Closure versus non-closure of the peritoneum at caesarean section: short- and long-term outcomes (Review)

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[Intervention Review]

Closure versus non-closure of the peritoneum at caesarean section: short- and long-term outcomes

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ABSTRACT

Background

Caesarean section is a very common surgical procedure worldwide. Suturing the peritoneal layers at caesarean section may or may not confer benefit, hence the need to evaluate whether this step should be omitted or routinely performed.

Objectives

The objective of this review was to assess the effects of non-closure as an alternative to closure of the peritoneum at caesarean section on intraoperative and immediate- and long-term postoperative outcomes.

Search methods

We searched the Cochrane Pregnancy and Childbirth Group's Trials Register (1 November 2013).

Selection criteria

Randomised controlled trials comparing leaving the visceral or parietal peritoneum, or both, unsutured at caesarean section with a technique which involves suturing the peritoneum in women undergoing elective or emergency caesarean section.

Data collection and analysis

Two review authors independently assessed trials for inclusion and risk of bias, extracted data and checked it for accuracy.

Main results

A total of 29 trials were included in this review and 21 trials (17,276 women) provided data that could be included in an analysis. The quality of the trials was variable.

1. Non-closure of visceral and parietal peritoneum versus closure of both parietal layers

Sixteen trials involving 15,480 women, were included and analysed, when both parietal peritoneum was left unclosed versus when both peritoneal surfaces were closed. Postoperative adhesion formation was assessed in only four trials with 282 women, and no difference

was found between groups (risk ratio (RR) 0.99, 95% confidence interval (CI) 0.76 to 1.29). There was significant reduction in the operative time (mean difference (MD) -5.81 minutes, 95% CI -7.68 to -3.93). The duration of hospital stay in a total of 13 trials involving 14,906 women, was also reduced (MD -0.26, 95% CI -0.47 to -0.05) days. In a trial involving 112 women, reduced chronic pelvic pain was found in the peritoneal non-closure group.

2. Non-closure of visceral peritoneum only versus closure of both peritoneal surfaces

Three trials involving 889 women were analysed. There was an increase in adhesion formation (two trials involving 157 women, RR 2.49, 95% CI 1.49 to 4.16) which was limited to one trial with high risk of bias.There was reduction in operative time, postoperative days in hospital and wound infection. There was no significant reduction in postoperative pyrexia.

3. Non-closure of parietal peritoneum only versus closure of both peritoneal layers

The two identified trials involved 573 women. Neither study reported on postoperative adhesion formation. There was reduction in operative time and postoperative pain with no difference in the incidence of postoperative pyrexia, endometritis, postoperative duration of hospital stay and wound infection. In only one study, postoperative day one wound pain assessed by the numerical rating scale, (MD -1.60, 95% CI -1.97 to -1.23) and chronic abdominal pain d by the visual analogue score (MD -1.10, 95% CI -1.39 to -0.81) was reduced in the non-closure group.

4. Non-closure versus closure of visceral peritoneum when parietal peritoneum is closed.

There was reduction in all the major urinary symptoms of frequency, urgency and stress incontinence when the visceral peritoneum is left unsutured.

Authors' conclusions

There was a reduction in operative time across all the subgroups. There was also a reduction in the period of hospitalisation post-caesarean section except in the subgroup where parietal peritoneum only was not sutured where there was no difference in the period of hospitalisation. The evidence on adhesion formation was limited and inconsistent. There is currently insufficient evidence of benefit to justify the additional time and use of suture material necessary for peritoneal closure. More robust evidence on long-term pain, adhesion formation and infertility is needed.

PLAIN LANGUAGE SUMMARY

Closure versus non-closure of the peritoneum at caesarean section: long- and short-term outcome

Not stitching the peritoneum after caesarean section takes less theatre time and therefore has less cost, but information on possible long-term disadvantages are limited.

There are many ways of performing a caesarean section and the techniques used depend on a number factors including the clinical situation and the preference of the operator. The peritoneum is a thin membrane of cells supported by a thin layer of connective tissue, and during caesarean section these peritoneal surfaces have to be cut through in order to reach the uterus and for the baby to be born. Following a caesarean section, it has been standard practice to close the peritoneum by stitching (suturing) the two layers of tissue that line the abdomen and cover the internal organs, to restore the anatomy. It has however been suggested that peritoneal adhesions may be more likely rather than less likely when the peritoneum is sutured, possibly as a result of a tissue reaction to the suture material. This review of trials sought to address whether to routinely suture these thin layers of tissue or not after delivering a baby by caesarean section. Twenty-nine randomised controlled trials were identified, with differences in their methodological quality; 21 trials involving over 17,000 women contributing data to the review. Several minutes were saved when the peritoneum was not stitched, and with a shorter period of hospital stay in most of the women. Postoperative adhesion formation was assessed in only four trials with 282 women, and no difference was found when leaving both layers of peritoneum unclosed was compared with closure of both. Longer-term outcomes were not adequately assessed, particularly adhesion formation, subfertility and ease of other surgeries in later life. Although the methodological quality of trials was variable, the results were in general consistent between the trials of better and poorer quality. Further studies are needed to further assess all these outcomes.

BACKGROUND

Description of the condition

Caesarean section is one of the most frequently performed major surgical procedures worldwide, accounting for anything up to 70% of deliveries, depending on the facility assessed and the country involved. In general, rates around the world are about 5% to over 20% of all deliveries (Lomas 1989). Rates between 20% and 25% have been reported from the UK (Thomas 2001), the United States of America (Menacker 2001), and China (Cai 1998). A rate of 57% was reported from a private hospital in South Africa (Naidoo 2009).

There are many possible ways of performing a caesarean section and operative techniques used for caesarean section vary. The techniques used may depend on many factors including the clinical situation and the preference of the operator. Some of these techniques have been evaluated through randomised trials. An overview of the techniques used, indications for caesarean section and postoperative complications is published as a separate review (Hofmeyr 2008).

Description of the intervention

Closure of the peritoneum at laparotomy has been a part of 'standard' surgical practice. The peritoneum is a thin membrane made of primitive cells called mesothelium and supported by a thin layer of connective tissue. It lines both the abdominal and pelvic cavities where it is called parietal peritoneum. When it covers the external surface of internal organs like the intestine, the bladder and the uterus, it is termed visceral peritoneum. During caesarean section, these peritoneal surfaces have to be breached before the uterus can be incised.

Extraperitoneal caesarean section in which the peritoneum is reflected but not opened, was used in the past in an attempt to limit spread of sepsis from the uterus in septic cases, is seldom if ever used today.

How the intervention might work

Cited reasons for closure of the peritoneum include restoration of anatomy and re-approximation of tissues, reduction of infection by re-establishing an anatomical barrier, reduction of wound dehiscence, reducing haemorrhage, minimisation of adhesions and continuation of what was thought as standard (Bamigboye 1999; Duffy 1994). In vivo experiments using dogs (Parulkar 1986) and rats (Kapur 1979; Kyzer 1986) have shown no difference in wound strength whether the peritoneum is closed or not, and have suggested that peritoneal adhesions may be more extensive when the peritoneum is closed, presumably as a result of the foreign body reaction from the suture material. The suture may cause peritoneal tissue ischaemia at the edges, which may delay healing and serve as a cause of intraperitoneal adhesions and febrile morbidity. Non-closure of the peritoneum will eliminate these potential complication of performing caesarean section.

Why it is important to do this review

Randomised controlled trials in general surgery of peritoneal closure or non-closure with vertical abdominal incisions (Ellis 1977; Gilbert 1987; Hugh 1990) have shown no significant short-term differences in postoperative complications or pain scores. In operative gynaecology, controlled trials of peritoneal non-closure in vaginal hysterectomy (Lipscomb 1996), abdominal and radical hysterectomy (Than 1994) and lymphadenectomy (Kananali 1996) have demonstrated no difference, or an improvement in short-term postoperative morbidity if the peritoneum is not closed. In the former study (Kananali 1996) where peritoneal non-closure was compared with closure during lymphadenectomy for ovarian cancer, peritoneal non-closure significantly reduced adhesion formation.

The step of either suturing or not suturing the peritoneal surfaces is one of several surgical techniques of caesarean section addressed in Cochrane reviews. If this step could be omitted without adverse effect or with benefit for the individual patient, and with a reduction in operating time and suture material, this could lead to a meaningful cost saving, taking into cognizance the large numbers of caesarean sections performed worldwide.

OBJECTIVES

To determine whether dispensing with closure of the peritoneum at caesarean section affects the postoperative course and long-term outcomes, and the duration of the operation.

METHODS

Criteria for considering studies for this review

Types of studies

All randomised controlled trials comparing leaving the peritoneum unsutured at caesarean section with the conventional approach of

suturing the peritoneum. Quasi-random allocation trials (for example, based on hospital number) were included in the analysis. Cluster-randomised trials are eligible for inclusion. Cross-over trials are not appropriate for this intervention.

Types of participants

Women undergoing caesarean section.

Types of interventions

The peritoneum, either visceral, or parietal, or both visceral and parietal were left unsutured for the experimental group, and were sutured, usually with a continuous suture, in the control group.

Types of outcome measures

Primary outcomes

- Postoperative adhesions (not prespecified in original protocol).

Secondary outcomes

- Wound infection.
- Wound dehiscence.
- Analgesic requirement.
- Postoperative fever.
- Endometritis.
- Operating time.
- Paralytic ileus.
- Duration of hospital stay.
- Cost.

Long-term outcomes (not prespecified at the protocol stage)

- Chronic pelvic pain.
- Urinary symptoms.
- Subfertility.

Outcomes not prespecified

- Blood transfusion > 1 unit.
- Maternal death.
- Intervention for postpartum haemorrhage.
- Readmission to hospital within six weeks.
- Mobilisation time in hours.
- Time to oral intake in hours.
- Drop in haemoglobin g/dL.
- Blood loss mL.
- Time to flatus.

Search methods for identification of studies

The following methods sections of this review is based on a standard template used by the Cochrane Pregnancy and Childbirth Group.

Electronic searches

We searched the Cochrane Pregnancy and Childbirth Group's Trials Register by contacting the Trials Search Co-ordinator (1 November 2013).

The Cochrane Pregnancy and Childbirth Group's Trials Register is maintained by the Trials Search Co-ordinator and contains trials identified from:

1. monthly searches of the Cochrane Central Register of Controlled Trials (CENTRAL);
2. weekly searches of MEDLINE;
3. weekly searches of Embase;
4. handsearches of 30 journals and the proceedings of major conferences;
5. weekly current awareness alerts for a further 44 journals plus monthly BioMed Central email alerts.

Details of the search strategies for CENTRAL, MEDLINE and Embase, the list of handsearched journals and conference proceedings, and the list of journals reviewed via the current awareness service can be found in the 'Specialized Register' section within the editorial information about the Cochrane Pregnancy and Childbirth Group.

We did not apply any language restrictions.

Data collection and analysis

For the methods used when assessing the trials identified in the previous version of this review, *see* Bamigboye 2003.

For this update, we used the following methods when assessing the reports identified by the updated search.

The following methods sections of this review is based on a standard template used by the Cochrane Pregnancy and Childbirth Group.

Selection of studies

Two review authors independently assessed for inclusion, all the potential studies we identified as a result of the search strategy. There was no need to consult a third party regarding any disagreement.

Data extraction and management

We designed a form to extract data. Two review authors extracted data using the agreed form. We resolved discrepancies through discussion. Data were entered into Review Manager software (

RevMan 2014) and checked for accuracy. There was no need to contact authors of any report for clarification on any information.

Assessment of risk of bias in included studies

Two review authors independently assessed risk of bias for each study using the criteria outlined in the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2011). We resolved disagreement by discussion.

(1) Random sequence generation (checking for possible selection bias)

We described for each included study the method used to generate the allocation sequence in sufficient detail to allow an assessment of whether it should produce comparable groups.
We assessed the method as:

- low risk of bias (any truly random process, e.g. random number table; computer random number generator);
- high risk of bias (any non-random process, e.g. odd or even date of birth; hospital or clinic record number);
- unclear risk of bias.

(2) Allocation concealment (checking for possible selection bias)

We described for each included study the method used to conceal the allocation sequence and determine whether intervention allocation could have been foreseen in advance of, or during recruitment, or changed after assignment.
We assessed the methods as:

- low risk (e.g. telephone or central randomisation; consecutively numbered sealed opaque envelopes);
- high risk of bias (open random allocation; unsealed or non-opaque envelopes, alternation; date of birth);
- unclear risk of bias.

(3.1) Blinding of participants and personnel(checking for possible performance bias)

We described for each included study the methods used, if any, to blind study participants and personnel from knowledge of which intervention a participant received. We considered that studies were at low risk of bias if they were blinded, or if we judged that the lack of blinding could not have affected the results. Blinding the surgeon in these trials was not possible but the data collectors and analyst were blinded from allocation.
We assessed the methods as:

- low, high or unclear risk of bias for participants;
- low, high or unclear risk of bias for personnel.

(3.2) Blinding of outcome assessment (checking for possible detection bias)

We described for each included study the methods used, if any, to blind outcome assessors from knowledge of which intervention a participant received. We assessed blinding separately for different outcomes or classes of outcomes.
We assessed methods used to blind outcome assessment as:

- low, high or unclear risk of bias.

(4) Incomplete outcome data (checking for possible attrition bias due to the amount, nature and handling of incomplete outcome data)

We described for each included study, and for each outcome or class of outcomes, the completeness of data including attrition and exclusions from the analysis. We stated whether attrition and exclusions were reported, the numbers included in the analysis at each stage (compared with the total randomised participants), reasons for attrition or exclusion where reported, and whether missing data were balanced across groups or were related to outcomes.
We assessed methods as:

- low risk of bias (e.g. no missing outcome data; missing outcome data balanced across groups);
- high risk of bias (e.g. numbers or reasons for missing data imbalanced across groups; 'as treated' analysis done with substantial departure of intervention received from that assigned at randomisation);
- unclear risk of bias.

(5) Selective reporting bias

We described for each included study how we investigated the possibility of selective outcome reporting bias and what we found.
We assessed the methods as:

- low risk of bias (where it was clear that all of the study's pre-specified outcomes and all expected outcomes of interest to the review have been reported);
- high risk of bias (where not all the study's pre-specified outcomes have been reported; one or more reported primary outcomes were not pre-specified; outcomes of interest are reported incompletely and so cannot be used; study fails to include results of a key outcome that would have been expected to have been reported);
- unclear risk of bias.

(6) Other bias (checking for bias due to problems not covered by (1) to (5) above)

We described for each included study any important concerns we have about other possible sources of bias.
We assessed whether each study was free of other problems that could put it at risk of bias:

- low risk of other bias;
- high risk of other bias;
- unclear whether there is risk of other bias.

(7) Overall risk of bias

We made explicit judgements about whether studies were at high risk of bias, according to the criteria given in the *Handbook* (Higgins 2011). With reference to (1) to (6) above, we assessed the likely magnitude and direction of the bias and whether it was likely to impact on the findings. We explored the impact of the level of bias through undertaking sensitivity analyses - *see* Sensitivity analysis.

Measures of treatment effect

Dichotomous data

For dichotomous data, we presented results as summary risk ratio with 95% confidence intervals.

Continuous data

For continuous data, we used the mean difference if outcomes were measured in the same way between trials. We planned to use the standardised mean difference to combine trials that measured the same outcome, but used different methods.

Unit of analysis issues

Cluster-randomised trials

We will include cluster-randomised trials if identified in future updates. We will include cluster-randomised trials in the analyses along with individually-randomised trials. We will adjust their sample sizes using the methods described in the *Handbook* using an estimate of the intracluster correlation co-efficient (ICC) derived from the trial (if possible), from a similar trial or from a study of a similar population. If we use ICCs from other sources, we will report this and conduct sensitivity analyses to investigate the effect of variation in the ICC. If we identify both cluster-randomised trials and individually-randomised trials, we plan to synthesise the relevant information. We will consider it reasonable to combine the results from both if there is little heterogeneity between the study designs and the interaction between the effect of intervention and the choice of randomisation unit is considered to be unlikely. We will also acknowledge heterogeneity in the randomisation unit and perform a sensitivity analysis to investigate the effects of the randomisation unit.

Cross-over trials

Cross-over trials are not appropriate for this intervention.

Dealing with missing data

For included studies, we noted levels of attrition. We explored the impact of including studies with high levels of missing data in the overall assessment of treatment effect by using sensitivity analysis. For all outcomes, we carried out analyses, as far as possible, on an intention-to-treat basis, i.e. we attempted to include all participants randomised to each group in the analyses, and all participants were analysed in the group to which they were allocated, regardless of whether or not they received the allocated intervention. The denominator for each outcome in each trial was the number randomised minus any participants whose outcomes are known to be missing.

Assessment of heterogeneity

We assessed statistical heterogeneity in each meta-analysis using the Tau^2, I^2 and Chi^2 statistics. We regarded heterogeneity as substantial if a Tau^2 was greater than zero and either an I^2 was greater than 30% or there was a low P value (< 0.10) in the Chi^2 test for heterogeneity.

Assessment of reporting biases

If there were 10 or more studies in the meta-analysis we investigated reporting biases (such as publication bias) using funnel plots. We assessed funnel plot asymmetry visually. If asymmetry was suggested by a visual assessment, we performed exploratory analyses to investigate it.

Data synthesis

We carried out statistical analysis using the Review Manager software (RevMan 2014). We used fixed-effect meta-analysis for combining data where it is reasonable to assume that studies were estimating the same underlying treatment effect: i.e. where trials were examining the same intervention, and the trials' populations and methods were judged sufficiently similar. If there was clinical heterogeneity sufficient to expect that the underlying treatment effects differed between trials, or if substantial statistical heterogeneity was detected, we used random-effects meta-analysis to produce an overall summary, if an average treatment effect across trials was considered clinically meaningful. The random-effects summary was treated as the average range of possible treatment effects and we discussed the clinical implications of treatment effects differing between trials. If the average treatment effect was not clinically meaningful, we did not combine trials.

