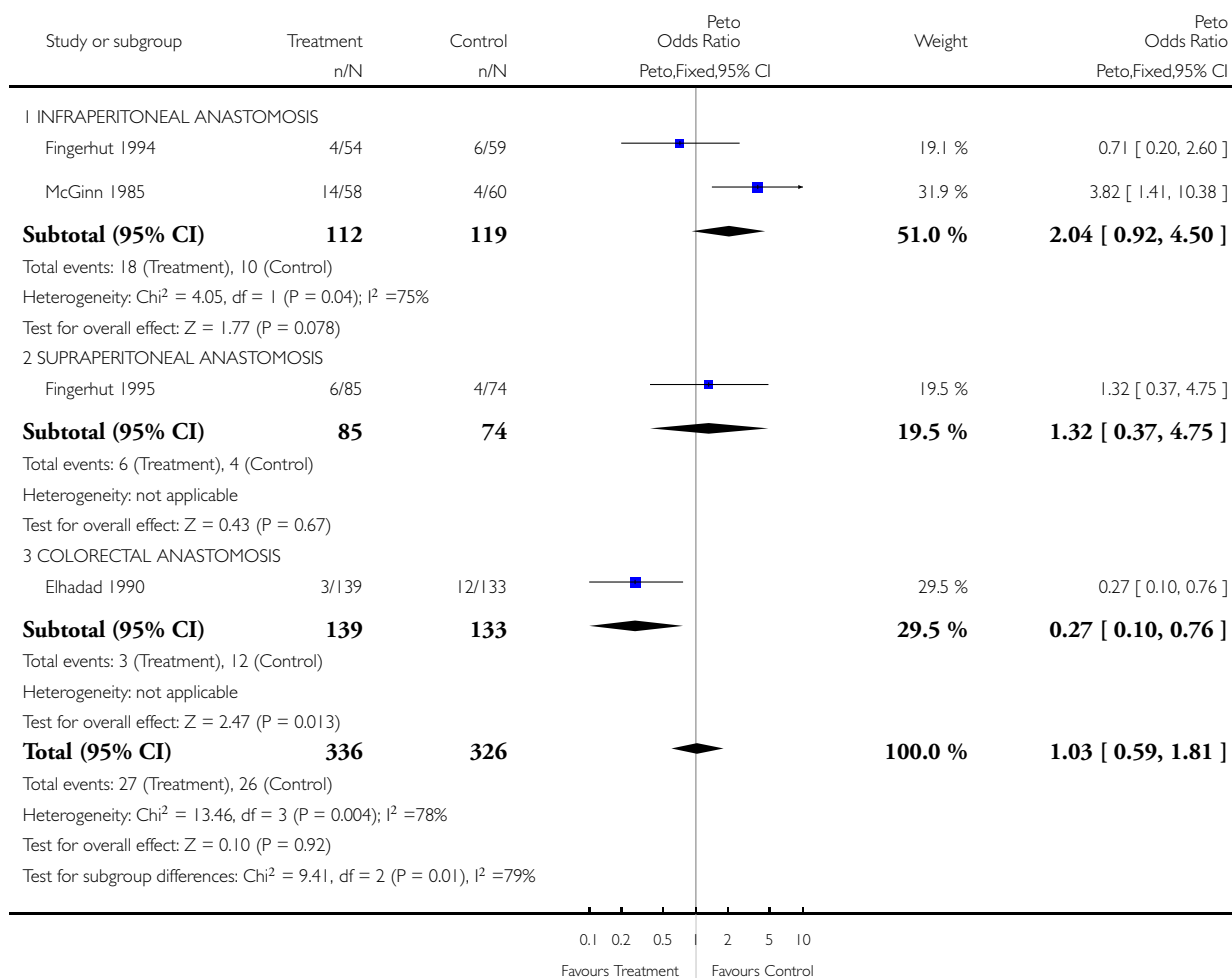


Analysis 2.4. Comparison 2 Studies with adequate allocation concealment, Outcome 4 radiological dehiscence.

