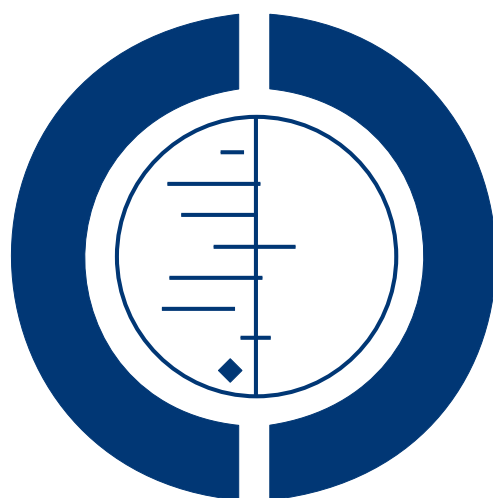


Abdominal surgical incisions for caesarean section (Review)

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[Intervention Review]

Abdominal surgical incisions for caesarean section

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ABSTRACT

Background

Caesarean section is the commonest major operation performed on women worldwide. Operative techniques, including abdominal incisions, vary. Some of these techniques have been evaluated through randomised trials.

Objectives

To determine the benefits and risks of alternative methods of abdominal surgical incisions for caesarean section.

Search strategy

We searched the Cochrane Pregnancy and Childbirth Group's Trials Register (30 April 2006).

Selection criteria

Randomised controlled trials of intention to perform caesarean section using different abdominal incisions.

Data collection and analysis

We extracted data from the sources, checked them for accuracy and analysed the data.

Main results

Four studies were included in this review.

Two studies (411 participants) compared the Joel-Cohen incision with the Pfannenstiel incision. Overall, there was a 65% reduction in reported postoperative morbidity (relative risk (RR) 0.35, 95% confidence interval (CI) 0.14 to 0.87) with the Joel-Cohen incision. One of the trials reported reduced postoperative analgesic requirements (RR 0.55, 95% CI 0.40 to 0.76); operating time (weighted mean difference (WMD) -11.40, 95% CI -16.55 to -6.25 minutes); delivery time (WMD -1.90, 95% CI -2.53 to -1.27); total dose of analgesia in the first 24 hours (WMD -0.89, 95% CI -1.19 to -0.59); estimated blood loss (WMD -58.00, 95% CI -108.51 to -7.49 ml); postoperative hospital stay for the mother (WMD -1.50, 95% CI -2.16 to -0.84); and increased time to the first dose of analgesia (WMD 0.80, 95% CI 0.12 to 1.48) compared to the Pfannenstiel group. No other significant differences were found in either trial.

Two studies compared muscle cutting incisions with Pfannenstiel incision. One study (68 women) comparing Mouchel incision with Pfannenstiel incision did not contribute data to this review. The other study (97 participants) comparing the Maylard muscle-cutting

incision with the Pfannenstiel incision, reported no difference in febrile morbidity (RR 1.26, 95% CI 0.08 to 19.50); need for blood transfusion (RR 0.42, 95% CI 0.02 to 9.98); wound infection (RR 1.26, 95% CI 0.27 to 5.91); physical tests on muscle strength at three months postoperative and postoperative hospital stay (WMD 0.40 days, 95% CI -0.34 to 1.14).

Authors' conclusions

The Joel-Cohen incision has advantages compared to the Pfannenstiel incision. These are less fever, pain and analgesic requirements; less blood loss; shorter duration of surgery and hospital stay. These advantages for the mother could be extrapolated to savings for the health system. However, these trials do not provide information on severe or long-term morbidity and mortality.

PLAIN LANGUAGE SUMMARY

Abdominal surgical incisions for caesarean section

In a caesarean section operation, there are various types of incisions in the abdominal wall that can be used. These include vertical and transverse incisions, and there are variations in the specific ways the incisions can be undertaken. The review of studies identified 4 trials involving 666 women. The Joel-Cohen incision showed better outcomes than the Pfannenstiel incision in terms of less fever for women, less postoperative pain, less blood loss, shorter duration of surgery and shorter hospital stay. However, the trials did not assess possible long-term problems associated with different surgical techniques.

BACKGROUND

Caesarean section is the commonest major operation performed on women worldwide. Operative techniques used for caesarean section vary and some of these techniques have been evaluated through randomised trials.

Various abdominal incisions have been used for caesarean delivery. These include vertical (midline and paramedian) incisions and transverse incisions (Pfannenstiel, Maylard, Cherney, Joel-Cohen). The type of incision used may depend on many factors including the clinical situation and the preferences of the operator.

Traditionally, vertical incisions were used for caesarean delivery ([Myerscough 1982](#)). Here the skin is incised in the midline between the umbilicus and the pubic symphysis. The rectus sheath and the peritoneum are incised in the midline. This area is least vascular. Vertical subumbilical midline incisions have the presumed advantage of speed of abdominal entry and less bleeding. A vertical midline incision may be extended upwards if more space is required for access. Moreover, this incision may be used if a caesarean delivery is planned under local anaesthesia ([WHO 2000](#)). The disadvantages of a vertical midline incision include the greater risk of postoperative wound dehiscence and development of incisional hernia. The scar is cosmetically less pleasing. In the paramedian incision, the skin incision is made to one side of the midline (usually right). The anterior rectus sheath is opened under the skin incision. The belly of the underlying rectus abdominus muscle is then retracted laterally and the posterior rectus sheath and peritoneum are opened. Because of a shutter-like effect, the stress on the scar is presumed

to be less. The paramedian incision is reportedly stronger ([Kendall 1991](#)) than the midline scar but has no cosmetic advantage.

The lower abdominal transverse incision is adequate for the vast majority of caesarean operations. It has the advantages of cosmetic approval and minimal risk of postoperative disruption. The risks of incisional hernia are less than those following vertical incisions. However, transverse abdominal incisions usually involve more dissection and may require more surgical skills. Blood loss following dissection may be more. Also, this incision may be difficult to make under local anaesthesia, though successful techniques have been described ([Sreenivasan 2006](#)). Transverse incisions are difficult to extend if increased access is required.