In random-effects analyses, the results were presented as the average treatment effect with its 95% confidence interval, and the estimates of Tau^2 and I^2.

Subgroup analysis and investigation of heterogeneity

When substantial heterogeneity was identified, we used random-effects analysis. Subgroup analysis will be carried out in future updates.

In future updates, we will carry out the following subgroup analysis.

- Vertical versus transverse incisions

We will use all outcomes in subgroup analysis.

We will assess subgroup differences by interaction tests available within RevMan (RevMan 2014). We will report the results of subgroup analyses quoting the ChiI² statistic and P value, and the interaction test I² value.

Sensitivity analysis

We did not perform sensitivity analysis. In future updates, we will perform sensitivity analyses to look at the effect of quasi-randomised versus truly randomised studies on primary outcomes.

RESULTS

Description of studies

Results of the search

We included 29 and excluded 32 studies. One study is awaiting classification and one study is an ongoing study.

Included studies

See table of Characteristics of included studies for details.

Excluded studies

For details of the excluded studies, *see* Characteristics of excluded studies.

Risk of bias in included studies

See table of Characteristics of included studies and Figure 1; Figure 2 for a summary of 'Risk of bias' assessments.

Figure 1. 'Risk of bias' graph: review authors' judgements about each risk of bias item presented as percentages across all included studies.

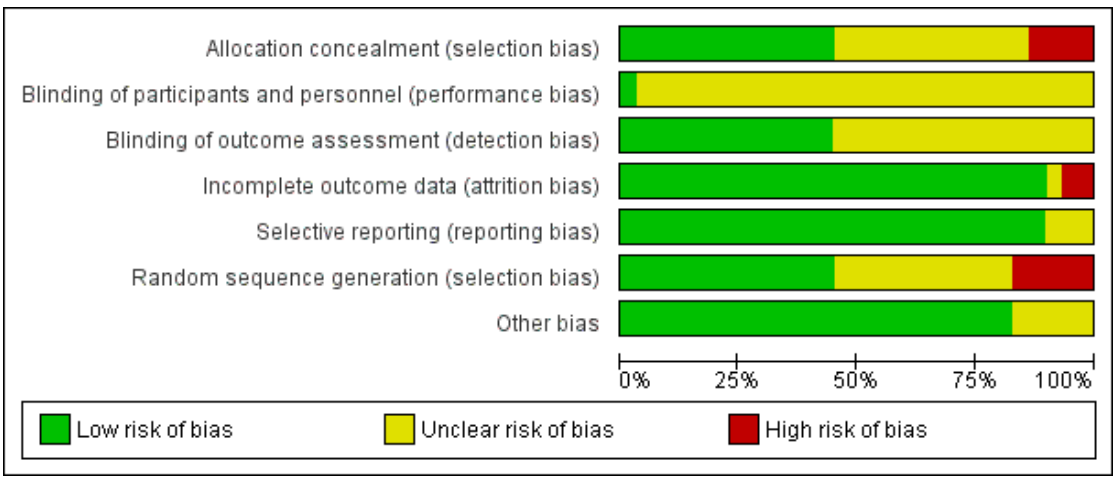
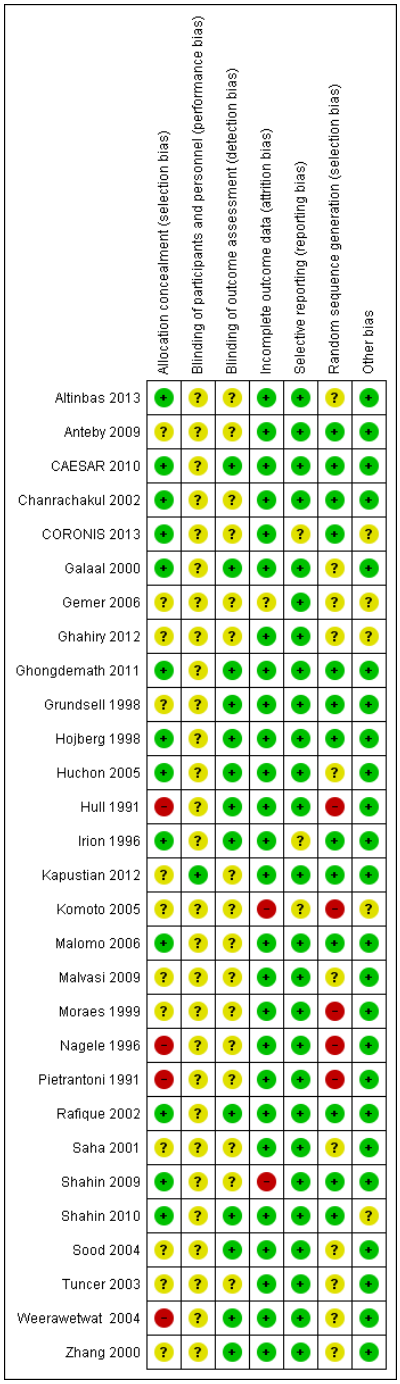


Figure 2. 'Risk of bias' summary: review authors' judgements about each risk of bias item for each included study.



The quality of the trials was variable. The general finding of studies that predated year 2000 was lack of adequate information to allocate the degree of bias. With more trials in future, studies of low quality will be sub-analysed. This was not done with the current update because there were few trials that assessed the primary outcome.

Allocation

In several studies the method of random allocation was not specified. A quasi-random method of allocation was used in the trials of Hull 1991, Komoto 2005, Moraes 1999, Nagele 1996, and Pietrantoni 1991.

The method of allocation in many of the older trials (pre year 2000) were poor. The trials were not properly concealed or allocation methods were not detailed in more than 50% of the included trials.

Blinding

Blinding of the procedure itself is not feasible, but outcome assessment could be blinded. However, in this review, more than 80% of trials were noted to have an unclear risk of performance and detection bias.

Incomplete outcome data

Attrition was less than 10% in the meta-analysis.

Selective reporting

In the majority of studies assessed, the published reports included all expected outcomes.

Other potential sources of bias

Due to lack of information, there might have been some other yet to be identified sources of error in the review.

Effects of interventions

A total of 29 trials were included in this review and 21 trials (17,276 women) provided data that could be included in an analysis. Thirty-eight meta-analyses were performed.

(1) Non-closure of both visceral and parietal peritoneum compared with suturing both visceral and parietal peritoneum

Sixteen trials involving 15,480 women, were included in the analysis. The methodological quality of the trials was variable with some of the outcomes demonstrating significant heterogeneity.

Primary outcomes

Postoperative adhesion formation was assessed in only four trials with 282 women, and no difference was found between groups (risk ratio (RR) 0.99, 95% confidence interval (CI) 0.76 to 1.29) Analysis 1.1.

Secondary outcomes

Non-closure of the peritoneum reduced operating time by -5.81 minutes, 95% CI -7.68 to -3.93, Analysis 1.8 (Heterogeneity: $Tau^2 = 12.63$; $I^2 = 95\%$). There was also a reduction in duration of hospitalisation post caesarean section when both visceral and parietal peritoneum were left unsutured compared to closure of both peritoneal layers, though the difference of 0.26 days may not be clinically meaningful (13 trials, 14, 906 women, mean difference (MD) in days -0.26, 95% CI -0.47 to -0.05), Analysis 1.9 (Heterogeneity: $Tau^2 = 0.11$; $I^2 = 90\%$). As regards chronic pelvic pain, a recent trial involving 112 women was included. There was an improvement in the outcome when both peritoneal surfaces were left unsutured (RR 0.49. 95% CI 0.25 to 0.98, one trial, 112 women) Analysis 1.10.

There was no difference in the number of narcotic analgesics used, infectious morbidity, endometritis, wound infection, chronic pelvic pain, need for transfusion more than 1 unit of blood (not prespecified outcome), and maternal death (not pre-specified outcome). Equally there was no difference in the pain six weeks postpartum and readmission to hospital (not prespecified outcome).

(2) Non-closure of the visceral peritoneum only compared with suturing both parietal and visceral peritoneum

Only three studies involving 889 women examined non-closure of visceral peritoneum versus closure of both peritoneal layers.

Primary outcomes

In two trials involving 157 women, adhesions formation was increased in the visceral peritoneal non-closure group (Malvasi 2009; Weerawetwat 2004) (RR 2.49 and 95% CI 1.49 to 4.16), Analysis 2.1. This effect was seen only in one of the trials (Malvasi 2009), which was at high risk of bias.

Secondary outcomes

One study (Nagele 1996) involving 544 women showed reduction in operating time (MD -6.30 minutes, 95% CI -9.22 to -3.38) Analysis 2.5, and postoperative days in hospital (MD -0.70, 95% CI -0.98 to -0.42), Analysis 2.6, in the non-closure group. Three

trials involving 889 women showed no reduction in postoperative fever (average RR 0.60, 95% CI 0.29 to 1.27; Heterogeneity: Tau^2 = 0.28; Chi^2 = 6.26, df = 2; P = 0.04); I^2 = 68%), Analysis 2.3, and two showed a reduction in wound infection (RR 0.36, 95% CI 0.14 to 0.89), Analysis 2.2. There was no difference in the one trial (Weerawetwat 2004), that assessed for endometritis, (RR 3.00, 95% CI 0.12 to 72.91), Analysis 2.4.

(3) Non-closure of parietal peritoneum only compared with closure of both parietal and visceral peritoneum

Two studies involving 573 women were identified (Pietrantoni 1991; Shahin 2009).

Primary outcomes

Neither study reported on postoperative adhesion formation.

Secondary outcomes

One study (Pietrantoni 1991) was a quasi-randomised trial. In this study, there were no significant differences in endometritis, fever, wound infection or hospital stay, but the operative time was reduced (MD -5.10 minutes, 95% CI -8.71 to -1.49), Analysis 3.5. The second study involved 325 women where postoperative pain was the outcome assessed. There was a reduction in pain in the non-closure group (RR 0.45, 95% CI 0.31 to 0.66), Analysis 3.2. The women were able to mobilise earlier in the non-closure group (not prespecified outcome) Analysis 3.7 (MD -1.89, 95% CI -3.18 to -0.60) and time to oral intake (not prespecified outcome) (MD -2.31, 95% CI -3.76 to -0.86) Analysis 3.8. However, there was no drop in haemoglobin (not prespecified outcome) Analysis 3.9 (MD 0.28, 95% CI -0.03 to 0.59), no difference in blood loss (not prespecified outcome) Analysis 3.10 and no improvement in time to flatus (not prespecified outcome) Analysis 3.11. There was more incidence of acute wound pain measured by visual analogue score (MD -1.60, 95% CI -1.97 to -1.23), Analysis 3.12, and persistent abdominal pain after eight months measured by numerical rating scale (MD -1.10, 95% CI -1.39 to -0.81) Analysis 3.13 in the closure group.

(4) Non-closure versus closure of visceral peritoneum when parietal peritoneum is closed

Primary outcome

No study reported on postoperative adhesion formation.

Secondary outcome

Only one study of (Shahin 2010) was identified. There was a reduction in frequency (RR 0.24, 95% CI 0.13 to 0.45), Analysis 4.1, urgency (RR 0.30, 95% CI 0.18 to 0.51), Analysis 4.2, and incontinence (RR 0.45, 95% CI 0.21 to 0.96), Analysis 4.3, when the visceral peritoneum was left unsutured.

Funnel plots for outcomes with more than 10 studies did not show any obvious asymmetry (Figure 3; Figure 4; Figure 5; Figure 6).

Figure 3. Funnel plot of comparison: 1 Non-closure of both parietal and visceral peritoneum versus closure of both peritoneal layers, outcome: 1.2 Wound infection.

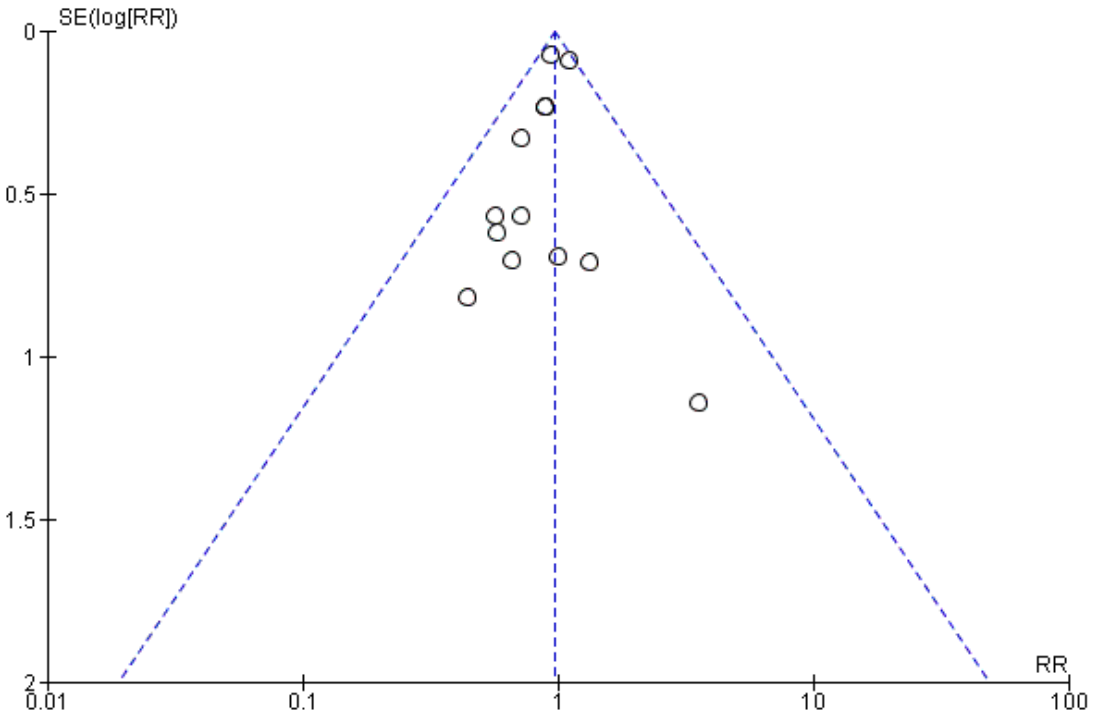


Figure 4. Funnel plot of comparison: 1 Non-closure of both parietal and visceral peritoneum versus closure of both peritoneal layers, outcome: 1.6 Infectious morbidity.

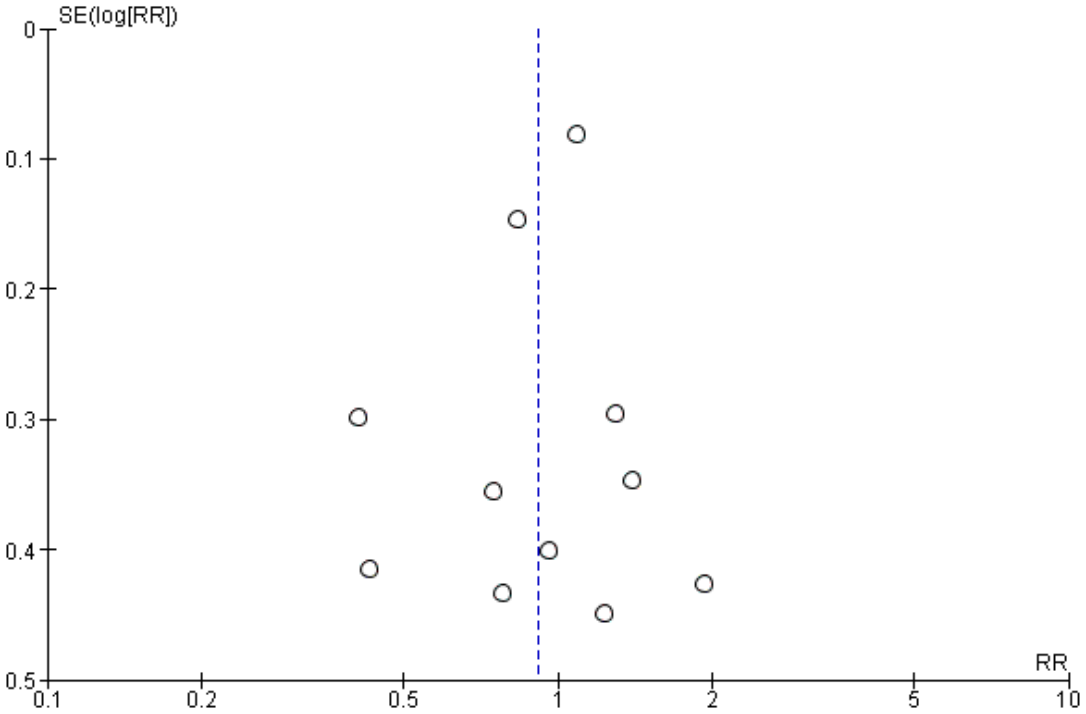


Figure 5. Funnel plot of comparison: 1 Non-closure of both parietal and visceral peritoneum versus closure of both peritoneal layers, outcome: 1.8 Operating time (minutes).