Review: Stapled versus handsewn methods for colorectal anastomosis surgery

Comparison: 2 Studies with adequate allocation concealment

Outcome: 4 radiological dehiscence

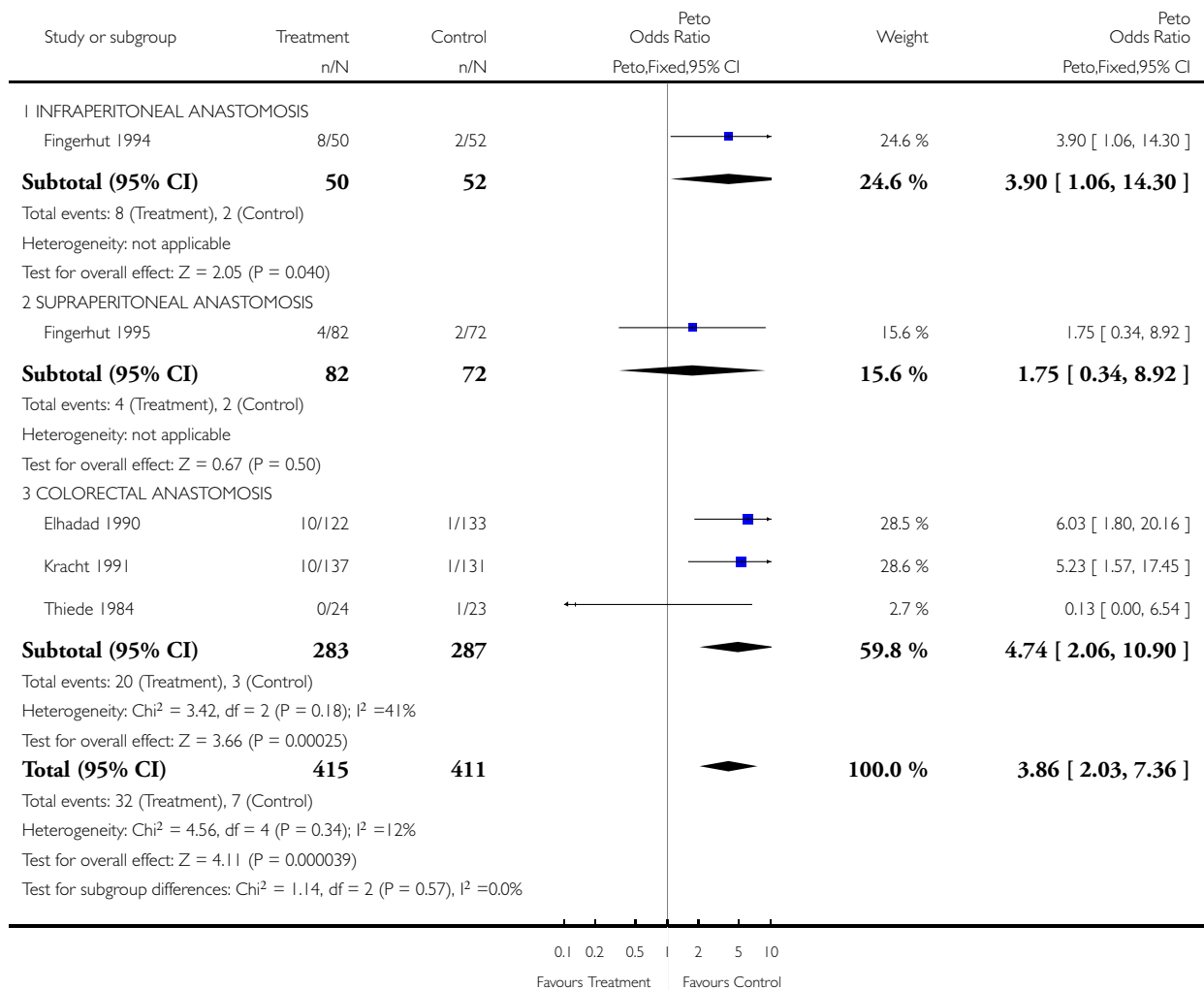


Analysis 2.5. Comparison 2 Studies with adequate allocation concealment, Outcome 5 stricture.