The traditional lower abdominal incision for caesarean delivery is the incision described in 1900 by Pfannenstiel. Classically, this incision is located two fingers-breadth above the pubic symphysis. Here the skin may be entered via a low transverse incision that curves gently upward, placed in a natural fold of skin (the 'smile' incision). After the skin is entered, the incision is rapidly carried through subcutaneous tissue to the fascia, which is then nicked on either side of the midline. The subcutaneous tissue is incised sharply with a scalpel. Once the fascia is exposed, it is incised transversely with heavy curved Mayo scissors. In the standard technique, the upper and then the lower fascial edges are next grasped with a heavy toothed clamp, such as a Kocher, and elevated. Under continuous tension, the fascia is then separated from the underlying muscles by blunt and sharp dissection. Once the upper and lower fascia have been dissected free, and any perforating vessel sutured

or electrocoagulated, the underlying rectus abdominus muscles are separated with finger dissection. If the muscles are adherent, sharp dissection is necessary to separate them. The peritoneum is then opened sharply in the midline. The initial entry is then widened sharply with fine scissors exposing intraperitoneal contents.

When exposure is limited and additional space is required, the Maylard or Cherney modification may be used. In the Maylard procedure, the rectus abdominus muscles are divided either sharply or by electrocautery to allow greater access to the abdomen. However, this may result in a good deal of tissue damage and the underlying artery may be entered (O'Grady 1995). The Maylard incision length is usually longer than the Pfannenstiel incision. However, difficulty in delivery of the fetus is minimal with Pfannenstiel incisions measuring at least 15 cm in length (Ayers 1987), the length of a standard Allis clamp - the Allis clamp test (Finan 1991). Shorter incisions may lead to difficulty in general exposure or delivery of the baby's head, or both.

In the Cherney procedure, the lower fascia is reflected exposing the tendinous attachment of the rectus abdominus muscle bodies to the fascia of the pubis (O'Grady 1995). The muscle is severed as low as possible and the proximal and distal ends suture ligated. One or both muscle attachments may be divided as required.

The Mouchel incision is similar to the Maylard incision. This transverse incision runs at the upper limit of the pubic hair and is thus lower than the Maylard incision. The muscles are divided above the openings of the inguinal canals (Mouchel 1981).

In the Pelosi technique (Wood 1999) for caesarean delivery, the skin is cut in a low transverse fashion with a knife. The subcutaneous tissues and fascia are incised with electrocautery. The upper aspect of the fascial incision is elevated and the median raphe is dissected cephalad 2 cm to 3 cm using electrocautery. The rectus muscles are separated bluntly with fingers to identify the underlying peritoneum, which is then entered by inserting the index finger inwards and upwards or sharply as required. The peritoneum and muscles are stretched to the full extent of the skin. In this technique, no bladder flap is created before hysterotomy. After delivery of the baby, the obstetrician awaits spontaneous placental expulsion before closing the hysterotomy in one layer. The fascia is closed and the skin edges are approximated with staples. The Pelosi technique was reported to be associated with decreased operative time, decreased blood loss, improved patient outcome and decreased overall cost (Wood 1999).

Joel-Cohen (Joel-Cohen 1977) described a transverse skin incision, which was subsequently adapted for caesarean sections. This modified incision is placed about 3 cm below the line joining the anterior superior iliac spines. This incision is higher than the traditional Pfannenstiel incision. Sharp dissection is minimised. After the skin is cut, the subcutaneous tissue and the anterior rectus sheath are opened a few centimetres only in the midline. The rectus sheath incision may be extended laterally by blunt finger dis-

section (Wallin 1999) or by pushing laterally with slightly opened scissor tips, deep to the subcutaneous tissues (Holmgren 1999). The rectus muscles are separated by finger traction. If exceptional speed is required in the transverse entry, the fascia may be incised in the midline and both the fascia and subcutaneous tissue are rapidly divided by blunt finger dissection (Joel-Cohen 1977). Stark used this incision for caesarean delivery along with single layer closure of the exteriorised uterus and non-closure of the peritoneum. This package of surgical techniques for caesarean section used at the Misgav-Ladach hospital, Jerusalem, has been popularised by Stark and others (Holmgren 1999). The reported advantages include shorter operating time (Darj 1999; Franchi 1998; Mathai 2002; Wallin 1999), less use of suture material (Bjorklund 2000), less intraoperative blood loss (Bjorklund 2000; Darj 1999; Wallin 1999), less postoperative pain (Darj 1999; Mathai 2002) and less wound infection (Franchi 1998) in the group undergoing caesarean by these techniques.

There are other Cochrane reviews on surgical techniques used at caesarean section, for example, techniques of repair of the uterine incision (Jokhan-Jacob 2004), techniques for closure of the abdominal wall (Anderson 2004) and skin (Alderdice 2003) after caesarean section. This review focuses specifically on abdominal surgical incisions for caesarean section.

OBJECTIVES

To determine, from the best available evidence, the benefits and risks of alternative methods of abdominal surgical incisions for caesarean section.

METHODS

Criteria for considering studies for this review

Types of studies

All comparisons of intention to perform caesarean section using different abdominal incisions, with random allocation to treatment and control groups, with adequate allocation concealment, and with violations of allocated management and exclusions after allocation not sufficient to materially affect outcomes. Quasi-randomised trials were not included.

Types of participants

Pregnant women due for delivery by caesarean section.

Types of interventions

Abdominal incisions for caesarean section performed according to a prespecified technique.

Types of outcome measures

Primary outcomes

1. Postoperative febrile morbidity as defined by trial authors;
2. postoperative analgesia as defined by trial authors;
3. blood loss as defined by the trial authors;
4. blood transfusion.

Secondary outcomes

For the mother

1. Duration of surgery;
2. operative complications;
3. postoperative complications;
4. postoperative haemoglobin level;
5. postoperative anaemia, as defined by trial authors;
6. postoperative pyrexia;
7. postoperative infection requiring additional antibiotic therapy;
8. wound complications (haematoma, infection, breakdown);
9. time to mobilisation;
10. time to oral intake;
11. time to return of bowel function;
12. time to breastfeeding initiation;
13. voiding problems;
14. length of postoperative hospital stay;
15. unsuccessful breastfeeding, as defined by trial authors;
16. mother not satisfied;
17. appearance of scar.