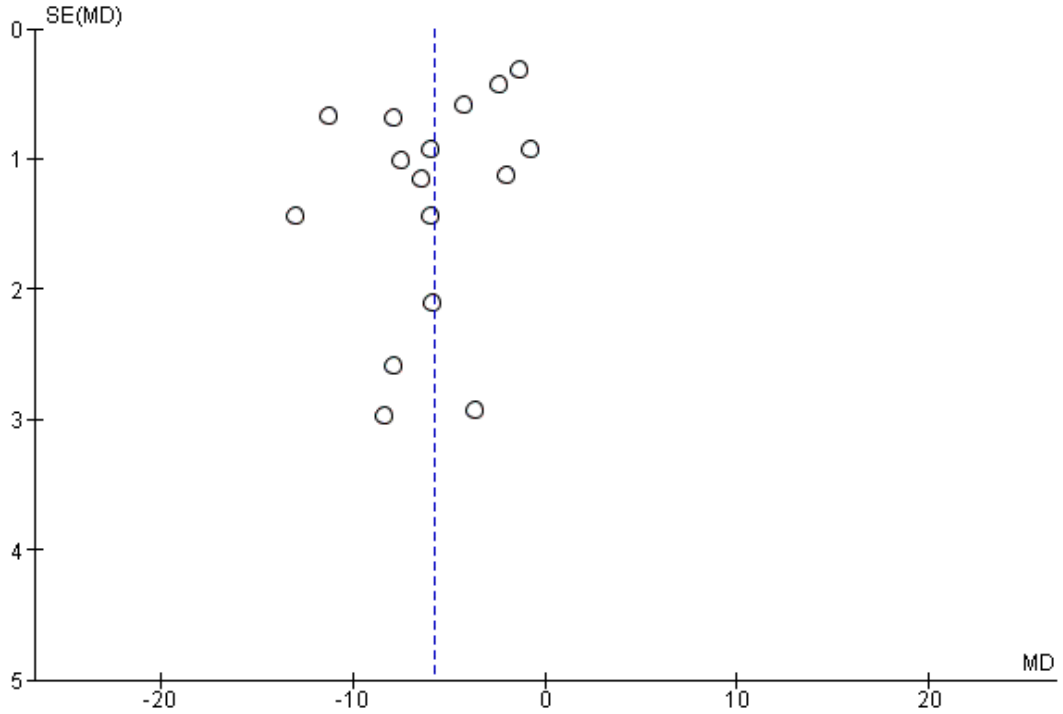
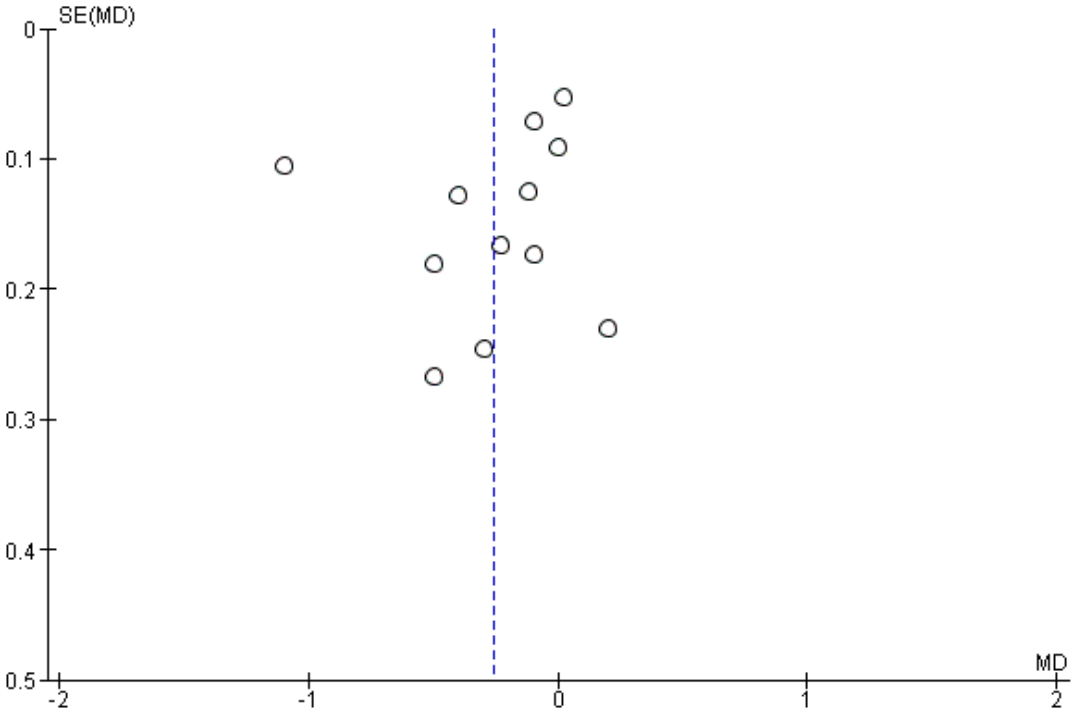


Figure 6. Funnel plot of comparison: 1 Non-closure of both parietal and visceral peritoneum versus closure of both peritoneal layers, outcome: 1.9 Postoperative days in hospital.



DISCUSSION

Summary of main results

Although the methodological quality of trials was variable, the results were in general, consistent between the trials of better and poorer quality. The results of two recent very large multicentre trials (CAESAR 2010; CORONIS 2013) were consistent with the overall results for those outcomes reported, except that in the CAESAR 2010 study the reduction in hospital stay did not reach statistical significance. There appears to be no difference in the immediate postoperative outcomes for non-closure of both peritoneum at caesarean section compared with routine closure of both. There was however, noticeable difference in the operating time and the duration of hospital stay in women who had non-closure of either peritoneum compared to those who had both peritoneal layers (subgroup 1) closed as well as those who had non-closure of the visceral peritoneum only compared with suturing both parietal and visceral peritoneum (subgroup 2). In this subgroup 2, a reduction in postoperative fever, wound infection and adhesions formation was noted. The only adverse outcome recorded was an increase in adhesion formation in one small trial at high risk of bias. Adhesion formation will be an important outcome in any future trial, which might be a long-term prospective randomised study with particular emphasis on long-term morbidity. The implication of adhesion formation could be legion from a vague abdominal pain to intestinal obstruction and subfertility. An outcome that was consistently reduced with the three subgroups was duration of surgery. While cost was not addressed directly in these trials, the use of less suture material and reduced operating time would reduce cost, which may be of particular importance in resource-poor countries. The data in this review on long-term benefits or hazards of leaving the peritoneum unsutured are variable to inform practice, though data from other surgical procedures and animal studies suggest long-term benefit from peritoneal non-closure, particularly regarding adhesion formation (*see* Background).

This scope of this review does not include the possible effect of methods of opening the peritoneum (e.g. sharp, blunt, cautery) on outcomes.

Overall completeness and applicability of evidence

The evidence includes a large number of trials from various settings, including two large multicentre trials. However, many outcomes, particularly long-term outcomes, were not reported in most trials.

Quality of the evidence

The later trials are of better quality than earlier trials. Future analysis will include a sensitivity analysis excluding pseudo-randomised trials. Although there was high heterogeneity for outcomes such as 1.6 (operating time) and 1.7 (postoperative stay), this was due to quantitative differences rather than differences in direction of effect.

Potential biases in the review process

None noted.

Agreements and disagreements with other studies or reviews

The review findings are in general consistent with those of two recent large multicentre trials.

AUTHORS' CONCLUSIONS

Implications for practice

Leaving the peritoneum unsutured reduces operative time and use of suture material. What evidence is available suggests that leaving the peritoneum unsutured is not likely to be hazardous in the short term, and may have some benefits such as reduced pain and infection (low-quality evidence). There was limited, inconsistent evidence on the risk of adhesions formation. There is currently insufficient evidence of benefit to justify the additional time and use of suture material necessary for peritoneal closure.

Implications for research

Further research on the long-term benefits or complications of non-closure of the peritoneum at caesarean section (particularly adhesion formation and infertility) is needed, and findings will be updated as they become available.

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* *Indicates the major publication for the study*

CHARACTERISTICS OF STUDIES

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

Altinbas 2013

Methods	Randomised trial.
Participants	Women for caesarean section.
Interventions	55 women were randomised to have caesarean section with closure of parietal peritoneum and 55 women had non-closure of the peritoneum
Outcomes	Drop in haemoglobin, blood loss, extra suture needed, operating time, time to passage of flatus, immobilisation, oral intake and postoperative pain
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	Low risk	Concealed envelope.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Impossible to blind a surgical procedure.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Lack of information.
Incomplete outcome data (attrition bias) All outcomes	Low risk	No loss found.
Selective reporting (reporting bias)	Low risk	No bias.
Random sequence generation (selection bias)	Unclear risk	Method of generation, not stated.
Other bias	Low risk	No obvious bias noted.

Anteby 2009

Methods	A prospective randomised trial.
Participants	533 women at term who were caesarean section naive.
Interventions	Closure versus non-closure of peritoneum at caesarean section

Anteby 2009 (*Continued*)

Outcomes	Short-term outcomes of analgesic need, febrile illness and surgical wound infection	
Notes	None.	
Risk of bias		
Bias	**Authors' judgement**	**Support for judgement**
Allocation concealment (selection bias)	Unclear risk	Random allocation but no mention of the method of concealment
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Lack of information.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Lack of information.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Data of all women were included.
Selective reporting (reporting bias)	Low risk	None observed.
Random sequence generation (selection bias)	Low risk	Computer-generated sequence.
Other bias	Low risk	None.

CAESAR 2010

Methods	This is a multicentre, randomised controlled trial of techniques of performing caesarean section	
Participants	30,033 women undergoing caesarean delivery.	
Interventions	Single versus double layer uterine closure; closure of the peritoneum and the use of sub rectus sheath drain	
Outcomes	Febrile infectious morbidity.	
Notes	None.	
Risk of bias		
Bias	**Authors' judgement**	**Support for judgement**
Allocation concealment (selection bias)	Low risk	Telephonic allocation.

CAESAR 2010 (*Continued*)

Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Lack of information.
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Data collectors and analyst were blinded but the surgeon could not be blinded
Incomplete outcome data (attrition bias) All outcomes	Low risk	The analysed women were only those who have any follow-up data
Selective reporting (reporting bias)	Low risk	None.
Random sequence generation (selection bias)	Low risk	Computer-generated randomisation.
Other bias	Low risk	None.

Chanrachakul 2002

Methods	Allocation was made randomly using sealed opaque envelopes in computer-generated random sequence
Participants	60 women to undergo caesarean section.
Interventions	1. Experimental (30): non-closure of both peritoneal surfaces. 2. Control (30): closure of both peritoneal surfaces.
Outcomes	Operating time, intraoperative blood loss, length of hospitalisation and analgesic doses required
Notes	No difference in the amount of analgesic dosages required.

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Allocation concealment (selection bias)	Low risk	Allocation by sealed opaque envelopes.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Surgeon could not be blinded.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Lack of information.

Chanrachakul 2002 (*Continued*)

Incomplete outcome data (attrition bias) All outcomes	Low risk	No loss of data.
Selective reporting (reporting bias)	Low risk	None noted.
Random sequence generation (selection bias)	Low risk	Computer generated.
Other bias	Low risk	None.

CORONIS 2013

Methods	Fractional, factorial trial.
Participants	15,935 women for caesarean section.
Interventions	1 of the 5 intervention pairs was closure versus non-closure of peritoneum of parietal and visceral peritoneum
Outcomes	Maternal mortality, infectious morbidity, further operative procedures, blood transfusion of more than 1 unit within 6 weeks of follow-up
Notes	

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Allocation concealment (selection bias)	Low risk	Envelopes which contain allocation sheet.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Surgeons could not be masked but unlikely to affect the outcome as in most surgical procedures
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Lack of information.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Percentage of data loss was low.
Selective reporting (reporting bias)	Unclear risk	None.
Random sequence generation (selection bias)	Low risk	Web-based randomisation.
Other bias	Unclear risk	Unclear.

Galaal 2000

Methods	Prospective randomised trial. Allocation by numbered envelope technique
Participants	60 women undergoing caesarean section.
Interventions	1. 30 women in the experimental group: non-closure of both peritoneal surfaces. 2. 30 women with both peritoneal surfaces closed serving as controls
Outcomes	Operating time, length of stay, blood loss, blood transfusion, drop in haemoglobin, postoperative pyrexia, and wound infection
Notes	

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Allocation concealment (selection bias)	Low risk	Adequate by sealed numbered envelopes.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Lack of information.
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Cannot be blinded but data collection blinded.
Incomplete outcome data (attrition bias) All outcomes	Low risk	None.
Selective reporting (reporting bias)	Low risk	None.
Random sequence generation (selection bias)	Unclear risk	Random allocation.
Other bias	Low risk	None noted.

Gemer 2006

Methods	Prospective randomised trial.
Participants	387 women at term were randomised.
Interventions	Closure versus non-closure.
Outcomes	Short-term outcomes - duration of surgery analgesic usage and febrile morbidity
Notes	This trial appears to precede the CORONIS trial.

Gemer 2006 (*Continued*)

Risk of bias		
Bias	**Authors' judgement**	**Support for judgement**
Allocation concealment (selection bias)	Unclear risk	No details.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Lack of information.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Lack of information.
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	No information.
Selective reporting (reporting bias)	Low risk	No details to suggest reporting was biased.
Random sequence generation (selection bias)	Unclear risk	Only the abstract could be obtained.
Other bias	Unclear risk	No information.

Ghahiry 2012

Methods	Randomised trial.
Participants	108 women undergoing caesarean section.
Interventions	52 women undergoing caesarean section randomised into the Misgav Ladach and 60 women randomised into traditional Pfannenstiel incision
Outcomes	Filmy and dense adhesions formation and chronic pelvic pain.
Notes	

Risk of bias		
Bias	**Authors' judgement**	**Support for judgement**
Allocation concealment (selection bias)	Unclear risk	Method of allocation not stated.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Lack of information.

Ghahiry 2012 (*Continued*)

Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Lack of information.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Complete.
Selective reporting (reporting bias)	Low risk	No evidence of bias.
Random sequence generation (selection bias)	Unclear risk	Method of generation, not stated.
Other bias	Unclear risk	None.

Ghongdemath 2011

Methods	Prospective randomised study.
Participants	200 women undergoing caesarean section.
Interventions	Closure versus non-closure of the peritoneum.
Outcomes	Operative time, pain score, febrile illness, wound infection and hospital stay
Notes	

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Allocation concealment (selection bias)	Low risk	Opaque envelope.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Lack of information.
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Data collectors and analysts blinded.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Data completed.
Selective reporting (reporting bias)	Low risk	None.
Random sequence generation (selection bias)	Low risk	Computer-generated sequence.

Ghongdemath 2011 (*Continued*)

Other bias	Low risk	None.

Grundsell 1998

Methods	A random-selection table was used to assign groups.
Participants	361 women "who were to undergo caesarean section".
Interventions	1. Experimental (179): both visceral and parietal peritoneum were left unclosed. 2. Control (182): both visceral and parietal peritoneum were closed with a running, delayed absorbable suture
Outcomes	Operating time, febrile morbidity, wound infection, urinary tract infection, fever of unknown origin, wound dehiscence, opening of bowels, admission days and postoperative paralytic ileus
Notes	None.

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Allocation concealment (selection bias)	Unclear risk	Unclear as to how allocation was concealed.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	No information.
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Blinding of data collectors.
Incomplete outcome data (attrition bias) All outcomes	Low risk	No data loss.
Selective reporting (reporting bias)	Low risk	None.
Random sequence generation (selection bias)	Low risk	Random generated tables.
Other bias	Low risk	None.

Hojberg 1998

Methods	Telephone-randomisation via a computer program.
Participants	40 women referred for elective caesarean section.
Interventions	1. 21 women with non-closure of parietal peritoneum and closure of visceral peritoneum. 2. 19 women had both peritoneal surfaces closed.
Outcomes	Analgesic requirement (less used in non-closure group, data not included as non-parametric data given), blood loss, febrile morbidity, return of bowel action and days in hospital
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	Low risk	Adequate.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	No information.
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Blinding of assessors.
Incomplete outcome data (attrition bias) All outcomes	Low risk	None.
Selective reporting (reporting bias)	Low risk	None.
Random sequence generation (selection bias)	Low risk	Telephone random sequence.
Other bias	Low risk	None.

Huchon 2005

Methods	Randomised trial.
Participants	240 women for caesarean section. 138 randomised.
Interventions	Closure versus non-closure of the peritoneum for caesarean section. 63 women versus 75 women respectively
Outcomes	Wound infection, haematoma, time for ileus,durations of surgery and hospitalisation, postoperative pain and analgesic requirements

Huchon 2005 (*Continued*)

Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	Low risk	Sealed envelopes.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	No information.
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Assessors blinded.
Incomplete outcome data (attrition bias) All outcomes	Low risk	None.
Selective reporting (reporting bias)	Low risk	None.
Random sequence generation (selection bias)	Unclear risk	Randomised but method not stated.
Other bias	Low risk	None.

Hull 1991

Methods	Allocation based on last digit of medical record.
Participants	113 women "who were to undergo caesarean section".
Interventions	1. Experimental (54): both visceral and parietal peritoneum were left unsutured. 2. Control (59): both the visceral and parietal peritoneum were closed with a running, delayed absorbable suture
Outcomes	Operating time, postoperative morbidity, hospital stay.
Notes	4 women excluded because had vertical uterine incisions.

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	High risk	Inadequate.

Hull 1991 (*Continued*)

Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Lack of information.
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Impossible to blind the surgeon but outcome assessors blinded
Incomplete outcome data (attrition bias) All outcomes	Low risk	Outcome data.
Selective reporting (reporting bias)	Low risk	None.
Random sequence generation (selection bias)	High risk	Allocation based on last digit of medical record.
Other bias	Low risk	None.

Irion 1996

Methods	Random allocation in blocks of varying size at the beginning of the operation by computer-generated random numbers. Sequentially numbered opaque sealed envelopes were used
Participants	280 women "were recruited" undergoing elective or emergency caesarean section
Interventions	1. Experimental (137): both the visceral and parietal peritoneum were left unsutured. 2. Control (143): both the visceral and parietal peritoneum were re-approximated using continuous, running, delayed absorbable sutures
Outcomes	Length of postoperative hospital stay (from operation notes), pain (visual analogue scale, analgesics on first postoperative day), duration of ileus (auscultation of bowel sounds) and febrile morbidity (sublingual temperature > 38 degrees centigrade lasting at least 24 hours). 7 years following the clinical study, a cohort of this women were contacted to assess the long-term follow-up (Roset E et al) Assessment for postsurgical adhesions and subfertility amongst others were made
Notes	

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Allocation concealment (selection bias)	Low risk	Sequentially-labelled opaque envelope.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Lack of information.

Irion 1996 (*Continued*)

Blinding of outcome assessment (detection bias) All outcomes	Low risk	Surgeon could not be blinded but the assessors.
Incomplete outcome data (attrition bias) All outcomes	Low risk	None.
Selective reporting (reporting bias)	Unclear risk	None.
Random sequence generation (selection bias)	Low risk	Computer-generated random sequence.
Other bias	Low risk	None.