Review: Stapled versus handsewn methods for colorectal anastomosis surgery

Comparison: 2 Studies with adequate allocation concealment

Outcome: 5 stricture

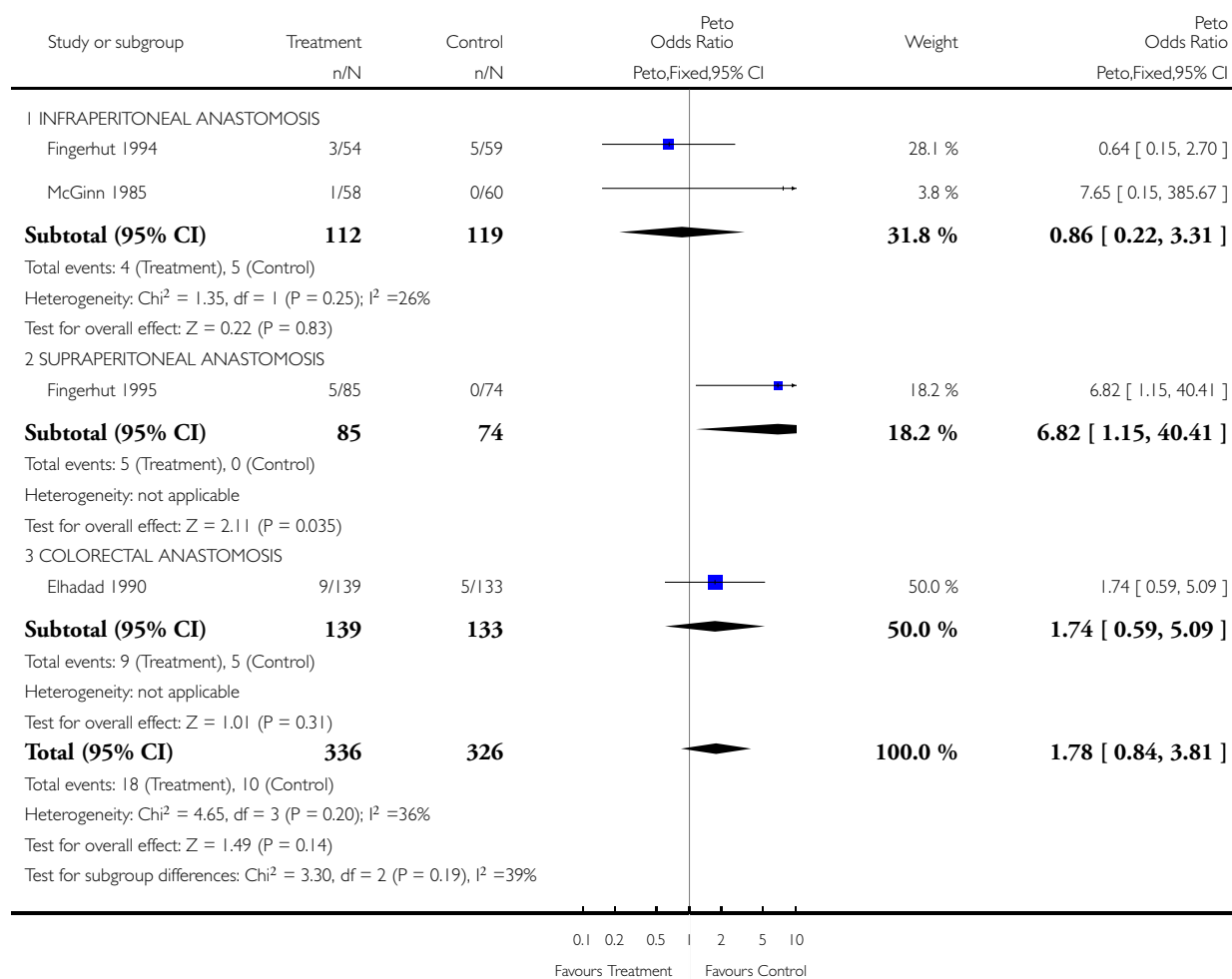


Analysis 2.6. Comparison 2 Studies with adequate allocation concealment, Outcome 6 hemorrhage.