For the baby

1. Time from anaesthesia to delivery;
2. Apgar score;
3. cord blood pH less than 7.20;
4. birth trauma;
5. admission to special care baby unit;
6. encephalopathy.

Other

1. Caregiver not satisfied;
2. cost.

Outcomes were included if these were clinically meaningful; reasonable measures had been taken to minimise observer bias; missing data were insufficient to materially influence conclusions; data

were available for analysis according to original allocation, irrespective of protocol violations; data were available in a format suitable for analysis.

Search methods for identification of studies

Electronic searches

We searched the Cochrane Pregnancy and Childbirth Group's Trials Register by contacting the Trials Search Co-ordinator (30 April 2006).

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

1. quarterly searches of the Cochrane Central Register of Controlled Trials (CENTRAL);
2. monthly searches of MEDLINE;
3. handsearches of 30 journals and the proceedings of major conferences;
4. weekly current awareness search of a further 37 journals.

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

Trials identified through the searching activities described above are given a code (or codes) depending on the topic. The codes are linked to review topics. The Trials Search Co-ordinator searches the register for each review using these codes rather than keywords. We did not apply any language restrictions.

Data collection and analysis

Selection of studies

Both authors assessed for inclusion all potential studies we identified as a result of the search strategy.

Assessment of methodological quality of included studies

Both authors assessed the validity of each study using the criteria outlined in the Cochrane Handbook for Systematic Reviews of Interventions (Higgins 2005). Methods used for generation of the randomisation sequence are described for each trial.

(1) Selection bias (allocation concealment)

We assigned a quality score for each trial, using the following criteria:

(A) adequate concealment of allocation: such as telephone randomisation, consecutively-numbered, sealed opaque envelopes;
(B) unclear whether adequate concealment of allocation: such as list or table used, sealed envelopes, or study does not report any concealment approach;
(C) inadequate concealment of allocation: such as open list of random-number tables, use of case record numbers, dates of birth or days of the week.

(2) Attrition bias (loss of participants, for example, withdrawals, dropouts, protocol deviations)

We assessed completeness to follow up using the following criteria:

- (A) less than 5% loss of participants;
- (B) 5% to 9.9% loss of participants;
- (C) 10% to 19.9% loss of participants;
- (D) more than 20% loss of participants.

(3) Performance bias (blinding of participants, researchers and outcome assessment)

We assessed blinding using the following criteria:

- (A) blinding of participants (yes/no/unclear);
- (B) blinding of caregiver (yes/no/unclear);
- (C) blinding of outcome assessment (yes/no/unclear).

Data extraction and management

Both review authors extracted the data using the agreed form. Discrepancies were resolved through discussion. When information regarding any of the above was unclear, we attempted to contact authors of the original reports to provide further details.

Measures of treatment effect

Statistical analysis was carried out using the Review Manager software (RevMan 2003). We used fixed-effect meta-analysis for combining data in the absence of significant heterogeneity if trials were sufficiently similar.

Dichotomous data

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

Continuous data

For continuous data, we used the weighted mean difference if outcomes were measured in the same way between trials.

Assessment of heterogeneity

We applied tests of heterogeneity between trials, if appropriate, using the I^2 statistic.

Subgroup analyses

We planned the following subgroup analyses:

1. primary, repeat and mixed or undefined caesarean sections;
2. general, regional and mixed or undefined anaesthesia.

RESULTS

Description of studies

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

Seventeen studies which compared various abdominal incisions were identified based on the search strategies. Four trials were excluded from the analyses as allocation to intervention groups were not based on randomisation in these trials ([Ansaloni 2001](#); [Ayers 1987](#); [Gaucherand 2001](#); [Redlich 2001](#)).

Twelve studies compared various abdominal incisions either alone or in combinations with other steps carried out during caesarean delivery. Six studies ([Dani 1998](#); [Darj 1999](#); [Ferrari 2001](#); [Franchi 1998](#); [Heimann 2000](#); [Wallin 1999](#)) which compared Joel-Cohen incision as part of the Misgav-Ladach technique with Pfannenstiel incision had differences in other steps between the two arms, such as closure of the uterotomy and peritoneum. These six studies were therefore excluded from the review, as were two studies ([Bjorklund 2000](#); [Moreira 2002](#)) which compared the Misgav-Ladach technique with the vertical incision.

For details of excluded studies, see the 'Characteristics of excluded studies' table.

Only two studies ([Franchi 2002](#); [Mathai 2002](#)) compared Joel-Cohen incision with Pfannenstiel incision for laparotomic access. Two studies compared transverse muscle-cutting incisions - Mouchel ([Berthet 1989](#)) and Maylard ([Giacalone 2002](#)) - with the Pfannenstiel incision and were included in the review. Thus a total of four studies comparing only different abdominal incisions for caesarean delivery were included in the review. Details of these studies are available in the 'Characteristics of included studies' table.

Risk of bias in included studies

The methodological quality of the included studies was variable. Allocation concealment was unclear in one trial ([Berthet 1989](#)). Given the type of intervention, the surgical team was aware of the allocated intervention. Assessment of intraoperative variables, for example, time taken for surgery and estimated blood loss, may have been subject to bias. However, outcomes assessed in the immediate postoperative period, for example, febrile morbidity, pain, analgesic requirements, were less subject to bias.

Effects of interventions

(1) Joel-Cohen incision versus Pfannenstiel incision

Two studies (Franchi 2002; Mathai 2002) compared the Joel-Cohen incision with Pfannenstiel incision. All other aspects of surgery in these two trials were similar in the two arms. Both trials (411 participants) assessed postoperative febrile morbidity. Overall, there was a 65% reduction in reported postoperative morbidity (relative risk (RR) 0.35, 95% confidence interval (CI) 0.14 to 0.87) in the Joel-Cohen group. There was no significant heterogeneity among the trials.