Kapustian 2012

Methods	Randomised controlled trial.
Participants	533 women undergoing caesarean section.
Interventions	Closure versus non-closure of peritoneum.
Outcomes	Adhesions were scored in repeat caesarean section.
Notes	

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Allocation concealment (selection bias)	Unclear risk	Not stated.
Blinding of participants and personnel (performance bias) All outcomes	Low risk	Surgeon was blinded during repeat caesarean section.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Lack of information.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Complete.
Selective reporting (reporting bias)	Low risk	None.
Random sequence generation (selection bias)	Low risk	Computer-generated sequence.

Kapustian 2012 (*Continued*)

Other bias	Low risk	None.

Komoto 2005

Methods	Pseudo-randomisation.
Participants	Women undergoing caesarean section.
Interventions	Closure of both peritoneal layers versus non-closure.
Outcomes	Operative time and number of analgesic doses required.
Notes	

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Allocation concealment (selection bias)	Unclear risk	Unknown.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Lack of information.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Lack of information.
Incomplete outcome data (attrition bias) All outcomes	High risk	Non-closure, 53 versus 70 closure.
Selective reporting (reporting bias)	Unclear risk	Not evident.
Random sequence generation (selection bias)	High risk	Hospital record.
Other bias	Unclear risk	Unknown.

Malomo 2006

Methods	Prospective randomised trial of uncomplicated women at term.
Participants	54 women who required delivery by caesarean section.
Interventions	Closure versus non-closure of both visceral and parietal peritoneum

Malomo 2006 (*Continued*)

Outcomes	Anaesthetic time, duration of operation, analgesic requirement, wound infection and ileus	
Notes	None.	
Risk of bias		
Bias	**Authors' judgement**	**Support for judgement**
Allocation concealment (selection bias)	Low risk	Opaque envelopes.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Lack of information.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Lack of information.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Complete.
Selective reporting (reporting bias)	Low risk	None.
Random sequence generation (selection bias)	Low risk	Table of random numbers was used.
Other bias	Low risk	None.

Malvasi 2009

Methods	Prospective randomised trial.	
Participants	Women who consented for elective caesarean section and for a repeat caesarean section in their next pregnancy	
Interventions	Closure of visceral peritoneum versus non-closure.	
Outcomes	Adhesions formation using the adhesions scoring system, fibrosis and neoangiogenesis of mesothelial cells under electron microscopy	
Notes	None.	
Risk of bias		
Bias	**Authors' judgement**	**Support for judgement**

Malvasi 2009 (*Continued*)

Allocation concealment (selection bias)	Unclear risk	No mention of the method used to conceal initial allocation of women during repeat caesarean section
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Lack of information.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Lack of information.
Incomplete outcome data (attrition bias) All outcomes	Low risk	All outcomes were clearly sought for and documented.
Selective reporting (reporting bias)	Low risk	None.
Random sequence generation (selection bias)	Unclear risk	Patients 'were consecutively allocated into 2 groups by the clinicians....' . method of allocation was not stated
Other bias	Low risk	None.

Moraes 1999

Methods	Prospective pseudo-randomised trial.
Participants	698 pregnant women for caesarean section.
Interventions	Closure versus non-closure of both peritoneal layers.
Outcomes	Duration of surgery, number of sutures used, postoperative pyrexia, wound infection, number of doses of analgesic, antiemetic and antiseptic requirement, and number of days spent in the hospital
Notes	None.

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Allocation concealment (selection bias)	Unclear risk	Method of concealment not stated.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Surgeon not blinded but would not have affected the result.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Lack of information.

Moraes 1999 (*Continued*)

Incomplete outcome data (attrition bias) All outcomes	Low risk	Complete data.
Selective reporting (reporting bias)	Low risk	None.
Random sequence generation (selection bias)	High risk	Sequential allocation.
Other bias	Low risk	None.

Nagele 1996

Methods	Pseudo-randomised based on days of the week.
Participants	549 women undergoing caesarean section were randomised.
Interventions	262 non-closure versus 287 closure visceral peritoneum.
Outcomes	Operating time, postoperative morbidity, hospital stay.
Notes	None.

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Allocation concealment (selection bias)	High risk	Inadequate.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Lack of information.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Lack of information.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Complete.
Selective reporting (reporting bias)	Low risk	None.
Random sequence generation (selection bias)	High risk	Pseudo-randomisation.
Other bias	Low risk	None.

Pietrantoni 1991

Methods	Allocation by last digit of hospital number (odd or even).
Participants	248 women undergoing caesarean section through a Pfannenstiel incision
Interventions	1. Experimental (127): non-closure of parietal peritoneum but closure of the visceral peritoneum. 2. Control (121): both visceral and parietal peritoneum were sutured
Outcomes	Postoperative morbidity, days in hospital. Standard errors of the mean converted to standard deviation for this analysis
Notes	6 women were excluded.

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Allocation concealment (selection bias)	High risk	Inadequate.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Lack of information.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Lack of information.
Incomplete outcome data (attrition bias) All outcomes	Low risk	None.
Selective reporting (reporting bias)	Low risk	None.
Random sequence generation (selection bias)	High risk	Allocation by using hospital number.
Other bias	Low risk	None.

Rafique 2002

Methods	Randomised controlled trial. Randomisation generated by computer and allocation by opaque sealed numbered envelopes
Participants	100 women undergoing caesarean section.
Interventions	1. Experimental group, non-closure: 50. 2. Control group: 50.
Outcomes	Operative time, number of days to discharge, postoperative haemoglobin, use of analgesia

Rafique 2002 (*Continued*)

Notes	None.

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	Low risk	Adequate.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Lack of information.
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Not blinded but surgeon could not have been blinded. Assessor blinded
Incomplete outcome data (attrition bias) All outcomes	Low risk	None.
Selective reporting (reporting bias)	Low risk	None.
Random sequence generation (selection bias)	Low risk	Computer-generated random sequence.
Other bias	Low risk	None.

Saha 2001

Methods	Randomised controlled trial. Method of randomisation not stated
Participants	100 women undergoing caesarean section.
Interventions	1. Experimental group, non-closure: 50. 2. Control group: 50 women who had non-closure of visceral peritoneum
Outcomes	Operative time, number of days to discharge, postoperative febrile illness, use of additional narcotics analgesia
Notes	None.

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	Unclear risk	Not stated.

Saha 2001 (*Continued*)

Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Lack of information.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Lack of information.
Incomplete outcome data (attrition bias) All outcomes	Low risk	None.
Selective reporting (reporting bias)	Low risk	None.
Random sequence generation (selection bias)	Unclear risk	Not stated.
Other bias	Low risk	None.

Shahin 2009

Methods	Prospective randomised trial.
Participants	Women at term, who consented to caesarean section and in the trial
Interventions	170 randomised to have the parietal peritoneum closed and 170 were left unclosed. Visceral peritoneum was closed in all women. 325 women were analysed
Outcomes	Postoperative abdominal pain, epigastric pain and wound pain
Notes	

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Allocation concealment (selection bias)	Low risk	Sealed opaque envelopes.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Lack of information.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Lack of information.
Incomplete outcome data (attrition bias) All outcomes	High risk	Outcomes were incomplete. 15 women were not analysed.

Shahin 2009 (*Continued*)

Selective reporting (reporting bias)	Low risk	None.
Random sequence generation (selection bias)	Low risk	Computer-generated random sequence.
Other bias	Low risk	None.

Shahin 2010

Methods	Randomised trial.
Participants	Women for caesarean section.
Interventions	Closure of parietal peritoneum versus non-closure.
Outcomes	Postoperative urinary symptoms assessed up to 6 months.
Notes	

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Allocation concealment (selection bias)	Low risk	Opaque envelopes.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Lack of information.
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Assessor of outcome not aware of allocation.
Incomplete outcome data (attrition bias) All outcomes	Low risk	285 women in the non-closure versus 290. All studied women were assessed for outcome
Selective reporting (reporting bias)	Low risk	No evidence of selective reporting.
Random sequence generation (selection bias)	Low risk	Computer based.
Other bias	Unclear risk	None noted.

Sood 2004

Methods	Randomised controlled trial. Method of randomisation not stated
Participants	149 women undergoing caesarean section.
Interventions	1. Experimental (71): non-closure of both parietal and visceral peritoneum. 2. Control (78): both visceral and parietal peritoneum were closed
Outcomes	Anaesthesia time, operating time, postoperative pain, no of analgesic doses, febrile morbidity, endomyometritis, cystitis, wound infection and days of hospitalisation
Notes	None.

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	Unclear risk	Unclear.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Lack of information.
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Blinding of assessor.
Incomplete outcome data (attrition bias) All outcomes	Low risk	None.
Selective reporting (reporting bias)	Low risk	None.
Random sequence generation (selection bias)	Unclear risk	Not stated.
Other bias	Low risk	None.

Tuncer 2003

Methods	Randomised controlled trial. Method of randomisation not stated
Participants	80 women undergoing caesarean section.
Interventions	1. 40 women with non-closure of parietal peritoneum and visceral peritoneum. 2. 40 women had both peritoneal surfaces closed.
Outcomes	Operative time, anaesthesia time, length of hospital stay, morphine consumption and visual analogue pain scores
Notes	

Tuncer 2003 (*Continued*)

Risk of bias		
Bias	**Authors' judgement**	**Support for judgement**
Allocation concealment (selection bias)	Unclear risk	Unclear.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Lack of information.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Lack of information.
Incomplete outcome data (attrition bias) All outcomes	Low risk	None.
Selective reporting (reporting bias)	Low risk	None.
Random sequence generation (selection bias)	Unclear risk	Method of randomisation, unknown.
Other bias	Low risk	None.

Weerawetwat 2004

Methods	"Each surgeon randomised and separated the women by running number into 3 groups. "
Participants	360 women undergoing caesarean section.
Interventions	3 groups: non-closure of both peritoneum, closure of only parietal peritoneum, closure of both peritoneum
Outcomes	Short- and long-term assessments including adhesions at repeat caesarean section
Notes	An important study that looks at the issue of adhesions during repeat caesarean section

Risk of bias		
Bias	**Authors' judgement**	**Support for judgement**
Allocation concealment (selection bias)	High risk	Inadequate.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Lack of information.

Blinding of outcome assessment (detection bias) All outcomes	Low risk	Assessor blinded.
Incomplete outcome data (attrition bias) All outcomes	Low risk	None.
Selective reporting (reporting bias)	Low risk	None.
Random sequence generation (selection bias)	Unclear risk	Yes.
Other bias	Low risk	None.

Zhang 2000

Methods	Randomised controlled trial. Method of randomisation not stated
Participants	Pregnant women 36-43 weeks undergoing caesarean section.
Interventions	Peritoneal non-closure in 158 women compared with 160 women with closure
Outcomes	Postoperative morbidity, bowel movement, analgesic requirement, infection, Apgar score, neonatal outcome
Notes	None.

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Allocation concealment (selection bias)	Unclear risk	Not known.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Lack of information.
Blinding of outcome assessment (detection bias) All outcomes	Low risk	To assessor.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Outcome was complete.
Selective reporting (reporting bias)	Low risk	None.
Random sequence generation (selection bias)	Unclear risk	Not clear.

Zhang 2000 (*Continued*)

Other bias	Low risk	None.

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

Study	Reason for exclusion
Ayres-de-Campos 2000	No data on the control group given. Information on the first 37 cases assigned to the experimental non-closure group was available
Balat 2000	Excluded because intervention include non-closure of the rectus muscle and subcutaneous fascia, as well as peritoneum. Allocation was made 'randomly' (using odd and even days). Participants: 266 women undergoing caesarean section. Interventions: 1. Experimental (134), both visceral and parietal peritoneum and rectus muscle and subcutaneous fascia were unsutured. 2. Control (132), all layers were sutured. Outcomes: operation time, hospitalisation time and postoperative complications
Behrens 1997	Allocation was effected in alternating order; no adequate randomisation and lack of data
Bjorklund 2000	Excluded because several aspects of caesarean section were compared, not only peritoneal non-closure. Allocation was based on last digit of medical record. 339 women "who were to undergo caesarean section" were enrolled. 1. Experimental (169) Misgav-Ladach technique, both visceral and parietal peritoneum were left unsutured. 2. Control (170) routine technique, both the visceral and parietal peritoneum were closed. Outcomes: Apgar scores at 5 and 10 minutes, postoperative course and use of antibiotics, number of sutures used, febrile morbidity, wound infection, urinary tract infection, wound dehiscence, opening of bowels, admission days and postoperative ileus
Chaudri 2009	This is a poster presentation that has no outcome data.
Dani 1998	This study did not demonstrate any difference in short-term outcome of newborn infants born by caesarean section whether the peritoneal surfaces are closed or not. Exclusion is on the basis of the outcome reported not being in the protocol
Darj 1999	Excluded because the whole Misgav-Ladach technique was compared with the Pfannenstiel method. Random allocation. Participants: 50 women undergoing caesarean section electively. Interventions: 1. Experimental group, Joel-Cohen technique including non-closure of peritoneal surfaces (25). 2. Control group with Pfannenstiel technique and closure of both peritoneal surfaces (25). Outcomes: duration of operation, amount of bleeding, analgesic doses required, scar appearance, and length of hospitalisation

(*Continued*)

Decavalas 1997	This well-conducted randomised trial was ambiguous as to whether the peritoneum was closed in the control Pfannenstiel group. It appears that the outcome measured was the technique of opening the abdomen and may not evaluate closure versus non-closure of peritoneum even though the original description of Pfannenstiel includes closure of peritoneal surfaces. This may therefore not be assumed. Letters have been written to the author for clarification but no response as at November 2006
Ferrari 2001	Excluded because whole Misgav-Ladach technique compared with Pfannenstiel. Allocation was made randomly using sealed envelopes. Participants: 158 women to undergo caesarean section. Interventions: 1. Experimental (83), Joel-Cohen technique including non-closure of both peritoneal surfaces and single layered closure of uterine incision. 2.Control (75), Pfannenstiel technique with closure of both peritoneal surfaces. Outcomes: operating time, extraction time, intra-operative blood loss, length of hospitalisation, total sutures used
Franchi 1998	Excluded because intervention included Joel-Cohen incision as well as peritoneal non-closure. Allocation was made "randomly". Participants: 299 women to undergo caesarean section. Interventions: 1. Experimental (149), Joel-Cohen incision and non-closure of both peritoneal surfaces. 2. Control (150), Pfannenstiel incision and closure of both peritoneal surfaces. Outcomes: operating time, intraoperative blood loss, blood transfusion, bladder injuries, wound dehiscence, endometritis, sepsis, febrile morbidity, and urinary tract infections
Gaucherand 2001	Excluded because whole Misgav-Ladach technique compared with Pfannenstiel technique. A prospective randomised trial. Participants: 104 women undergoing caesarean section. Interventions: 1. 49 women in experimental group, Misgav-Ladach technique with non-closure of both peritoneal surfaces. 2. 55 women in Pfannenstiel group with closure of both peritoneal surfaces-control. Outcomes: duration of surgery, duration of time between incision - birth, blood loss rate, postoperative pain, the delay before flatus passed, number of days with postoperative fever and duration of hospitalisation
Ghezzi 2001	Excluded because whole Joel-Cohen technique compared with Pfannenstiel technique. A prospective randomised trial. Participants: 310 women undergoing caesarean section. Interventions: 1. Experimental 152 Joel-Cohen with non-closure of both peritoneal surfaces. 2. 158 women who had Pfannenstiel technique with both peritoneal surfaces closed. Outcomes: operative time, opening time, laparotomy wound length, intraoperative complications and postoperative morbidity
Hagen 1999	Excluded because several techniques were compared, not only peritoneal non-closure. Women were "randomly allocated". Participants: 98 women to undergo caesarean section. Interventions: 1. Experimental (48) Misgav-Ladach, non-closure of both visceral and parietal peritoneum. 2. Control (50) Pfannenstiel method, women had both peritoneal surfaces closed. Outcomes: time from skin incision to delivery, duration of operation, analgesics required, wound healing

(*Continued*)

	problems, bowel and bladder function, urinary tract infection and length of hospital stay
Heimann 2000	Excluded because it is a comparison of Misgav-Ladach versus Pfannenstiel techniques, not only peritoneal non-closure
Ho 1997	Excluded because not clear which data refer to which group, and appear to have used standard error of the mean rather than standard deviations (differences stated to be non-significant would be significant if the figures were standard deviations). Prospective randomised trial, "randomly allocated". Participants: 190 women who underwent caesarean section. Interventions: 1. 96 women with non-closure of both peritoneal surfaces. 2. 94 women with closure of both peritoneal surfaces. Outcomes: duration of operation, length of hospitalisation, pain visual analogue score, amount of analgesia required, fever, wound infection
Hojberg 1996	No difference in analgesic doses was found between the 2 groups. However, the study did not include numerical information hence the exclusion. Letter written in November 2006 to author for information
Jacobson 1992	This prospective study did not provide data for analysis.
Juszczak 2011	This paper brings into focus the feasibility of carrying out a randomised trial in a developing country. It does not address any of the outcomes
Khadem 2008	No details of data in this poster presentation.
Khadem 2009	It is a postal presentation the details of outcome data sought but in vain. However, non-closure of peritoneum conferred improved outcomes like infectious morbidity and duration of surgery
Lange 1993	Study was pseudo-randomised and data were incomplete. This study showed that uterine involution was earlier in the non-closure group
Moreira 2002	Comparison of entire Misgav-Ladach versus traditional technique, not only peritoneal non-closure
Ohel 1996	This was a well-conducted randomised controlled trial examining the use of closure or non-closure of peritoneum at caesarean section along with the use of a double or single layer uterine closure. Unfortunately, it was not possible to separate the effect of double- or single-layer uterine closure from the closure or non-closure of peritoneum on operation time and morbidity because of the methodology used
Rathnamala 2000	A well-reported trial unfortunately, the method of group selection was not stated hence the exclusion. There is an imbalance in the proportions with a vertical abdominal incision (45% in the non-closure versus 65% in the closure group)
Rengerink 2011	This study compared the 2 methods of skin closure - skin staples or sutures . It also assessed the need or otherwise of subcutaneous fat layer. It did not looked at peritoneal closure
Sodowski 2000	Method of randomisation was not stated, and data were not provided in a usable format. However, the outcomes in this study followed the general trend of favouring peritoneal non-closure as regards operating time and complication rate

(*Continued*)

Stark 1995	Retrospective analysis of 2 different operating techniques by 2 groups of surgeons, using different techniques of uterine and peritoneal closure. There was significant reduction in febrile morbidity and adhesions in repeat sections when the peritoneum was not closed, without differences in haematocrit or haemoglobin changes. Although analysis of the 2 groups showed no differences in age, gestation, gravidity, parity, previous caesarean section or rupture of membranes, this was not a randomised controlled trial, and is thus excluded. The direction of effect is consistent with the included studies
Svigos 1990	Data sought but in vain.
Ugur 2010	A very important long-time outcome of adhesions formation in this trial but no data were supplied for analysis. This is an abstract of a congress presentation
Wallin 1999	Excluded because peritoneal non-closure was not the only intervention studied. Allocation was by last digit of hospital number (odd or even). 72 women undergoing caesarean section through a Pfannenstiel incision. 1. Experimental (36), non-closure of parietal and visceral peritoneum. 2. Control (36), both visceral and parietal peritoneum were sutured. Postoperative morbidity, days in hospital
Woyton 2000	Participants were divided into 2 groups without randomisation (307 no closure of visceral peritoneum, 270 closure). It is noteworthy that non-closure of peritoneum was associated with less bladder peritoneal adhesions
Xavier 1999	Excluded because whole Joel-Cohen technique used. Randomised trial with pre-allocation concealment. Participants: 46 women undergoing caesarean section. Interventions: 1. 23 women in the experimental Joel Cohen group including non-closure of both peritoneal surfaces. 2. 23 women in the control group with Pfannenstiel technique, where both surfaces were closed. Outcomes: duration of operation, analgesic dosages, bowel emptying, postoperative fever and antibiotics, scar complications

Characteristics of studies awaiting assessment *[ordered by study ID]*

Mocanasu 2005

Methods	Randomised trial.
Participants	80 pregnant women undergoing caesarean section.
Interventions	Closure of peritoneum versus non-closure.
Outcomes	Short-term outcomes.
Notes	Awaiting full data from Romanian translator.