Review: Stapled versus handsewn methods for colorectal anastomosis surgery

Comparison: 2 Studies with adequate allocation concealment

Outcome: 6 hemorrhage

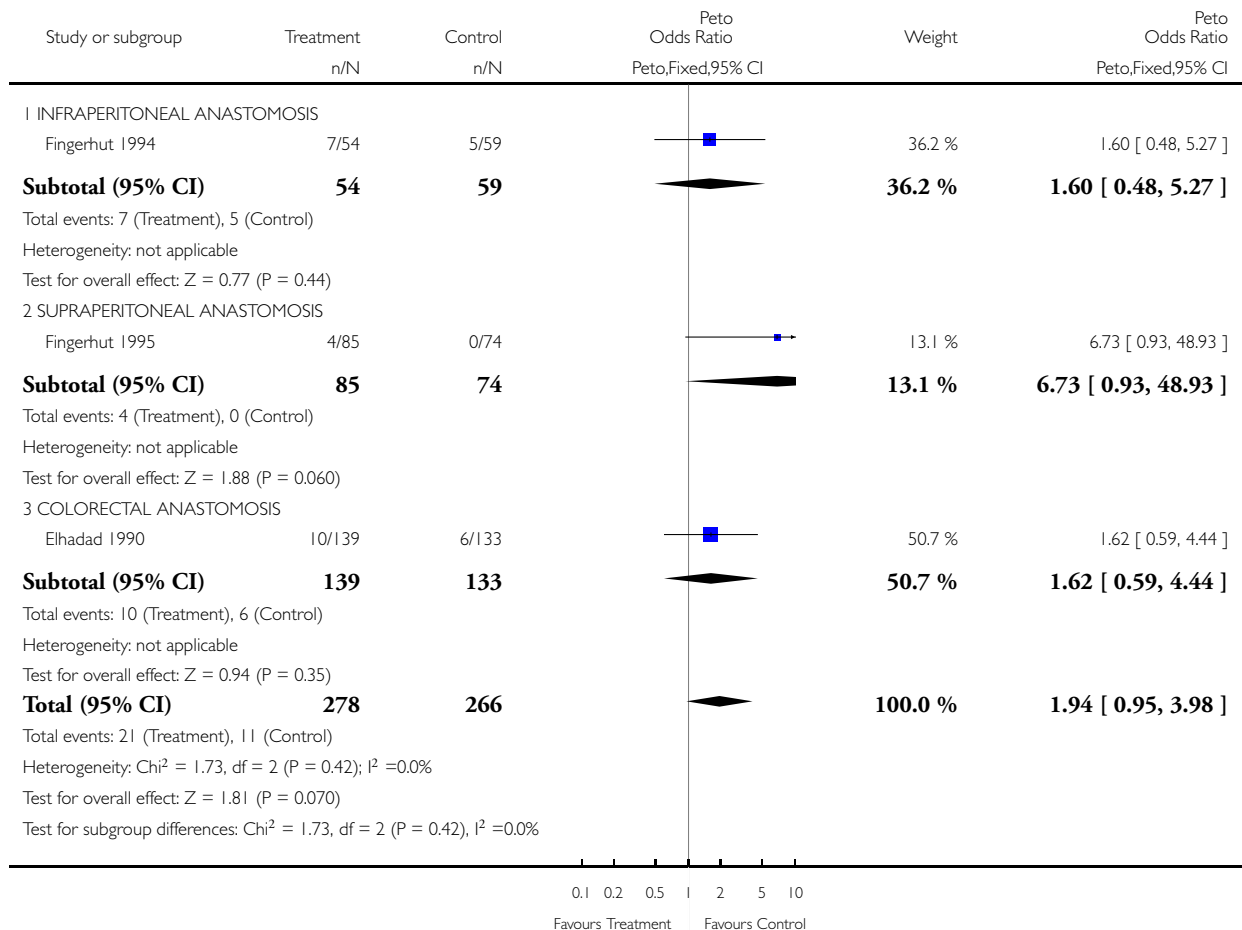


Analysis 2.7. Comparison 2 Studies with adequate allocation concealment, Outcome 7 reoperation.