Other outcomes were reported only in Mathai 2002 (101 women). Postoperative analgesic requirements were less in the Joel-Cohen group (RR 0.55, 95% CI 0.40 to 0.76); operating time was reduced (weighted mean difference (WMD) -11.40, 95% CI -16.55 to -6.25 minutes); delivery time was reduced (WMD -1.90, 95% CI -2.53 to -1.27); the time to the first dose of analgesia was increased (WMD 0.80, 95% CI 0.12 to 1.48); the total dose of analgesia in the first 24 hours was reduced (WMD -0.89, 95% CI -1.19 to -0.59); estimated blood loss was reduced (WMD -58.00, 95% CI -108.51 to -7.49 ml); and postoperative hospital stay for the mother was reduced (WMD -1.50; 95% CI -2.16 to -0.84), compared to the Pfannenstiel group. All women in this study had had surgery under spinal analgesia. No other significant differences were found in either trial.

Women having Joel-Cohen incisions initiated breastfeeding earlier than those having Pfannenstiel incisions but this difference was not statistically significant (WMD -5.50, 95% CI -13.62 to 2.62 hours). None of the studies reported on postoperative voiding difficulties. There was no difference in the duration of infant's stay in special care baby unit in one study (101 participants) (Mathai 2002) reporting on this outcome (WMD -0.46; 95% CI -0.95 to 0.03).

(2) Joel-Cohen incision versus vertical incision

No studies directly compared these incisions.

(3) Muscle cutting incision versus Pfannenstiel incision

Two studies compared muscle cutting incisions with Pfannenstiel incision. None of the outcomes of interest for this review were reported by Berthet 1989 comparing Mouchel incision with Pfannenstiel incision. Giacalone 2002 (97 participants) compared Maylard incision with Pfannenstiel incision and reported no difference in febrile morbidity (RR 1.26, 95% CI 0.08 to 19.50), need for blood transfusion (RR 0.42, 95% CI 0.02 to 9.98) or wound infection (RR 1.26, 95% CI 0.27 to 5.91) between the two groups. There was no difference in physical tests on muscle strength (Janda) at three months postoperative between the two incisions (54 participants). No difference was observed in postoperative hospital stay between Maylard muscle-cutting incision and Pfannenstiel incision (WMD 0.40 days, 95% CI -0.34 to 1.14).

None of the studies reported on the need for readmission to the hospital for mother or baby. Maternal death, severe disability and thromboembolism were not reported by any of the trials included. There were no reports comparing other long-term wound problems like incisional hernia, hypertrophic scar, future fertility problems, complications in later pregnancies and complications at later surgery. No subgroup analysis was done.

DISCUSSION

The limited data comparing muscle-cutting incisions with Pfannenstiel incisions showed no differences.

The Joel-Cohen incision was associated with some immediate benefits for the woman undergoing caesarean delivery in comparison to the Pfannenstiel incision. Postoperative morbidity was less following this incision as indicated by fever, postoperative pain and analgesic requirements. Although measurements were subjective, estimated intraoperative blood loss was reportedly less with Joel-Cohen incision compared to Pfannenstiel and vertical incisions. The clinical significance of the reported difference (less than 100 mL) in estimated blood loss is probably less important in non-anaemic women but may be of greater significance in anaemic women.

Caesarean delivery using the Joel-Cohen incision took less time than caesarean delivery by Pfannenstiel incision. The time from skin incision to delivery of the baby and the total duration of surgery were both shorter. However, it is unclear if the difference in time for delivery is of clinical significance. However, less time taken for surgery may be significant in situations where there is a shortage of operation theatre facilities and staff availability. Lastly, women having Joel-Cohen incision had shorter periods of hospitalisation compared to the Pfannenstiel incision.

None of the studies report on significant long-term outcomes such as long-term problems associated with surgery and the outcomes in subsequent pregnancy.

AUTHORS' CONCLUSIONS

Implications for practice

The Joel-Cohen incision has several advantages compared to the Pfannenstiel incision. These include less fever, less pain (and therefore less analgesic requirements), less blood loss, shorter duration of surgery and shorter hospital stay. These advantages for the mother could be extrapolated to advantages for the health system through less demand on resources.

Implications for research

Opinions of women and caregivers were not evaluated. None of the studies have assessed severe immediate morbidity or long-term morbidity and mortality among mothers and infants. Larger trials, which include these outcomes and plan adequate follow up at least until the end of the next pregnancy, would be required to assess these issues. Additional outcomes could include long-term pain, presence of numb patches, appearance of and satisfaction with scar, development of hernia, etc. There is also a need to study if these procedures can be done safely under local anaesthesia in settings where safe general or regional anaesthesia is not available.

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As part of the pre-publication editorial process, this review has been commented on by three peers (an editor and two referees who are external to the editorial team), one or more members of the Pregnancy and Childbirth Group's international panel of consumers and the Group's Statistical Adviser.

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* Indicates the major publication for the study

CHARACTERISTICS OF STUDIES

Characteristics of included studies [ordered by study ID]

Berthet 1989

Methods	Randomisation to Mouchel incision or Pfannenstiel incision. Method of randomisation unclear.	
Participants	58 women undergoing caesarean section by Mouchel or Pfannenstiel incision. The study also included 61 women undergoing gynaecological surgery in Grenoble, France.	
Interventions	Mouchel (muscle-cutting) incision (n = 28) versus Pfannenstiel incision (n = 30).	
Outcomes	Extraction time. Apgar scores. Umbilical cord pH.	
Notes		
<i>Risk of bias</i>		
Item	Authors' judgement	Description
Allocation concealment?	Unclear	B - Unclear

Franchi 2002

Methods	Multicentre study. Sealed envelopes containing computer-generated random codes.	
Participants	Women over 18 years, singleton pregnancy with indication for caesarean delivery in Varese, Italy and Berne, Switzerland. Exclusion criteria were: gestation less than 32 weeks, previous myomectomy, previous longitudinal abdominal incision, previous caesarean section prior to 32 weeks, 2 or more caesarean sections, maternal diseases requiring long-term medical treatment. 2 in Joel-Cohen group were excluded after randomisation because they required caesarean hysterectomy.	
Interventions	Joel-Cohen incision (n = 154) versus Pfannenstiel incision (n = 158) for laparotomic access.	
Outcomes	Extraction time defined as interval from skin incision to the clamping of the umbilical cord. Total operative time defined as the time from skin incision to the end of the skin closure. Postoperative morbidity defined when at least one of the following conditions occurred: wound infection grade 2-5, endometritis, sepsis, requirement of blood transfusion, febrile morbidity, puerperal infection, urinary tract infection, and requirement of a re-laparotomy. Neurodevelopmental assessment of infant at 6 months of age by single neonatologist.	