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

Nokiani 2010

Trial name or title	
Methods	Randomised trial.
Participants	Women for caesarean section.
Interventions	Peritoneum repaired versus not repaired.
Outcomes	Postoperative pain, ileus, analgesic requirement.
Starting date	2010.
Contact information	
Notes	May be published in Arabic.

DATA AND ANALYSES

Comparison 1. Non-closure of both parietal and visceral peritoneum versus closure of both peritoneal layers

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Postoperative adhesions	4	282	Risk Ratio (M-H, Fixed, 95% CI)	0.99 [0.76, 1.29]
2 Wound infection	13	15430	Risk Ratio (M-H, Fixed, 95% CI)	0.96 [0.86, 1.07]
3 Uterine dehiscence	1	100	Risk Ratio (M-H, Fixed, 95% CI)	0.14 [0.01, 2.70]
4 Numbers of narcotic analgesics required	7	1657	Mean Difference (IV, Random, 95% CI)	-0.18 [-0.39, 0.02]
5 Additional analgesia after 24-48 hours	1	9675	Risk Ratio (M-H, Fixed, 95% CI)	0.94 [0.79, 1.12]
6 Infectious morbidity	11	14985	Risk Ratio (M-H, Random, 95% CI)	0.92 [0.72, 1.16]
7 Endometritis	5	10538	Risk Ratio (M-H, Fixed, 95% CI)	1.07 [0.78, 1.46]
8 Operating time (minutes)	16	15480	Mean Difference (IV, Random, 95% CI)	-5.81 [-7.68, -3.93]
9 Postoperative days in hospital	13	14906	Mean Difference (IV, Random, 95% CI)	-0.26 [-0.47, -0.05]
10 Chronic pelvic pain	1	112	Risk Ratio (M-H, Fixed, 95% CI)	0.49 [0.25, 0.98]
11 Pain at 6 weeks postpartum	1	9465	Risk Ratio (M-H, Fixed, 95% CI)	1.04 [0.80, 1.36]
12 Secondary infertility	1	144	Risk Ratio (M-H, Fixed, 95% CI)	0.89 [0.23, 3.44]
13 Blood transfusion > 1 unit (not prespecified outcome)	1	9675	Risk Ratio (M-H, Fixed, 95% CI)	0.98 [0.69, 1.39]
14 Maternal death (not prespecified outcome)	1	9675	Risk Ratio (M-H, Fixed, 95% CI)	1.49 [0.25, 8.92]
15 Intervention for postpartum haemorrhage (not prespecified outcome)	1	9675	Risk Ratio (M-H, Fixed, 95% CI)	0.99 [0.72, 1.38]
16 Readmission to hospital within 6 weeks (not prespecified outcome)	1	9465	Risk Ratio (M-H, Fixed, 95% CI)	1.00 [0.67, 1.49]

Comparison 2. Non-closure of visceral peritoneum only versus closure of both peritoneal layers

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Adhesion formation	2	157	Risk Ratio (M-H, Fixed, 95% CI)	2.49 [1.49, 4.16]
2 Wound infection	2	789	Risk Ratio (M-H, Fixed, 95% CI)	0.36 [0.14, 0.89]
3 Postoperative fever	3	889	Risk Ratio (M-H, Random, 95% CI)	0.60 [0.29, 1.27]
4 Endometritis	1	240	Risk Ratio (M-H, Fixed, 95% CI)	3.0 [0.12, 72.91]
5 Operating time (minutes)	1	544	Mean Difference (IV, Fixed, 95% CI)	-6.30 [-9.22, -3.38]
6 Postoperative days in hospital	1	549	Mean Difference (IV, Fixed, 95% CI)	-0.70 [-0.98, -0.42]

Comparison 3. Non-closure of parietal peritoneum only versus closure of both peritoneal layers

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Wound infection	1	248	Risk Ratio (M-H, Fixed, 95% CI)	0.95 [0.14, 6.66]
2 Postoperative pain	1	325	Risk Ratio (M-H, Fixed, 95% CI)	0.45 [0.31, 0.66]
3 Postoperative fever	1	40	Risk Ratio (M-H, Fixed, 95% CI)	0.18 [0.01, 3.56]
4 Endometritis	1	248	Risk Ratio (M-H, Fixed, 95% CI)	0.88 [0.53, 1.46]
5 Operating time (minutes)	1	248	Mean Difference (IV, Fixed, 95% CI)	-5.10 [-8.71, -1.49]
6 Postoperative days in hospital	2	288	Mean Difference (IV, Random, 95% CI)	-0.15 [-1.20, 0.91]
7 Mobilisation time in hours (not prespecified outcome)	1	110	Mean Difference (IV, Fixed, 95% CI)	-1.89 [-3.18, -0.60]
8 Time to oral intake in hours (not prespecified outcome)	1	110	Mean Difference (IV, Fixed, 95% CI)	-2.31 [-3.76, -0.86]
9 Drop in haemoglobin g/dL (not prespecified outcome)	1	110	Mean Difference (IV, Fixed, 95% CI)	0.28 [-0.03, 0.59]
10 Blood loss (not prespecified outcome)	1	110	Mean Difference (IV, Fixed, 95% CI)	56.97 [-28.08, 142.02]
11 Time to flatus (not prespecified outcome)	1	110	Mean Difference (IV, Fixed, 95% CI)	-0.04 [-1.99, 1.91]
12 Wound pain, day 1 (visual analogue score)	1	325	Mean Difference (IV, Fixed, 95% CI)	-1.60 [-1.97, -1.23]
13 Persistent abdominal pain after 8 months (numerical rating scale)	1	325	Mean Difference (IV, Fixed, 95% CI)	-1.10 [-1.39, -0.81]

Comparison 4. Non closure versus closure of visceral peritoneum when parietal peritoneum is closed

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Urinary frequency at 8 weeks	1	582	Risk Ratio (M-H, Fixed, 95% CI)	0.24 [0.13, 0.45]
2 Urgency of urination	1	582	Risk Ratio (M-H, Fixed, 95% CI)	0.30 [0.18, 0.51]
3 Stress incontinence	1	582	Risk Ratio (M-H, Fixed, 95% CI)	0.45 [0.21, 0.96]

Analysis 1.1. Comparison 1 Non-closure of both parietal and visceral peritoneum versus closure of both peritoneal layers, Outcome 1 Postoperative adhesions.

Review: Closure versus non-closure of the peritoneum at caesarean section: short- and long-term outcomes

Comparison: 1 Non-closure of both parietal and visceral peritoneum versus closure of both peritoneal layers

Outcome: 1 Postoperative adhesions

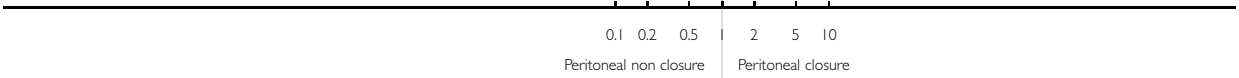
Study or subgroup	Peritoneal non closure n/N	Peritoneal closure n/N	Risk Ratio M-H,Fixed,95% CI	Weight	Risk Ratio M-H,Fixed,95% CI
Ghahiry 2012	26/52	30/60		46.2 %	1.00 [0.69, 1.45]
Irion 1996	8/14	6/14		10.0 %	1.33 [0.63, 2.84]
Kapustian 2012	20/50	23/47		39.4 %	0.82 [0.52, 1.28]
Weerawetwat 2004	4/20	3/25		4.4 %	1.67 [0.42, 6.60]
Total (95% CI)	**136**	**146**		**100.0 %**	**0.99 [0.76, 1.29]**

Total events: 58 (Peritoneal non closure), 62 (Peritoneal closure)

Heterogeneity: $Chi^2 = 1.85$, df = 3 (P = 0.60); $I^2 = 0.0\%$

Test for overall effect: Z = 0.07 (P = 0.95)

Test for subgroup differences: Not applicable



Analysis 1.2. Comparison 1 Non-closure of both parietal and visceral peritoneum versus closure of both peritoneal layers, Outcome 2 Wound infection.

Review: Closure versus non-closure of the peritoneum at caesarean section: short- and long-term outcomes

Comparison: 1 Non-closure of both parietal and visceral peritoneum versus closure of both peritoneal layers

Outcome: 2 Wound infection

Study or subgroup	Peritoneal non closure n/N	Peritoneal closure n/N	Risk Ratio M-H,Fixed,95% CI	Weight	Risk Ratio M-H,Fixed,95% CI
Anteby 2009	29/256	35/277		5.3 %	0.90 [0.56, 1.42]
CAESAR 2010	200/1499	182/1496		28.5 %	1.10 [0.91, 1.32]
CORONIS 2013	310/4851	330/4824		51.8 %	0.93 [0.80, 1.09]
Galaal 2000	4/30	7/30		1.1 %	0.57 [0.19, 1.75]
Gemer 2006	14/187	20/192		3.1 %	0.72 [0.37, 1.38]
Ghongdemath 2011	5/100	7/100		1.1 %	0.71 [0.23, 2.18]
Grundsell 1998	4/179	7/182		1.1 %	0.58 [0.17, 1.95]
Huchon 2005	3/63	1/75		0.1 %	3.57 [0.38, 33.49]
Hull 1991	3/54	5/59		0.7 %	0.66 [0.16, 2.61]
Kapustian 2012	29/256	35/277		5.3 %	0.90 [0.56, 1.42]
Malomo 2006	4/27	3/27		0.5 %	1.33 [0.33, 5.40]
Sood 2004	2/71	5/78		0.7 %	0.44 [0.09, 2.19]
Weerawetwat 2004	4/120	4/120		0.6 %	1.00 [0.26, 3.91]
Total (95% CI)	**7693**	**7737**		**100.0 %**	**0.96 [0.86, 1.07]**

Total events: 611 (Peritoneal non closure), 641 (Peritoneal closure)

Heterogeneity: $Chi^2 = 7.48$, df = 12 (P = 0.82); $I^2 = 0.0\%$

Test for overall effect: Z = 0.76 (P = 0.45)

Test for subgroup differences: Not applicable

Analysis 1.3. Comparison 1 Non-closure of both parietal and visceral peritoneum versus closure of both peritoneal layers, Outcome 3 Uterine dehiscence.

Review: Closure versus non-closure of the peritoneum at caesarean section: short- and long-term outcomes

Comparison: 1 Non-closure of both parietal and visceral peritoneum versus closure of both peritoneal layers

Outcome: 3 Uterine dehiscence

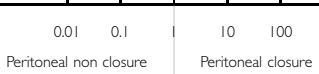
Study or subgroup	Peritoneal non closure n/N	Peritoneal closure n/N	Risk Ratio M-H,Fixed,95% CI	Weight	Risk Ratio M-H,Fixed,95% CI
Ghahiry 2012	0/50	3/50		100.0 %	0.14 [0.01, 2.70]
Total (95% CI)	**50**	**50**		**100.0 %**	**0.14 [0.01, 2.70]**

Total events: 0 (Peritoneal non closure), 3 (Peritoneal closure)

Heterogeneity: not applicable

Test for overall effect: Z = 1.30 (P = 0.19)

Test for subgroup differences: Not applicable



Analysis 1.4. Comparison 1 Non-closure of both parietal and visceral peritoneum versus closure of both peritoneal layers, Outcome 4 Numbers of narcotic analgesics required.

Review: Closure versus non-closure of the peritoneum at caesarean section: short- and long-term outcomes

Comparison: 1 Non-closure of both parietal and visceral peritoneum versus closure of both peritoneal layers

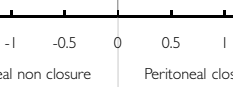
Outcome: 4 Numbers of narcotic analgesics required

Study or subgroup	Peritoneal non closure N	Mean(SD)	Peritoneal closure N	Mean(SD)	Mean Difference IV,Random,95% CI	Weight	Mean Difference IV,Random,95% CI
Anteby 2009	256	1.09 (1.2)	277	1.05 (1)		19.0 %	0.04 [-0.15, 0.23]
Gemer 2006	187	1.4 (1)	192	1.3 (1)		18.5 %	0.10 [-0.10, 0.30]
Hull 1991	54	8.6 (4.9)	59	11.1 (6.3)		0.9 %	-2.50 [-4.57, -0.43]
Irion 1996	137	2.5 (1.8)	143	2.7 (1.7)		11.9 %	-0.20 [-0.61, 0.21]
Komoto 2005	53	2 (0.9)	70	2.4 (1.1)		13.5 %	-0.40 [-0.75, -0.05]
Sood 2004	71	3.3 (0.4)	78	3.4 (0.5)		20.3 %	-0.10 [-0.24, 0.04]
Tuncer 2003	40	1.25 (0.59)	40	1.8 (0.68)		15.9 %	-0.55 [-0.83, -0.27]
Total (95% CI)	**798**		**859**			**100.0 %**	**-0.18 [-0.39, 0.02]**

Heterogeneity: $Tau^2 = 0.05$; $Chi^2 = 24.05$, df = 6 (P = 0.00051); $I^2 = 75\%$

Test for overall effect: Z = 1.75 (P = 0.081)

Test for subgroup differences: Not applicable



Analysis 1.5. Comparison 1 Non-closure of both parietal and visceral peritoneum versus closure of both peritoneal layers, Outcome 5 Additional analgesia after 24-48 hours.