Review: Stapled versus handsewn methods for colorectal anastomosis surgery

Comparison: 2 Studies with adequate allocation concealment

Outcome: 7 reoperation

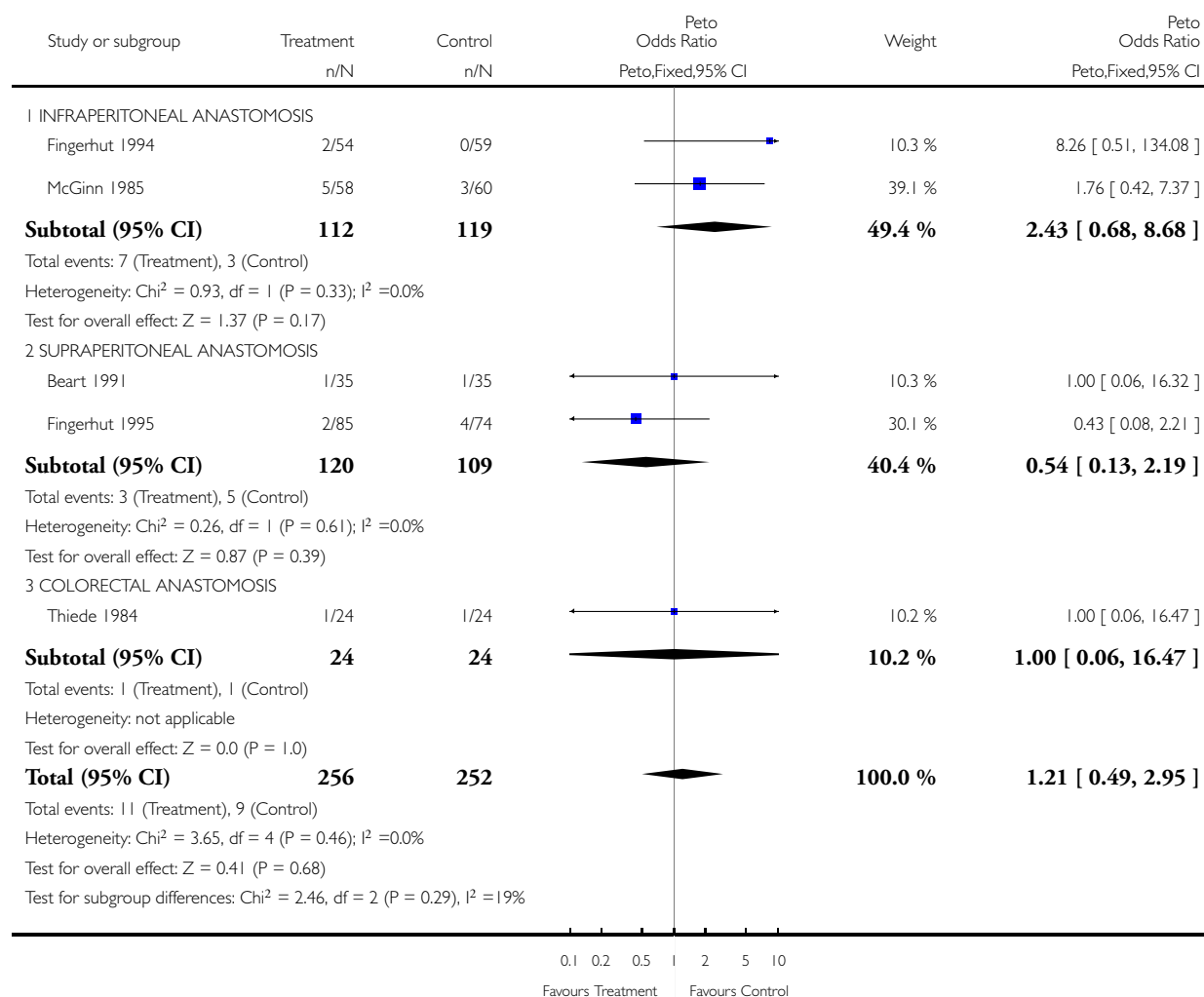


Analysis 2.8. Comparison 2 Studies with adequate allocation concealment, Outcome 8 wound infection.