Franchi 2002 (Continued)

Notes	Abdominal wound infection was graded with a 6-grade score. Febrile morbidity was defined as temperature elevation to 38 deg C on 2 occasions 4 h apart, excluding the first 24 h and in the absence of known operative or non-operative site infection. Puerperal endometritis was defined as postpartum temperature elevation to 38 deg C on 2 occasions 4 h apart with uterine tenderness, foul-smelling lochia, and no other apparent sources of fever.	
<i>Risk of bias</i>		
Item	Authors' judgement	Description
Allocation concealment?	Yes	A - Adequate

Giacalone 2002

Methods	Consecutively-numbered, sealed envelopes containing allocation code.	
Participants	Women (n = 120) more than 18 years old and at gestation more than 37 weeks undergoing elective or emergency caesarean delivery in Montpellier, France. Excluded were women with scarred abdominal wall, previous caesarean delivery, hernia, multifetal gestation, grand multiparity, diabetes mellitus, myopathy, corticosteroid therapy during pregnancy, on anticoagulants or having haemostatic disorder, having general anaesthesia. Mother was not asked to participate when neonate was at risk of transfer to neonatal unit. Postoperative questionnaires and outcome variables were available for 97 (87%). Postoperative isokinetic assessment was performed on 54 of these women only.	
Interventions	Maylard (muscle-cutting) incision (n = 43) versus Pfannenstiel incision (n = 54) for laparotomic access.	
Outcomes	Intraoperative and postoperative morbidity. Immediate and late postoperative pain. Health-related quality of life. Evaluation of abdominal wall function by physical therapist.	
Notes		
<i>Risk of bias</i>		
Item	Authors' judgement	Description
Allocation concealment?	Yes	A - Adequate

Mathai 2002

Methods	Sealed, consecutively-numbered envelopes containing randomisation code. Block randomisation to 1 of 2 interventions.	
Participants	Women (n = 105) with singleton pregnancies at longitudinal lie at term requiring cesarean delivery under spinal anaesthesia in Vellore, India. Excluded were those with multiple pregnancy, any previous abdominal surgery, conditions where midline or paramedian incisions were planned, and where spinal anaesthesia was contraindicated. Spinal anaesthesia was ineffective in 1 in each group. 2 women in Joel Cohen group (1 underwent caesarean hysterectomy; 1 had vaginal delivery prior to caesarean section).	
Interventions	Joel-Cohen incision (n = 51) versus Pfannenstiel incision (n = 50) for laparotomic access.	
Outcomes	Analgesia on demand within the first 4 h after surgery. Time between surgery and first dose of analgesic. Time between skin incision and delivery of infant. Time between skin incision and closure. Estimated blood loss. Time between surgery and intake of oral fluids. Total dose of analgesics in first 24 h. Febrile morbidity. Hematocrit - preoperative and postoperative. Time from surgery to start of breastfeeding. Duration of stay in special care nursery. Duration of postoperative hospitalisation.	
Notes		
<i>Risk of bias</i>		
Item	Authors' judgement	Description
Allocation concealment?	Yes	A - Adequate

deg: degree

h: hour

min: minute

Characteristics of excluded studies [ordered by study ID]

Ansalmi 2001	Alternate allocation, not randomised.
Ayers 1987	Treatment allocation based on hospital number.
Ayres-de-Campos 2000	Not enough data provided in abstract for assessment.
Behrens 1997	Not enough data provided in abstract for assessment.
Bjorklund 2000	Comparison of abdominal incisions along with different combinations of other steps of surgery.
Dani 1998	Comparison of abdominal incisions along with different combinations of other steps of surgery.
Darj 1999	Comparison of abdominal incisions along with different combinations of other steps of surgery.
Decavalas 1997	Not enough data provided in abstract for assessment.
Direnzo 2001	Not enough data provided in abstract for assessment.
Falls 1958	Not a randomised controlled trial.
Ferrari 2001	Comparison of abdominal incisions along with different combinations of other steps of surgery.
Franchi 1998	Comparison of abdominal incisions along with different combinations of other steps of surgery.
Gaucherand 2001	Treatment allocation by year of birth.
Hagen 1999	Not enough data provided in abstract for assessment.
Heimann 2000	Comparison of abdominal incisions along with different combinations of other steps of surgery.
Hohlgeschwandtner	Not a comparison of abdominal incisions.
Meyer 1998	Not enough data provided in abstract for assessment.
Meyer BA 1997	Not enough data provided in abstract for assessment.
Moreira 2002	Comparison of abdominal incisions along with different combinations of other steps of surgery.
Redlich 2001	Treatment allocation by first letter of surname.
Wallin 1999	Comparison of abdominal incisions along with different combinations of other steps of surgery.
Xavier 1999	Not enough data provided in abstract for assessment.