Review: Closure versus non-closure of the peritoneum at caesarean section: short- and long-term outcomes

Comparison: 1 Non-closure of both parietal and visceral peritoneum versus closure of both peritoneal layers

Outcome: 5 Additional analgesia after 24-48 hours

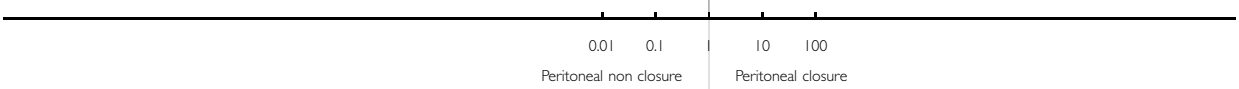
Study or subgroup	Peritoneal non closure n/N	Peritoneal closure n/N	Risk Ratio M-H,Fixed,95% CI	Weight	Risk Ratio M-H,Fixed,95% CI
CORONIS 2013	236/4851	250/4824		100.0 %	0.94 [0.79, 1.12]
Total (95% CI)	**4851**	**4824**		**100.0 %**	**0.94 [0.79, 1.12]**

Total events: 236 (Peritoneal non closure), 250 (Peritoneal closure)

Heterogeneity: not applicable

Test for overall effect: Z = 0.71 (P = 0.47)

Test for subgroup differences: Not applicable

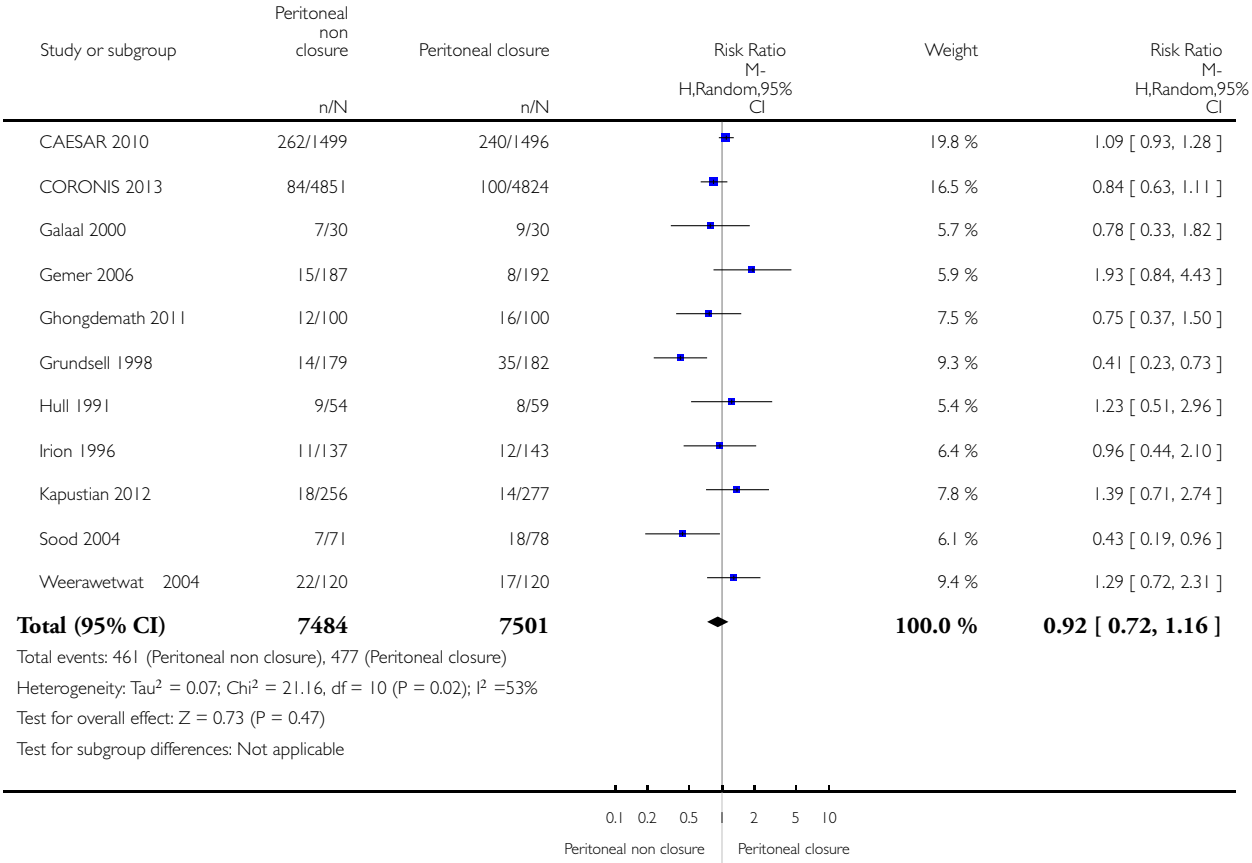


Analysis 1.6. Comparison 1 Non-closure of both parietal and visceral peritoneum versus closure of both peritoneal layers, Outcome 6 Infectious morbidity.

Review: Closure versus non-closure of the peritoneum at caesarean section: short- and long-term outcomes

Comparison: 1 Non-closure of both parietal and visceral peritoneum versus closure of both peritoneal layers

Outcome: 6 Infectious morbidity

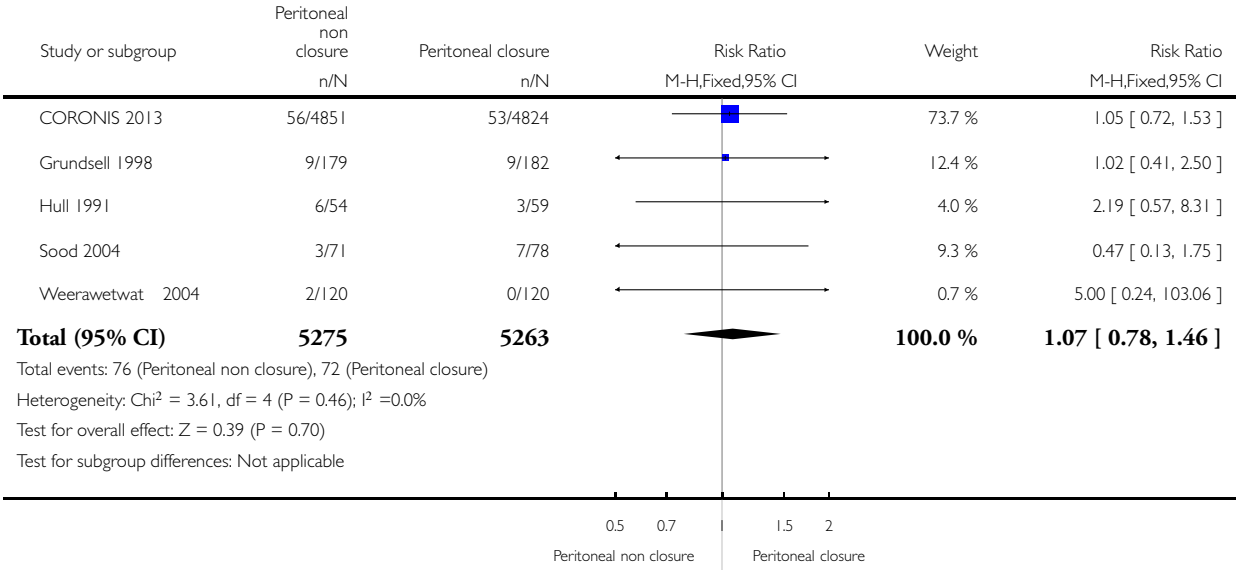


Analysis 1.7. Comparison 1 Non-closure of both parietal and visceral peritoneum versus closure of both peritoneal layers, Outcome 7 Endometritis.

Review: Closure versus non-closure of the peritoneum at caesarean section: short- and long-term outcomes

Comparison: 1 Non-closure of both parietal and visceral peritoneum versus closure of both peritoneal layers

Outcome: 7 Endometritis



Analysis 1.8. Comparison 1 Non-closure of both parietal and visceral peritoneum versus closure of both peritoneal layers, Outcome 8 Operating time (minutes).

Review: Closure versus non-closure of the peritoneum at caesarean section: short- and long-term outcomes

Comparison: 1 Non-closure of both parietal and visceral peritoneum versus closure of both peritoneal layers

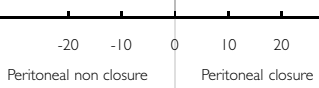
Outcome: 8 Operating time (minutes)

Study or subgroup	Peritoneal non closure N	Mean(SD)	Peritoneal closure N	Mean(SD)	Mean Difference IV,Random,95% CI	Weight	Mean Difference IV,Random,95% CI
Anteby 2009	256	40.8 (13.3)	277	42.8 (12.8)		6.6 %	-2.00 [-4.22, 0.22]
CAESAR 2010	1499	36.1 (11.5)	1496	38.5 (12)		7.1 %	-2.40 [-3.24, -1.56]
Chanrachakul 2002	30	51.6 (10.5)	30	55.3 (12.1)		4.3 %	-3.70 [-9.43, 2.03]
CORONIS 2013	4851	39.57 (15.58)	4824	40.88 (15.37)		7.2 %	-1.31 [-1.93, -0.69]
Galaal 2000	30	53.56 (11.21)	30	61.9 (11.73)		4.3 %	-8.34 [-14.15, -2.53]
Gemer 2006	187	41.6 (5.6)	192	42.4 (11.6)		6.8 %	-0.80 [-2.63, 1.03]
Ghongdemath 2011	100	32.02 (4.9)	100	43.24 (4.61)		7.0 %	-11.22 [-12.54, -9.90]
Grundsell 1998	179	33.4 (6.2)	182	41.3 (6.9)		7.0 %	-7.90 [-9.25, -6.55]
Hull 1991	54	50 (13.5)	59	57.9 (13.9)		4.8 %	-7.90 [-12.95, -2.85]
Irion 1996	137	47.3 (19.4)	143	53.2 (15.5)		5.4 %	-5.90 [-10.02, -1.78]
Komoto 2005	53	35.3 (5.9)	70	41.7 (6.9)		6.6 %	-6.40 [-8.67, -4.13]
Malomo 2006	27	50.5 (4.5)	27	63.5 (6)		6.2 %	-13.00 [-15.83, -10.17]
Rafique 2002	50	32.8 (6.8)	50	38.8 (7.6)		6.2 %	-6.00 [-8.83, -3.17]
Sood 2004	71	30.9 (6.13)	78	38.4 (6.3)		6.7 %	-7.50 [-9.50, -5.50]
Tuncer 2003	40	19.05 (3.13)	40	25.05 (4.94)		6.8 %	-6.00 [-7.81, -4.19]
Zhang 2000	160	20.2 (4.8)	158	24.4 (5.6)		7.1 %	-4.20 [-5.35, -3.05]
Total (95% CI)	**7724**		**7756**			**100.0 %**	**-5.81 [-7.68, -3.93]**

Heterogeneity: $Tau^2 = 12.63$; $Chi^2 = 315.79$, df = 15 ($P<0.00001$); $I^2 = 95\%$

Test for overall effect: $Z = 6.07$ ($P < 0.00001$)

Test for subgroup differences: Not applicable



Analysis 1.9. Comparison 1 Non-closure of both parietal and visceral peritoneum versus closure of both peritoneal layers, Outcome 9 Postoperative days in hospital.

Review: Closure versus non-closure of the peritoneum at caesarean section: short- and long-term outcomes

Comparison: 1 Non-closure of both parietal and visceral peritoneum versus closure of both peritoneal layers

Outcome: 9 Postoperative days in hospital

Study or subgroup	Peritoneal non closure		Peritoneal closure		Mean Difference	Weight	Mean Difference
	N	Mean(SD)	N	Mean(SD)	IV,Random,95% CI		IV,Random,95% CI
CAESAR 2010	1499	4.7 (2)	1496	4.8 (1.9)		9.7 %	-0.10 [-0.24, 0.04]
Chanrachakul 2002	30	4.1 (0.4)	30	4.1 (0.3)		9.5 %	0.0 [-0.18, 0.18]
CORONIS 2013	4850	4.93 (2.61)	4822	4.91 (2.6)		9.9 %	0.02 [-0.08, 0.12]
Galaal 2000	30	5.5 (1.14)	30	6 (0.91)		6.2 %	-0.50 [-1.02, 0.02]
Ghongdemath 2011	100	7.17 (0.75)	100	7.29 (1)		8.9 %	-0.12 [-0.36, 0.12]
Grundsell 1998	179	5.3 (1)	182	6.4 (1)		9.2 %	-1.10 [-1.31, -0.89]
Huchon 2005	75	5.56 (0)	63	5.84 (0)			Not estimable
Hull 1991	54	4.02 (0.79)	59	4.25 (0.98)		8.2 %	-0.23 [-0.56, 0.10]
Irion 1996	137	6.5 (1.9)	143	6.8 (2.2)		6.6 %	-0.30 [-0.78, 0.18]
Moraes 1999	349	3.6 (2.33)	349	3.7 (2.25)		8.0 %	-0.10 [-0.44, 0.24]
Rafique 2002	50	4.1 (1.2)	50	3.9 (1.1)		6.9 %	0.20 [-0.25, 0.65]
Sood 2004	71	6.1 (0.5)	78	6.5 (1)		8.9 %	-0.40 [-0.65, -0.15]
Tuncer 2003	40	4.3 (0.9)	40	4.8 (0.7)		7.9 %	-0.50 [-0.85, -0.15]
Total (95% CI)	**7464**		**7442**			**100.0 %**	**-0.26 [-0.47, -0.05]**

Heterogeneity: $Tau^2 = 0.11$; $Chi^2 = 106.78$, df = 11 (P<0.00001); $I^2 = 90\%$

Test for overall effect: Z = 2.42 (P = 0.016)

Test for subgroup differences: Not applicable

Analysis 1.10. Comparison 1 Non-closure of both parietal and visceral peritoneum versus closure of both peritoneal layers, Outcome 10 Chronic pelvic pain.

Review: Closure versus non-closure of the peritoneum at caesarean section: short- and long-term outcomes

Comparison: 1 Non-closure of both parietal and visceral peritoneum versus closure of both peritoneal layers

Outcome: 10 Chronic pelvic pain

Study or subgroup	Peritoneal non closure n/N	Peritoneal closure n/N	Risk Ratio M-H,Fixed,95% CI	Weight	Risk Ratio M-H,Fixed,95% CI
Ghahiry 2012	9/52	21/60		100.0 %	0.49 [0.25, 0.98]
Total (95% CI)	**52**	**60**		**100.0 %**	**0.49 [0.25, 0.98]**

Total events: 9 (Peritoneal non closure), 21 (Peritoneal closure)

Heterogeneity: not applicable

Test for overall effect: Z = 2.01 (P = 0.045)

Test for subgroup differences: Not applicable

Analysis 1.11. Comparison 1 Non-closure of both parietal and visceral peritoneum versus closure of both peritoneal layers, Outcome 11 Pain at 6 weeks postpartum.

Review: Closure versus non-closure of the peritoneum at caesarean section: short- and long-term outcomes

Comparison: 1 Non-closure of both parietal and visceral peritoneum versus closure of both peritoneal layers

Outcome: 11 Pain at 6 weeks postpartum

Study or subgroup	Peritoneal non closure n/N	Peritoneal closure n/N	Risk Ratio M-H,Fixed,95% CI	Weight	Risk Ratio M-H,Fixed,95% CI
CORONIS 2013	108/4744	103/4721		100.0 %	1.04 [0.80, 1.36]
Total (95% CI)	**4744**	**4721**		**100.0 %**	**1.04 [0.80, 1.36]**

Total events: 108 (Peritoneal non closure), 103 (Peritoneal closure)

Heterogeneity: not applicable

Test for overall effect: Z = 0.31 (P = 0.75)

Test for subgroup differences: Not applicable

Analysis 1.12. Comparison 1 Non-closure of both parietal and visceral peritoneum versus closure of both peritoneal layers, Outcome 12 Secondary infertility.

Review: Closure versus non-closure of the peritoneum at caesarean section: short- and long-term outcomes

Comparison: 1 Non-closure of both parietal and visceral peritoneum versus closure of both peritoneal layers

Outcome: 12 Secondary infertility

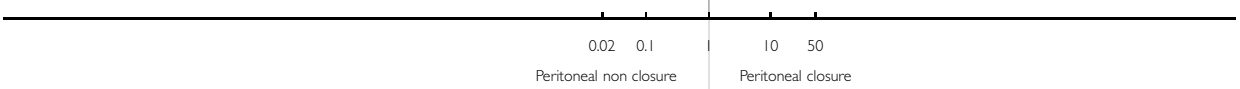
Study or subgroup	Peritoneal non closure n/N	Peritoneal closure n/N	Risk Ratio M-H,Fixed,95% CI	Weight	Risk Ratio M-H,Fixed,95% CI
Irion 1996	4/76	4/68		100.0 %	0.89 [0.23, 3.44]
Total (95% CI)	**76**	**68**		**100.0 %**	**0.89 [0.23, 3.44]**

Total events: 4 (Peritoneal non closure), 4 (Peritoneal closure)

Heterogeneity: not applicable

Test for overall effect: Z = 0.16 (P = 0.87)

Test for subgroup differences: Not applicable



Analysis 1.13. Comparison 1 Non-closure of both parietal and visceral peritoneum versus closure of both peritoneal layers, Outcome 13 Blood transfusion > 1 unit (not prespecified outcome).

Review: Closure versus non-closure of the peritoneum at caesarean section: short- and long-term outcomes

Comparison: 1 Non-closure of both parietal and visceral peritoneum versus closure of both peritoneal layers

Outcome: 13 Blood transfusion > 1 unit (not prespecified outcome)

Study or subgroup	Peritoneal non closure n/N	Peritoneal closure n/N	Risk Ratio M-H,Fixed,95% CI	Weight	Risk Ratio M-H,Fixed,95% CI
CORONIS 2013	62/4851	63/4824		100.0 %	0.98 [0.69, 1.39]
Total (95% CI)	**4851**	**4824**		**100.0 %**	**0.98 [0.69, 1.39]**

Total events: 62 (Peritoneal non closure), 63 (Peritoneal closure)

Heterogeneity: not applicable

Test for overall effect: Z = 0.12 (P = 0.90)

Test for subgroup differences: Not applicable

Analysis 1.14. Comparison 1 Non-closure of both parietal and visceral peritoneum versus closure of both peritoneal layers, Outcome 14 Maternal death (not prespecified outcome).

Review: Closure versus non-closure of the peritoneum at caesarean section: short- and long-term outcomes

Comparison: 1 Non-closure of both parietal and visceral peritoneum versus closure of both peritoneal layers

Outcome: 14 Maternal death (not prespecified outcome)

Study or subgroup	Peritoneal non closure n/N	Peritoneal closure n/N	Risk Ratio M-H,Fixed,95% CI	Weight	Risk Ratio M-H,Fixed,95% CI
CORONIS 2013	3/4851	2/4824		100.0 %	1.49 [0.25, 8.92]
Total (95% CI)	**4851**	**4824**		**100.0 %**	**1.49 [0.25, 8.92]**

Total events: 3 (Peritoneal non closure), 2 (Peritoneal closure)

Heterogeneity: not applicable

Test for overall effect: Z = 0.44 (P = 0.66)

Test for subgroup differences: Not applicable

Analysis 1.15. Comparison 1 Non-closure of both parietal and visceral peritoneum versus closure of both peritoneal layers, Outcome 15 Intervention for postpartum haemorrhage (not prespecified outcome).