Review: Stapled versus handsewn methods for colorectal anastomosis surgery

Comparison: 2 Studies with adequate allocation concealment

Outcome: 8 wound infection

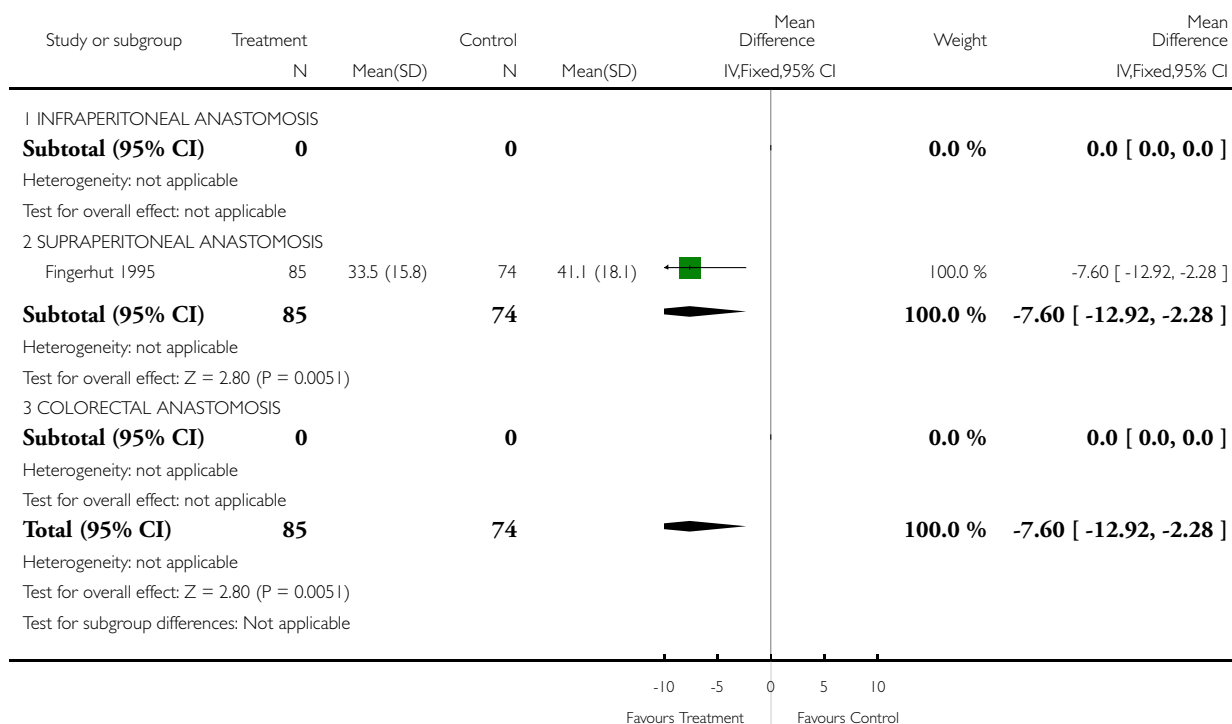


Analysis 2.9. Comparison 2 Studies with adequate allocation concealment, Outcome 9 anastomosis duration.