DATA AND ANALYSES

Comparison 1. Joel-Cohen versus Pfannenstiel incision

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Postoperative febrile morbidity	2	411	Risk Ratio (M-H, Fixed, 95% CI)	0.35 [0.14, 0.87]
1.1 Joel-Cohen versus Pfannenstiel incision	2	411	Risk Ratio (M-H, Fixed, 95% CI)	0.35 [0.14, 0.87]
2 Postoperative analgesia on demand	1	101	Risk Ratio (M-H, Fixed, 95% CI)	0.55 [0.40, 0.76]
3 Time between surgery and first dose of analgesic (hours)	1	101	Mean Difference (IV, Fixed, 95% CI)	0.80 [0.12, 1.48]
4 Total dose of analgesics in 24 hours	1	101	Mean Difference (IV, Fixed, 95% CI)	-0.89 [-1.19, -0.59]
6 Number of analgesic injections required	0	0	Mean Difference (IV, Fixed, 95% CI)	Not estimable
7 Duration of analgesics (hours)	0	0	Mean Difference (IV, Fixed, 95% CI)	Not estimable
8 Number of analgesic doses required	0	0	Mean Difference (IV, Fixed, 95% CI)	Not estimable
9 Estimated blood loss (mL)	1	101	Mean Difference (IV, Fixed, 95% CI)	-58.0 [-108.51, -7.49]
10 Change in pre- and postoperative haemoglobin levels (g)	0	0	Mean Difference (IV, Fixed, 95% CI)	Not estimable
12 Blood transfusion	1	310	Risk Ratio (M-H, Fixed, 95% CI)	Not estimable
13 Wound infection as defined by trial authors	1	310	Risk Ratio (M-H, Random, 95% CI)	1.56 [0.45, 5.42]
14 Wound haematoma	0	0	Risk Ratio (M-H, Fixed, 95% CI)	Not estimable
15 Postoperative pain absent on day 1	0	0	Risk Ratio (M-H, Fixed, 95% CI)	Not estimable
16 Postoperative pain absent on day 2	0	0	Risk Ratio (M-H, Fixed, 95% CI)	Not estimable
17 "Significant" postoperative pain by visual analogue score	0	0	Risk Ratio (M-H, Fixed, 95% CI)	Not estimable
18 Time (hours) from surgery to start of breastfeeding	1	101	Mean Difference (IV, Fixed, 95% CI)	-5.5 [-13.62, 2.62]
20 Total operative time (minutes)	1	101	Mean Difference (IV, Fixed, 95% CI)	-11.40 [-16.55, -6.25]
23 Need for re-laparotomy	1	310	Risk Ratio (M-H, Fixed, 95% CI)	Not estimable
25 Long-term "significant" wound pain assessed by visual analogue score	0	0	Risk Ratio (M-H, Fixed, 95% CI)	Not estimable
31 Not satisfied with wound	0	0	Risk Ratio (M-H, Fixed, 95% CI)	Not estimable
34 Delivery time (minutes)	1	101	Mean Difference (IV, Fixed, 95% CI)	-1.90 [-2.53, -1.27]
35 5-minute Apgar score less than 7	0	0	Risk Ratio (M-H, Fixed, 95% CI)	Not estimable

37 Admissions to special care baby unit - all types	1	310	Risk Ratio (M-H, Fixed, 95% CI)	1.19 [0.44, 3.20]
38 Admission to special care baby unit - emergency caesarean section	1	98	Risk Ratio (M-H, Fixed, 95% CI)	1.45 [0.54, 3.86]
40 Postoperative hospital stay for mother (days)	1	101	Mean Difference (IV, Fixed, 95% CI)	-1.5 [-2.16, -0.84]
41 Stay in special care nursery (days)	1	101	Mean Difference (IV, Fixed, 95% CI)	-0.46 [-0.95, 0.03]

Comparison 2. Muscle-cutting/Maylard versus Pfannenstiell incision

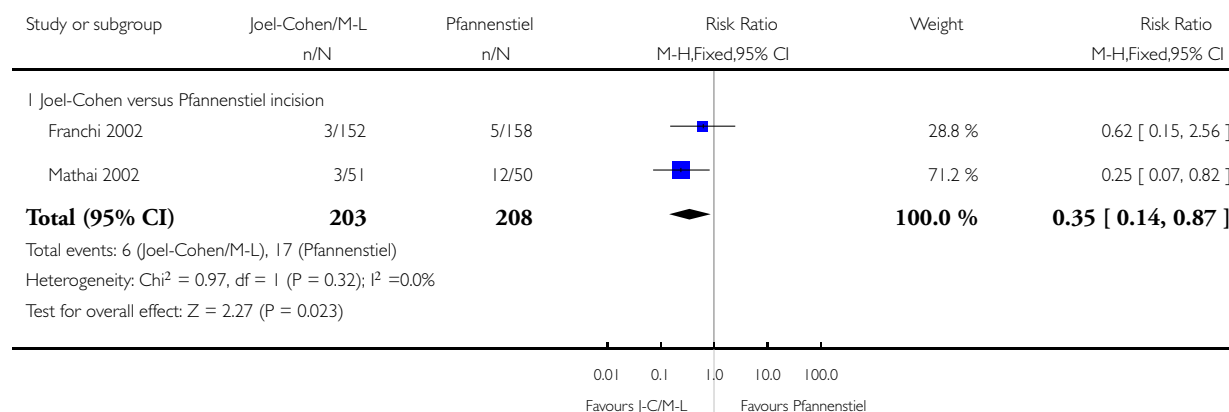
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Postoperative febrile morbidity	1	97	Risk Ratio (M-H, Fixed, 95% CI)	1.26 [0.08, 19.50]
12 Blood transfusion	1	97	Risk Ratio (M-H, Fixed, 95% CI)	0.42 [0.02, 9.98]
13 Wound infection as defined by trial authors	1	97	Risk Ratio (M-H, Fixed, 95% CI)	1.26 [0.27, 5.91]
24 Long-term complication - physical test at 3 months (Janda)	1	54	Mean Difference (IV, Fixed, 95% CI)	0.10 [-0.73, 0.93]
40 Postoperative hospital stay for mother (days)	1	97	Mean Difference (IV, Fixed, 95% CI)	0.40 [-0.34, 1.14]

Analysis 1.1. Comparison 1 Joel-Cohen versus Pfannenstiell incision, Outcome 1 Postoperative febrile morbidity.