Review: Closure versus non-closure of the peritoneum at caesarean section: short- and long-term outcomes

Comparison: 1 Non-closure of both parietal and visceral peritoneum versus closure of both peritoneal layers

Outcome: 15 Intervention for postpartum haemorrhage (not prespecified outcome)

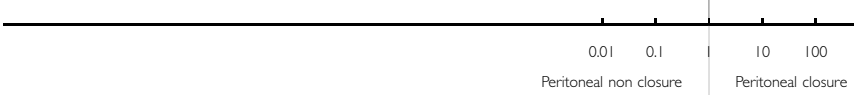
Study or subgroup	Peritoneal non closure n/N	Peritoneal closure n/N	Risk Ratio M-H,Fixed,95% CI	Weight	Risk Ratio M-H,Fixed,95% CI
CORONIS 2013	71/4851	71/4824		100.0 %	0.99 [0.72, 1.38]
Total (95% CI)	**4851**	**4824**		**100.0 %**	**0.99 [0.72, 1.38]**

Total events: 71 (Peritoneal non closure), 71 (Peritoneal closure)

Heterogeneity: not applicable

Test for overall effect: Z = 0.03 (P = 0.97)

Test for subgroup differences: Not applicable

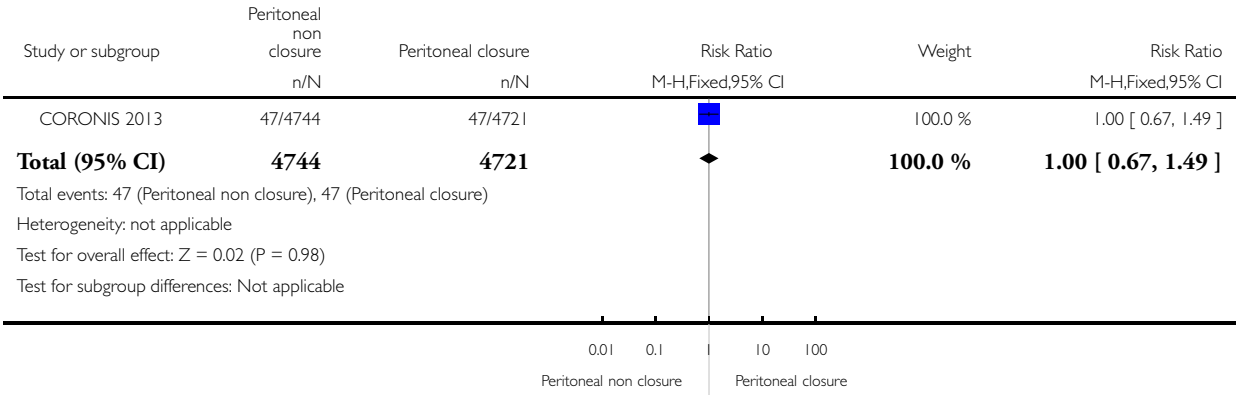


Analysis 1.16. Comparison 1 Non-closure of both parietal and visceral peritoneum versus closure of both peritoneal layers, Outcome 16 Readmission to hospital within 6 weeks (not prespecified outcome).

Review: Closure versus non-closure of the peritoneum at caesarean section: short- and long-term outcomes

Comparison: 1 Non-closure of both parietal and visceral peritoneum versus closure of both peritoneal layers

Outcome: 16 Readmission to hospital within 6 weeks (not prespecified outcome)

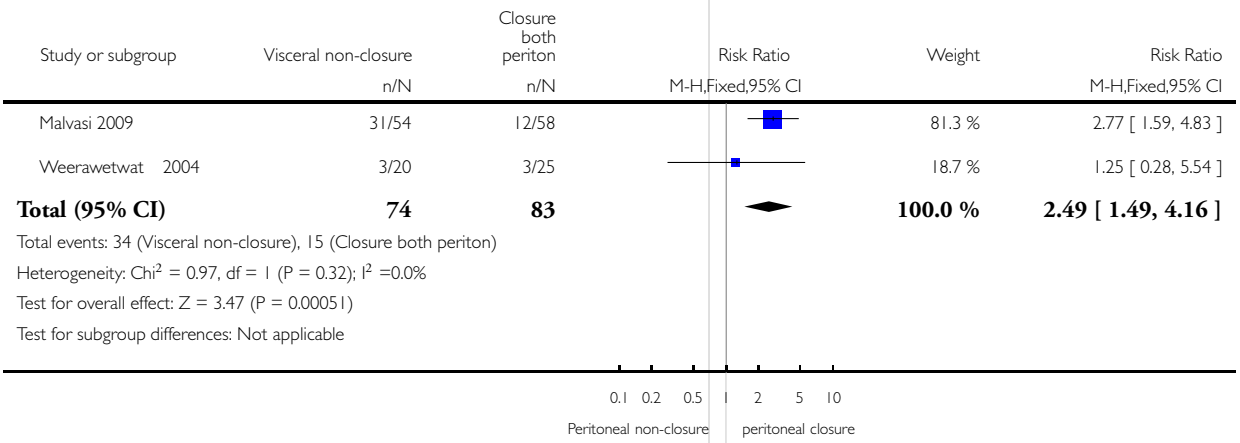


Analysis 2.1. Comparison 2 Non-closure of visceral peritoneum only versus closure of both peritoneal layers, Outcome 1 Adhesion formation.

Review: Closure versus non-closure of the peritoneum at caesarean section: short- and long-term outcomes

Comparison: 2 Non-closure of visceral peritoneum only versus closure of both peritoneal layers

Outcome: 1 Adhesion formation

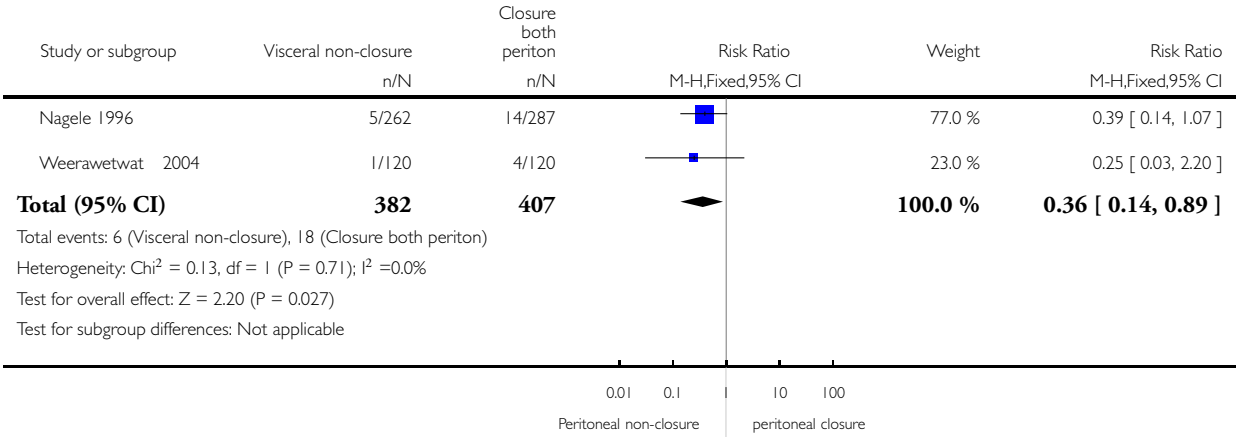


Analysis 2.2. Comparison 2 Non-closure of visceral peritoneum only versus closure of both peritoneal layers, Outcome 2 Wound infection.

Review: Closure versus non-closure of the peritoneum at caesarean section: short- and long-term outcomes

Comparison: 2 Non-closure of visceral peritoneum only versus closure of both peritoneal layers

Outcome: 2 Wound infection



Analysis 2.3. Comparison 2 Non-closure of visceral peritoneum only versus closure of both peritoneal layers, Outcome 3 Postoperative fever.

Review: Closure versus non-closure of the peritoneum at caesarean section: short- and long-term outcomes

Comparison: 2 Non-closure of visceral peritoneum only versus closure of both peritoneal layers

Outcome: 3 Postoperative fever

Study or subgroup	Visceral non-closure n/N	Closure both Periton n/N	Risk Ratio M-H,Random,95% CI	Weight	Risk Ratio M-H,Random,95% CI
Nagele 1996	22/262	45/287		43.3 %	0.54 [0.33, 0.87]
Saha 2001	2/50	10/50		17.4 %	0.20 [0.05, 0.87]
Weerawetwat 2004	19/120	17/120		39.3 %	1.12 [0.61, 2.04]
Total (95% CI)	**432**	**457**		**100.0 %**	**0.60 [0.29, 1.27]**

Total events: 43 (Visceral non-closure), 72 (Closure both Periton)

Heterogeneity: $Tau^2 = 0.28$; $Chi^2 = 6.26$, df = 2 (P = 0.04); $I^2 = 68\%$

Test for overall effect: Z = 1.33 (P = 0.18)

Test for subgroup differences: Not applicable

Analysis 2.4. Comparison 2 Non-closure of visceral peritoneum only versus closure of both peritoneal layers, Outcome 4 Endometritis.

Review: Closure versus non-closure of the peritoneum at caesarean section: short- and long-term outcomes

Comparison: 2 Non-closure of visceral peritoneum only versus closure of both peritoneal layers

Outcome: 4 Endometritis

Study or subgroup	Visceral non-closure n/N	Closure both Periton n/N	Risk Ratio M-H,Fixed,95% CI	Weight	Risk Ratio M-H,Fixed,95% CI
Weerawetwat 2004	1/120	0/120		100.0 %	3.00 [0.12, 72.91]
Total (95% CI)	**120**	**120**		**100.0 %**	**3.00 [0.12, 72.91]**

Total events: 1 (Visceral non-closure), 0 (Closure both Periton)

Heterogeneity: not applicable

Test for overall effect: Z = 0.67 (P = 0.50)

Test for subgroup differences: Not applicable

Analysis 2.5. Comparison 2 Non-closure of visceral peritoneum only versus closure of both peritoneal layers, Outcome 5 Operating time (minutes).

Review: Closure versus non-closure of the peritoneum at caesarean section: short- and long-term outcomes

Comparison: 2 Non-closure of visceral peritoneum only versus closure of both peritoneal layers

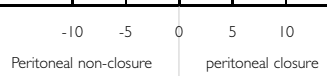
Outcome: 5 Operating time (minutes)

Study or subgroup	Visceral non-closure		Closure both periton		Mean Difference	Weight	Mean Difference
	N	Mean(SD)	N	Mean(SD)	IV,Fixed,95% CI		IV,Fixed,95% CI
Nagele 1996	262	50.6 (16.8)	282	56.9 (17.9)		100.0 %	-6.30 [-9.22, -3.38]
Total (95% CI)	**262**		**282**			**100.0 %**	**-6.30 [-9.22, -3.38]**

Heterogeneity: not applicable

Test for overall effect: Z = 4.23 (P = 0.000023)

Test for subgroup differences: Not applicable



Analysis 2.6. Comparison 2 Non-closure of visceral peritoneum only versus closure of both peritoneal layers, Outcome 6 Postoperative days in hospital.

Review: Closure versus non-closure of the peritoneum at caesarean section: short- and long-term outcomes

Comparison: 2 Non-closure of visceral peritoneum only versus closure of both peritoneal layers

Outcome: 6 Postoperative days in hospital

Study or subgroup	Visceral non-closure N	Mean(SD)	Closure both periton N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Nagele 1996	262	7.2 (1.6)	287	7.9 (1.8)		100.0 %	-0.70 [-0.98, -0.42]
Total (95% CI)	**262**		**287**			**100.0 %**	**-0.70 [-0.98, -0.42]**

Heterogeneity: not applicable

Test for overall effect: Z = 4.82 (P < 0.00001)

Test for subgroup differences: Not applicable

Analysis 3.1. Comparison 3 Non-closure of parietal peritoneum only versus closure of both peritoneal layers, Outcome 1 Wound infection.

Review: Closure versus non-closure of the peritoneum at caesarean section: short- and long-term outcomes

Comparison: 3 Non-closure of parietal peritoneum only versus closure of both peritoneal layers

Outcome: 1 Wound infection

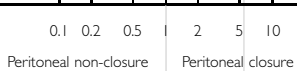
Study or subgroup	Parietal non-closure n/N	Closure both periton n/N	Risk Ratio M-H,Fixed,95% CI	Weight	Risk Ratio M-H,Fixed,95% CI
Pietrantoni 1991	2/127	2/121		100.0 %	0.95 [0.14, 6.66]
Total (95% CI)	**127**	**121**		**100.0 %**	**0.95 [0.14, 6.66]**

Total events: 2 (Parietal non-closure), 2 (Closure both periton)

Heterogeneity: not applicable

Test for overall effect: Z = 0.05 (P = 0.96)

Test for subgroup differences: Not applicable



Analysis 3.2. Comparison 3 Non-closure of parietal peritoneum only versus closure of both peritoneal layers, Outcome 2 Postoperative pain.

Review: Closure versus non-closure of the peritoneum at caesarean section: short- and long-term outcomes

Comparison: 3 Non-closure of parietal peritoneum only versus closure of both peritoneal layers

Outcome: 2 Postoperative pain

Study or subgroup	Parietal non-closure n/N	Closure both peritoneal n/N	Risk Ratio M-H,Fixed,95% CI	Weight	Risk Ratio M-H,Fixed,95% CI
Shahin 2009	30/164	65/161		100.0 %	0.45 [0.31, 0.66]
Total (95% CI)	**164**	**161**		**100.0 %**	**0.45 [0.31, 0.66]**

Total events: 30 (Parietal non-closure), 65 (Closure both peritoneal)

Heterogeneity: not applicable

Test for overall effect: Z = 4.15 (P = 0.000033)

Test for subgroup differences: Not applicable

Analysis 3.3. Comparison 3 Non-closure of parietal peritoneum only versus closure of both peritoneal layers, Outcome 3 Postoperative fever.

Review: Closure versus non-closure of the peritoneum at caesarean section: short- and long-term outcomes

Comparison: 3 Non-closure of parietal peritoneum only versus closure of both peritoneal layers

Outcome: 3 Postoperative fever

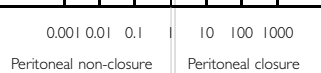
Study or subgroup	Parietal non-closure n/N	Closure both periton n/N	Risk Ratio M-H,Fixed,95% CI	Weight	Risk Ratio M-H,Fixed,95% CI
Hojberg 1998	0/21	2/19		100.0 %	0.18 [0.01, 3.56]
Total (95% CI)	**21**	**19**		**100.0 %**	**0.18 [0.01, 3.56]**

Total events: 0 (Parietal non-closure), 2 (Closure both periton)

Heterogeneity: not applicable

Test for overall effect: Z = 1.12 (P = 0.26)

Test for subgroup differences: Not applicable

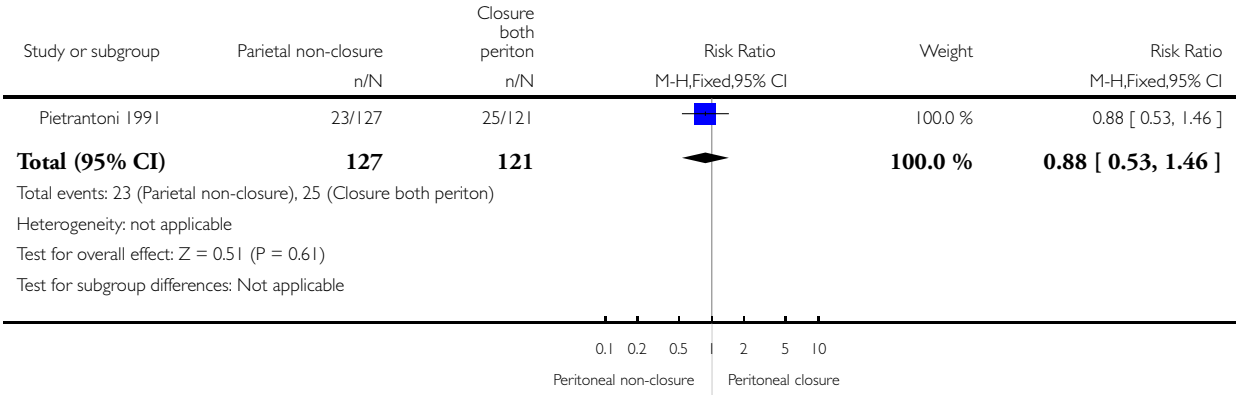


Analysis 3.4. Comparison 3 Non-closure of parietal peritoneum only versus closure of both peritoneal layers, Outcome 4 Endometritis.

Review: Closure versus non-closure of the peritoneum at caesarean section: short- and long-term outcomes

Comparison: 3 Non-closure of parietal peritoneum only versus closure of both peritoneal layers

Outcome: 4 Endometritis



Analysis 3.5. Comparison 3 Non-closure of parietal peritoneum only versus closure of both peritoneal layers, Outcome 5 Operating time (minutes).

Review: Closure versus non-closure of the peritoneum at caesarean section: short- and long-term outcomes

Comparison: 3 Non-closure of parietal peritoneum only versus closure of both peritoneal layers

Outcome: 5 Operating time (minutes)

Study or subgroup	Parietal non-closure N	Mean(SD)	Closure both periton N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Pietrantoni 1991	127	48.1 (13.52)	121	53.2 (15.4)		100.0 %	-5.10 [-8.71, -1.49]
Total (95% CI)	**127**		**121**			**100.0 %**	**-5.10 [-8.71, -1.49]**

Heterogeneity: not applicable

Test for overall effect: Z = 2.77 (P = 0.0057)

Test for subgroup differences: Not applicable

Analysis 3.6. Comparison 3 Non-closure of parietal peritoneum only versus closure of both peritoneal layers, Outcome 6 Postoperative days in hospital.

Review: Closure versus non-closure of the peritoneum at caesarean section: short- and long-term outcomes

Comparison: 3 Non-closure of parietal peritoneum only versus closure of both peritoneal layers

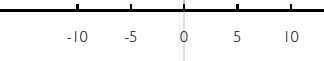
Outcome: 6 Postoperative days in hospital

Study or subgroup	Parietal non-closure N	Mean(SD)	Closure both periton N	Mean(SD)	Mean Difference IV,Random,95% CI	Weight	Mean Difference IV,Random,95% CI
Hojberg 1998	21	6.3 (1.37)	19	7.1 (1.74)		40.6 %	-0.80 [-1.78, 0.18]
Pietrantoni 1991	127	4.8 (1.13)	121	4.5 (1.1)		59.4 %	0.30 [0.02, 0.58]
Total (95% CI)	**148**		**140**			**100.0 %**	**-0.15 [-1.20, 0.91]**

Heterogeneity: $Tau^2 = 0.47$; $Chi^2 = 4.50$, df = 1 (P = 0.03); $I^2 = 78\%$

Test for overall effect: Z = 0.27 (P = 0.79)

Test for subgroup differences: Not applicable



Analysis 3.7. Comparison 3 Non-closure of parietal peritoneum only versus closure of both peritoneal layers, Outcome 7 Mobilisation time in hours (not prespecified outcome).