Review: Stapled versus handsewn methods for colorectal anastomosis surgery

Comparison: 2 Studies with adequate allocation concealment

Outcome: 9 anastomosis duration

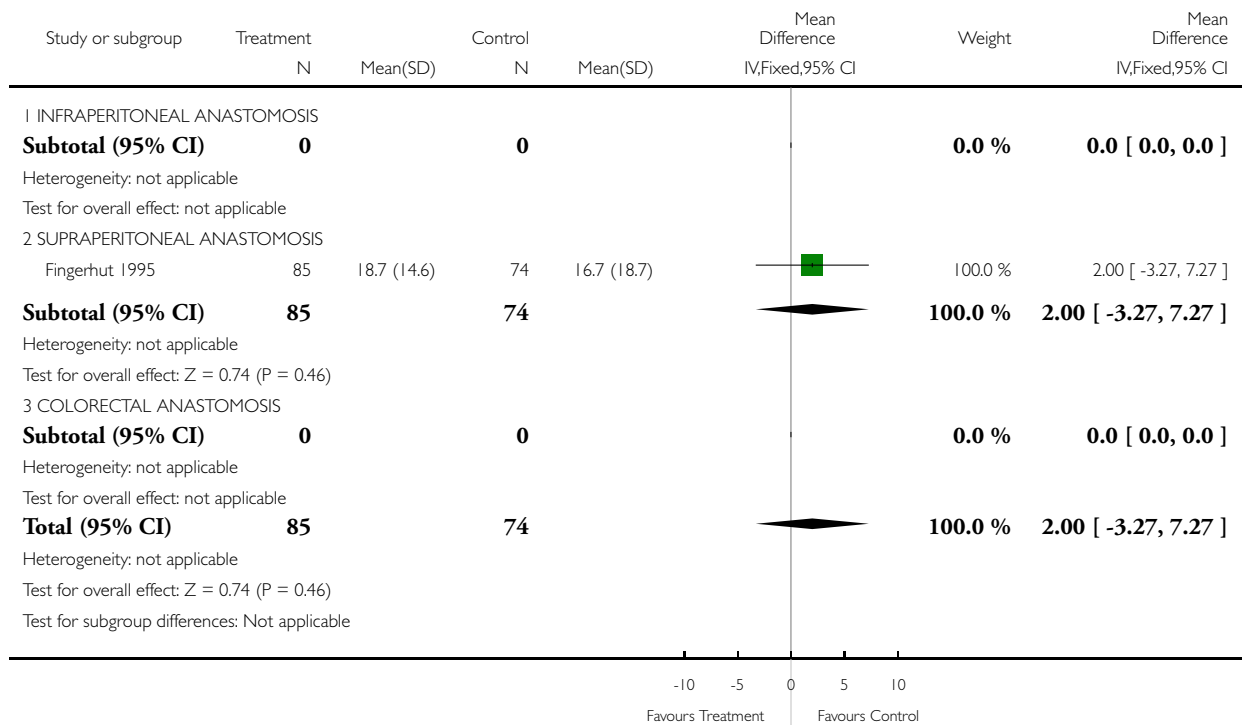


Analysis 2.10. Comparison 2 Studies with adequate allocation concealment, Outcome 10 hospital stay.

Review: Stapled versus handsewn methods for colorectal anastomosis surgery

Comparison: 2 Studies with adequate allocation concealment

Outcome: 10 hospital stay



APPENDICES

Appendix I. MEDLINE search strategy

MEDLINE (Ovid) 30.05.11 - 152 hits

Search history

1. exp Colorectal Surgery/
2. exp Intestines/
3. (colon* or rect* or colorect* or intestin* or bowel).mp.
4. 1 or 2 or 3
5. exp Anastomosis, Surgical/
6. anastomos*.mp.
7. 5 or 6
8. exp Surgical Stapling/
9. exp Surgical Staplers/

10. stapl*.mp.
11. 8 or 9 or 10
12. exp Sutures/
13. exp Suture Techniques/
14. (sutur* or sew* or handsew* or stitch).mp.
15. 12 or 13 or 14
16. 4 and 7 and 11 and 15
17. randomized controlled trial.pt.
18. controlled clinical trial.pt.
19. randomized.ab.
20. placebo.ab.
21. clinical trial.sh.
22. randomly.ab.
23. trial.ti.
24. 17 or 18 or 19 or 20 or 21 or 22 or 23
25. humans.sh.
26. 24 and 25
27. 16 and 26

Appendix 2. EMBASE search strategy

EMBASE (Ovid) 30.05.11 - 354 hits

Search history

1. exp colorectal surgery/
2. exp intestine/
3. (colon* or rect* or colorect* or intestin* or bowel).mp.
4. 1 or 2 or 3
5. exp anastomosis/
6. anastomos*.mp.
7. 5 or 6
8. exp surgical stapling/
9. exp surgical stapler/
10. stapl*.mp.
11. 8 or 9 or 10
12. exp suture/
13. exp suturing method/
14. (sutur* or sew* or handsew* or stitch).mp.
15. 12 or 13 or 14
16. 4 and 7 and 11 and 15
17. randomized controlled trial/
18. randomization/
19. controlled study/
20. multicenter study/
21. phase 3 clinical trial/
22. phase 4 clinical trial/
23. double blind procedure/
24. single blind procedure/
25. ((singl* or doubl* or trebl* or tripl*) adj (blind* or mask*)).ti,ab.
26. (random* or cross* over* or factorial* or placebo* or volunteer*).ti,ab.
27. 22 or 19 or 23 or 25 or 18 or 24 or 20 or 17 or 26 or 21
28. "human*".ti,ab.
29. (animal* or nonhuman*).ti,ab.