Review: Abdominal surgical incisions for caesarean section

Comparison: 1 Joel-Cohen versus Pfannenstiell incision

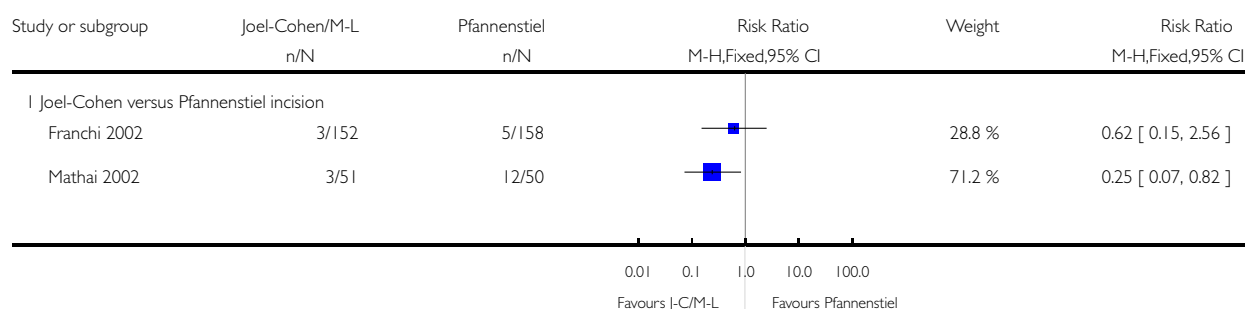
Outcome: 1 Postoperative febrile morbidity



Review: Abdominal surgical incisions for caesarean section

Comparison: 1 Joel-Cohen versus Pfannenstiel incision

Outcome: 1 Postoperative febrile morbidity

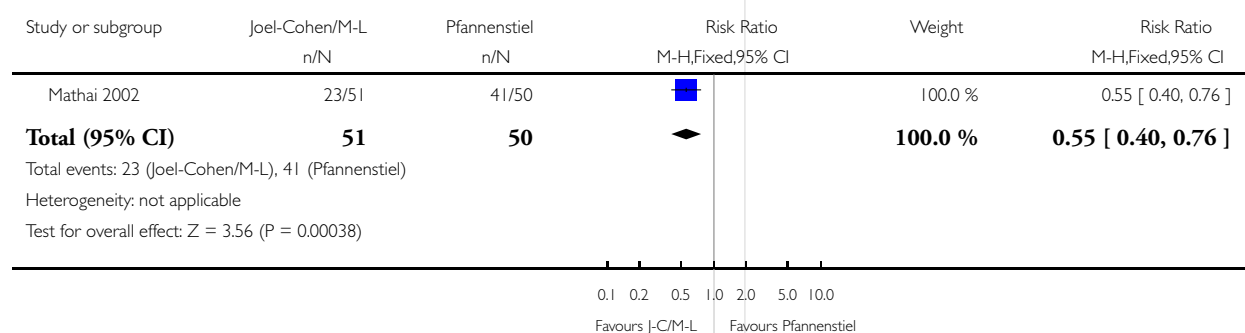


Analysis 1.2. Comparison 1 Joel-Cohen versus Pfannenstiel incision, Outcome 2 Postoperative analgesia on demand.

Review: Abdominal surgical incisions for caesarean section

Comparison: 1 Joel-Cohen versus Pfannenstiel incision

Outcome: 2 Postoperative analgesia on demand

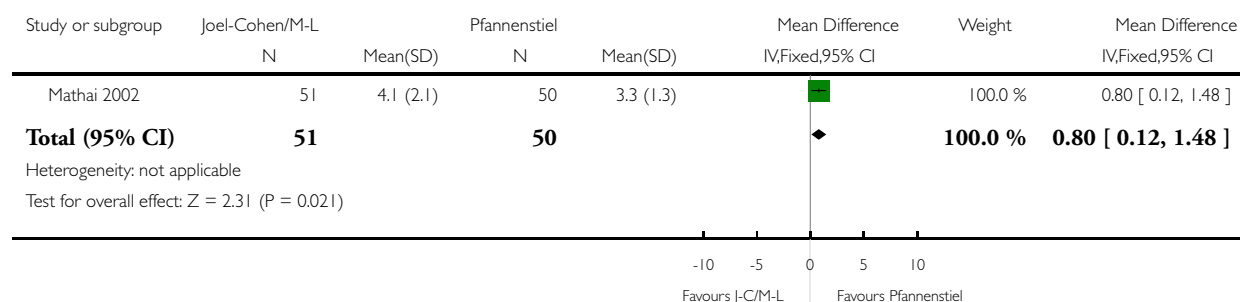


Analysis I.3. Comparison I Joel-Cohen versus Pfannenstiel incision, Outcome 3 Time between surgery and first dose of analgesic (hours).

Review: Abdominal surgical incisions for caesarean section

Comparison: I Joel-Cohen versus Pfannenstiel incision

Outcome: 3 Time between surgery and first dose of analgesic (hours)

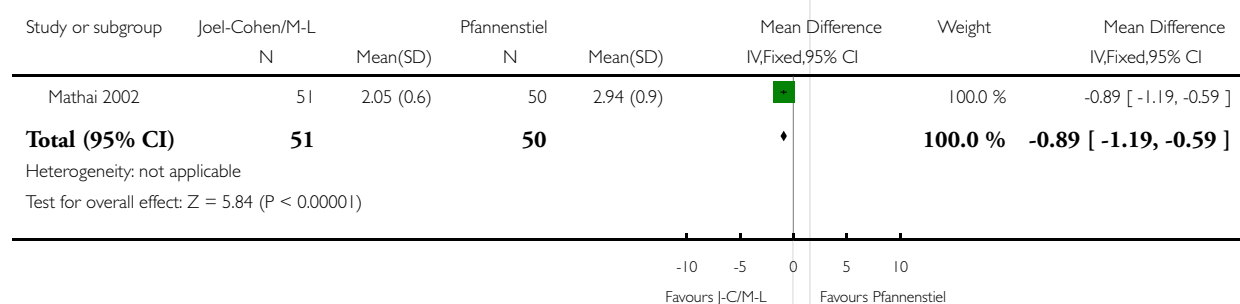


Analysis I.4. Comparison I Joel-Cohen versus Pfannenstiel incision, Outcome 4 Total dose of analgesics in 24 hours.