Review: Closure versus non-closure of the peritoneum at caesarean section: short- and long-term outcomes

Comparison: 3 Non-closure of parietal peritoneum only versus closure of both peritoneal layers

Outcome: 7 Mobilisation time in hours (not prespecified outcome)

Study or subgroup	Parietal non-closure N	Mean(SD)	Closure N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Altinbas 2013	55	9.36 (3.24)	55	11.25 (3.65)		100.0 %	-1.89 [-3.18, -0.60]
Total (95% CI)	**55**		**55**			**100.0 %**	**-1.89 [-3.18, -0.60]**
Heterogeneity: not applicable							
Test for overall effect: Z = 2.87 (P = 0.0041)							
Test for subgroup differences: Not applicable							

Analysis 3.8. Comparison 3 Non-closure of parietal peritoneum only versus closure of both peritoneal layers, Outcome 8 Time to oral intake in hours (not prespecified outcome).

Review: Closure versus non-closure of the peritoneum at caesarean section: short- and long-term outcomes

Comparison: 3 Non-closure of parietal peritoneum only versus closure of both peritoneal layers

Outcome: 8 Time to oral intake in hours (not prespecified outcome)

Study or subgroup	Parietal non-closure N	Mean(SD)	Closure N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Altinbas 2013	55	9.45 (3.27)	55	11.76 (4.41)		100.0 %	-2.31 [-3.76, -0.86]
Total (95% CI)	**55**		**55**			**100.0 %**	**-2.31 [-3.76, -0.86]**
Heterogeneity: not applicable							
Test for overall effect: Z = 3.12 (P = 0.0018)							
Test for subgroup differences: Not applicable							

Analysis 3.9. Comparison 3 Non-closure of parietal peritoneum only versus closure of both peritoneal layers, Outcome 9 Drop in haemoglobin g/dL (not prespecified outcome).

Review: Closure versus non-closure of the peritoneum at caesarean section: short- and long-term outcomes

Comparison: 3 Non-closure of parietal peritoneum only versus closure of both peritoneal layers

Outcome: 9 Drop in haemoglobin g/dL (not prespecified outcome)

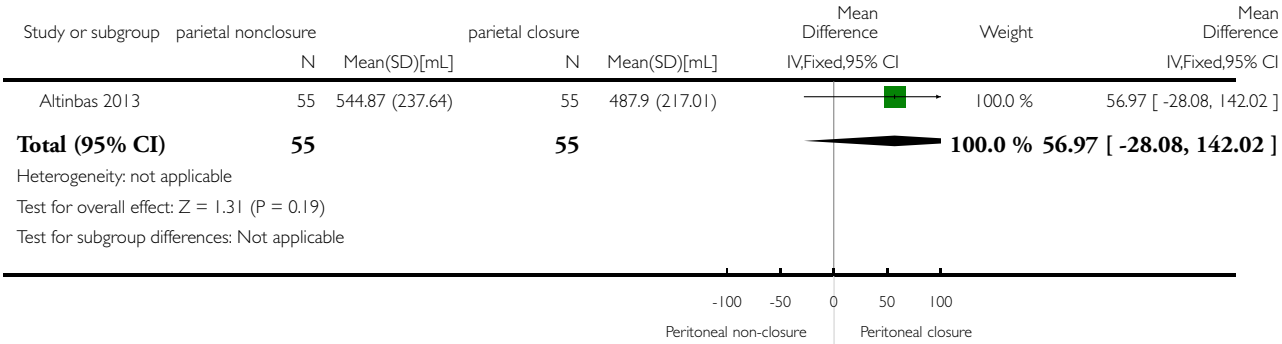
Study or subgroup	parietal nonclosure N	Mean(SD)	parietal closure N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Altinbas 2013	55	1.41 (0.82)	55	1.13 (0.86)		100.0 %	0.28 [-0.03, 0.59]
Total (95% CI)	**55**		**55**			**100.0 %**	**0.28 [-0.03, 0.59]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.75 (P = 0.081)							
Test for subgroup differences: Not applicable							

Analysis 3.10. Comparison 3 Non-closure of parietal peritoneum only versus closure of both peritoneal layers, Outcome 10 Blood loss (not prespecified outcome).

Review: Closure versus non-closure of the peritoneum at caesarean section: short- and long-term outcomes

Comparison: 3 Non-closure of parietal peritoneum only versus closure of both peritoneal layers

Outcome: 10 Blood loss (not prespecified outcome)

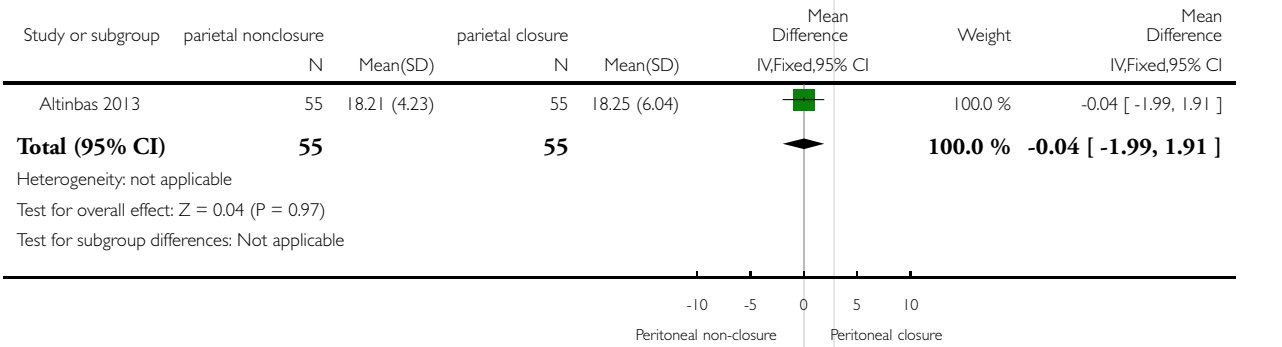


Analysis 3.11. Comparison 3 Non-closure of parietal peritoneum only versus closure of both peritoneal layers, Outcome 11 Time to flatus (not prespecified outcome).

Review: Closure versus non-closure of the peritoneum at caesarean section: short- and long-term outcomes

Comparison: 3 Non-closure of parietal peritoneum only versus closure of both peritoneal layers

Outcome: 11 Time to flatus (not prespecified outcome)



Analysis 3.12. Comparison 3 Non-closure of parietal peritoneum only versus closure of both peritoneal layers, Outcome 12 Wound pain, day 1 (visual analogue score).

Review: Closure versus non-closure of the peritoneum at caesarean section: short- and long-term outcomes

Comparison: 3 Non-closure of parietal peritoneum only versus closure of both peritoneal layers

Outcome: 12 Wound pain, day 1 (visual analogue score)

Study or subgroup	nonclosure N	Mean(SD)	closure N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Shahin 2009	164	4.5 (1.6)	161	6.1 (1.8)		100.0 %	-1.60 [-1.97, -1.23]
Total (95% CI)	**164**		**161**			**100.0 %**	**-1.60 [-1.97, -1.23]**

Heterogeneity: not applicable

Test for overall effect: Z = 8.46 (P < 0.00001)

Test for subgroup differences: Not applicable

Analysis 3.13. Comparison 3 Non-closure of parietal peritoneum only versus closure of both peritoneal layers, Outcome 13 Persistent abdominal pain after 8 months (numerical rating scale).

Review: Closure versus non-closure of the peritoneum at caesarean section: short- and long-term outcomes

Comparison: 3 Non-closure of parietal peritoneum only versus closure of both peritoneal layers

Outcome: 13 Persistent abdominal pain after 8 months (numerical rating scale)

Study or subgroup	nonclosure N	Mean(SD)	closure N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Shahin 2009	164	1.7 (1.1)	161	2.8 (1.5)		100.0 %	-1.10 [-1.39, -0.81]
Total (95% CI)	**164**		**161**			**100.0 %**	**-1.10 [-1.39, -0.81]**

Heterogeneity: not applicable

Test for overall effect: Z = 7.53 (P < 0.00001)

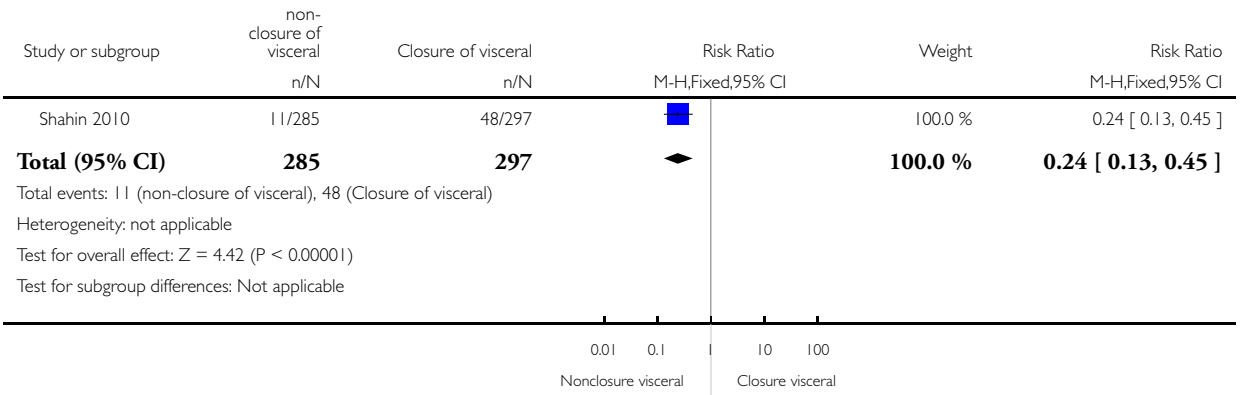
Test for subgroup differences: Not applicable

Analysis 4.1. Comparison 4 Non closure versus closure of visceral peritoneum when parietal peritoneum is closed, Outcome 1 Urinary frequency at 8 weeks.

Review: Closure versus non-closure of the peritoneum at caesarean section: short- and long-term outcomes

Comparison: 4 Non closure versus closure of visceral peritoneum when parietal peritoneum is closed

Outcome: 1 Urinary frequency at 8 weeks

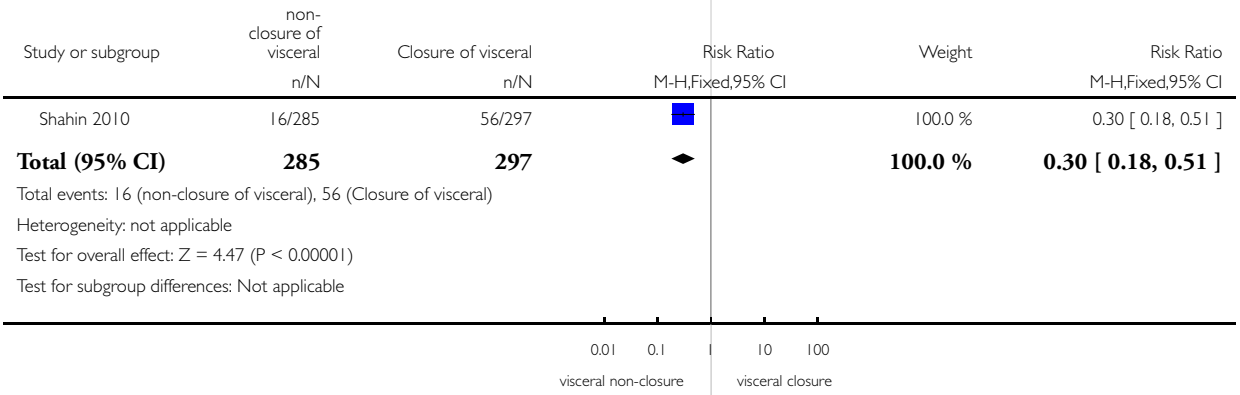


Analysis 4.2. Comparison 4 Non closure versus closure of visceral peritoneum when parietal peritoneum is closed, Outcome 2 Urgency of urination.

Review: Closure versus non-closure of the peritoneum at caesarean section: short- and long-term outcomes

Comparison: 4 Non closure versus closure of visceral peritoneum when parietal peritoneum is closed

Outcome: 2 Urgency of urination

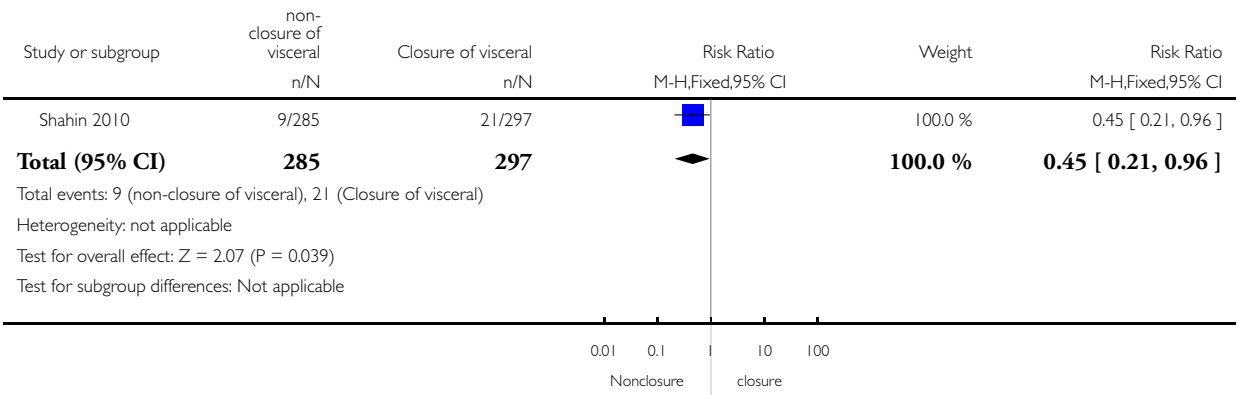


Analysis 4.3. Comparison 4 Non closure versus closure of visceral peritoneum when parietal peritoneum is closed, Outcome 3 Stress incontinence.

Review: Closure versus non-closure of the peritoneum at caesarean section: short- and long-term outcomes

Comparison: 4 Non closure versus closure of visceral peritoneum when parietal peritoneum is closed

Outcome: 3 Stress incontinence



F E E D B A C K

Wein, 19 February 2008

Summary

This review has been interpreted by the Royal College of Obstetricians and Gynaecologists in the UK as saying that non-closure of both layers of peritoneum is better than closure. However, there are no RCTs comparing closure with non-closure of the parietal peritoneum alone when the visceral peritoneum is not closed in either arm. Cohort studies and at least one RCT have suggested that non-closure of the parietal peritoneum is associated with more adhesions at the next caesarean section. This should be acknowledged in the conclusions and recommendations of this review.

Reply

The data on adhesions formation involved a few women assessed in two trials where visceral peritoneum was not closed. The numbers involved appears to be too small to advice on practice. However the finding is noted for future update as we have more data to base an informed advice.

Contributors

P Wein

WHAT'S NEW

Last assessed as up-to-date: 1 November 2013.

Date	Event	Description
1 November 2013	New citation required and conclusions have changed	Fifteen new trials were incorporated (Altinbas 2013; Anteby 2009; CAESAR 2010; CORONIS 2013; Gemer 2006; Ghahiry 2012; Ghongdemath 2011; Huchon 2005; Kapustian 2012; Komoto 2005; Malomo 2006; Malvasi 2009; Moraes 1999; Shahin 2009; Shahin 2010), which resulted to changes in the short- and long-term outcomes. There is now no reduction in analgesic dose or post-operative fever for women who received non-closure of visceral and parietal peritoneum when compared with closure of both layers. There was an increase in postoperative adhesion formation in women who received non-closure of visceral peritoneum only when compared with closure of both peritoneal layers
1 November 2013	New search has been performed	Search updated. Methods updated.

HISTORY

Protocol first published: Issue 1, 1995

Review first published: Issue 1, 1995

Date	Event	Description
2 December 2009	Amended	Search updated. Fourteen new reports added to Studies awaiting classification.
25 June 2008	Feedback has been incorporated	Feedback from Peter Wein added.
23 June 2008	Amended	Converted to new review format.
1 December 2006	New search has been performed	Search updated. We identified nine new trials; five have been included and four excluded. The inclusion of the new trials has not changed the conclusions The result of large randomised multicentre trials of

(*Continued*)

		surgical techniques for caesarean section (CAESAR, CORONIS) are awaited.
1 July 2003	New citation required and conclusions have changed	Substantive amendment

CONTRIBUTIONS OF AUTHORS

Anthony Bamigboye wrote the initial protocol, which was checked by Justus Hofmeyr. The first version of the review and the 2003 and 2014 updates were prepared by Anthony Bamigboye and Justus Hofmeyr. Anthony Bamigboye is the guarantor of the review.

DECLARATIONS OF INTEREST

None known.

SOURCES OF SUPPORT

Internal sources

- Effective Care Research Unit, University of the Witwatersrand/Fort Hare, East London Hospital Complex, South Africa.

External sources

- HRP-UNDP/UNFPA/WHO/World Bank Special Programme in Human Reproduction, Geneva, Switzerland.

DIFFERENCES BETWEEN PROTOCOL AND REVIEW

Additional outcomes not specified in the protocol were reported, and identified as such in the text.

- Blood transfusion > 1 unit.
- Maternal death.
- Intervention for postpartum haemorrhage.
- Readmission to hospital within six weeks.
- Mobilisation time in hours.
- Time to oral intake in hours.
- Drop in haemoglobin g/dL.
- Blood loss mL.
- Time to flatus.

INDEX TERMS

Medical Subject Headings (MeSH)

*Abdominal Wound Closure Techniques; Cesarean Section [*methods]; Length of Stay [statistics & numerical data]; Operative Time; Peritoneal Diseases [etiology]; Peritoneum [*surgery]; Randomized Controlled Trials as Topic; Suture Techniques; Tissue Adhesions [etiology]

MeSH check words

Female; Humans; Pregnancy