30. 29 and 28
31. 29 not 30
32. 27 not 31
33. 16 and 32

Appendix 3. CENTRAL search strategy

The Cochrane Library 30.05.11 - 98 hits (87 hits in CENTRAL)

- #1 MeSH descriptor Colorectal Surgery explode all trees
- #2 MeSH descriptor Intestines explode all trees
- #3 (colon* or rect* or colorect* or intestin* or bowel):ti,ab,kw
- #4 (#1 OR #2 OR #3)
- #5 MeSH descriptor Anastomosis, Surgical explode all trees
- #6 (anastomos*):ti,ab,kw
- #7 (#5 OR #6)
- #8 MeSH descriptor Surgical Stapling explode all trees
- #9 MeSH descriptor Surgical Staplers explode all trees
- #10 (stapl*):ti,ab,kw
- #11 (#8 OR #9 OR #10)
- #12 MeSH descriptor Sutures explode all trees
- #13 MeSH descriptor Suture Techniques explode all trees
- #14 (sutur* or sew* or handsew* or stitch):ti,ab,kw
- #15 (#12 OR #13 OR #14)
- #16 (#4 AND #7 AND #11 AND #15)

WHAT'S NEW

Last assessed as up-to-date: 26 October 2011.

Date	Event	Description
26 October 2011	New search has been performed	New search 5 May 2011.
26 October 2011	New citation required but conclusions have not changed	No new studies included, but 14 eligible studies, identified and commented on, were excluded in this update

HISTORY

Protocol first published: Issue 4, 1998

Review first published: Issue 3, 2001

Date	Event	Description
25 May 2001	New citation required and conclusions have changed	Substantive amendment

CONTRIBUTIONS OF AUTHORS

Conceiving the review: DM, SASL

Designing the review: CBN, SASL, DM, IP, EMKS

Coordinating the review: CBN

Data collection for the review: CBN, SALS

Developing search strategy: Marija Barbatescovic

Undertaking searches: CBN, SASL

Screening search results: CBN, SASL, DM

Organising retrieval of papers: CBN, SASL, DM

Screening retrieved papers against inclusion criteria: CBN, SASL

Appraising quality of papers: CBN, SASL, DM, IP

Abstracting data from papers: CBN, SASL, DM

Writing to authors of papers for additional information: DM, SASL

Providing additional data about papers: CBN, SASL, EMKS, IP

Obtaining and screening data on unpublished studies: not applicable

Data management for the review: CBN, SALS, DMS

Entering data into RevMan: CBN, EMKS

Analysis of data: CBN, DM, SALS

Interpretation of data: CBN, SALS, DM, EMKS

Providing a methodological perspective: CBN, EMKS

Providing a clinical perspective: CBN, DM, SALS

Providing a policy perspective: DM

Providing a consumer perspective: none

Writing the review: CBN, EKMS, DM

Providing general advice on the review: DM, EKMS

Securing funding for the review: DM, EKMS

Performing previous work that was the foundation of current study: SALS, DM

DECLARATIONS OF INTEREST

None.

SOURCES OF SUPPORT

Internal sources

- Clinical Trials and Meta-analysis Unit, Federal University of São Paulo, Brazil.
- Gastroenterology Surgical Division, Federal University of São Paulo, Brazil.

External sources

- Centro Universitario de Volta Redonda (UniFOA), Brazil.
- Fundação Coordenação de Aperfeiçoamento de Pessoal do Ensino Superior (CAPES), Brazil.

INDEX TERMS

Medical Subject Headings (MeSH)

*Suture Techniques; Anastomosis, Surgical [methods]; Colon [*surgery]; Randomized Controlled Trials as Topic; Rectum [*surgery]; Surgical Stapling

MeSH check words

Adult; Humans