Review: Abdominal surgical incisions for caesarean section

Comparison: I Joel-Cohen versus Pfannenstiel incision

Outcome: 4 Total dose of analgesics in 24 hours

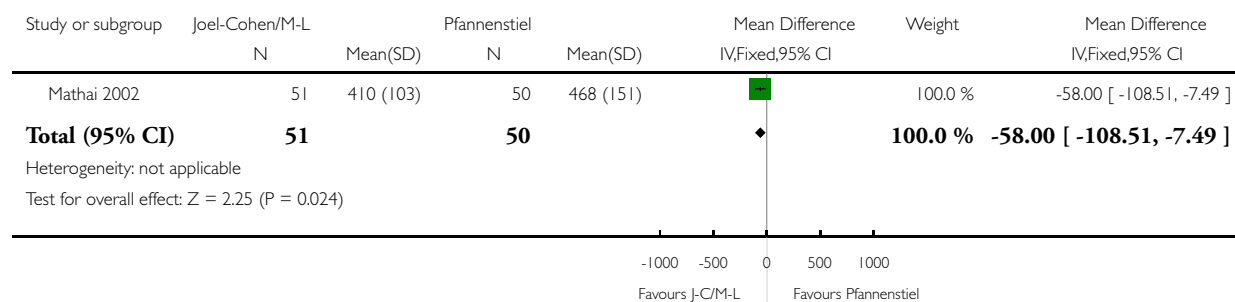


Analysis 1.9. Comparison 1 Joel-Cohen versus Pfannenstiel incision, Outcome 9 Estimated blood loss (mL).

Review: Abdominal surgical incisions for caesarean section

Comparison: 1 Joel-Cohen versus Pfannenstiel incision

Outcome: 9 Estimated blood loss (mL)

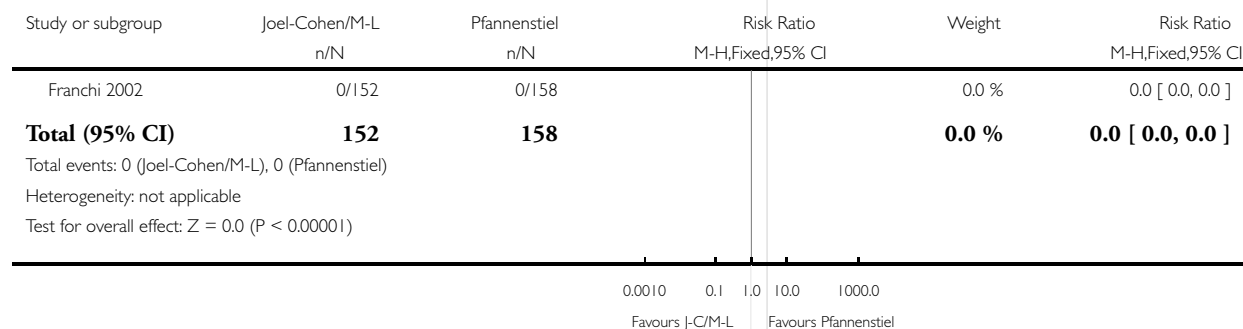


Analysis 1.12. Comparison 1 Joel-Cohen versus Pfannenstiel incision, Outcome 12 Blood transfusion.

Review: Abdominal surgical incisions for caesarean section

Comparison: 1 Joel-Cohen versus Pfannenstiel incision

Outcome: 12 Blood transfusion

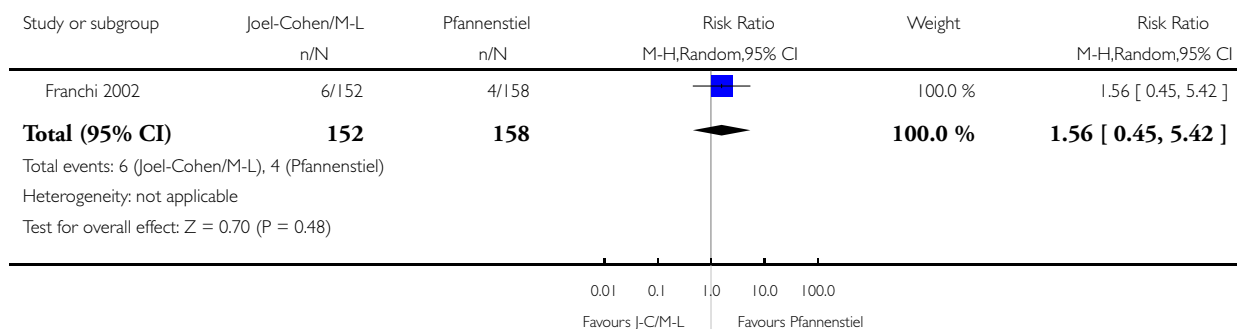


Analysis 1.13. Comparison 1 Joel-Cohen versus Pfannenstiel incision, Outcome 13 Wound infection as defined by trial authors.

Review: Abdominal surgical incisions for caesarean section

Comparison: 1 Joel-Cohen versus Pfannenstiel incision

Outcome: 13 Wound infection as defined by trial authors

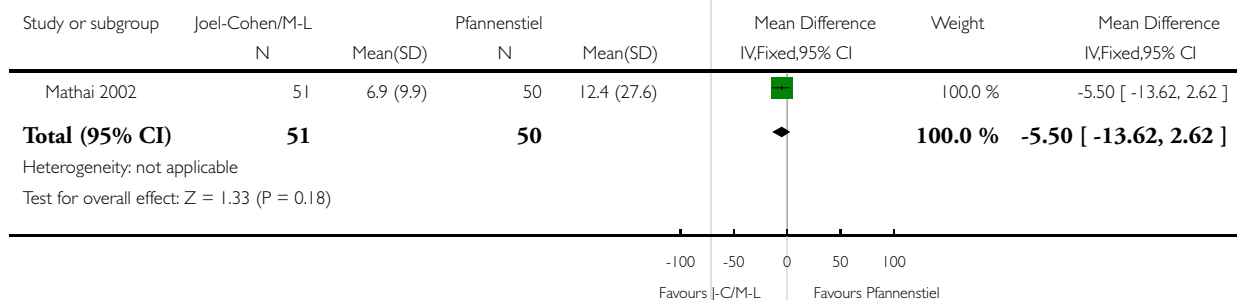


Analysis 1.18. Comparison 1 Joel-Cohen versus Pfannenstiel incision, Outcome 18 Time (hours) from surgery to start of breastfeeding.

Review: Abdominal surgical incisions for caesarean section

Comparison: 1 Joel-Cohen versus Pfannenstiel incision

Outcome: 18 Time (hours) from surgery to start of breastfeeding

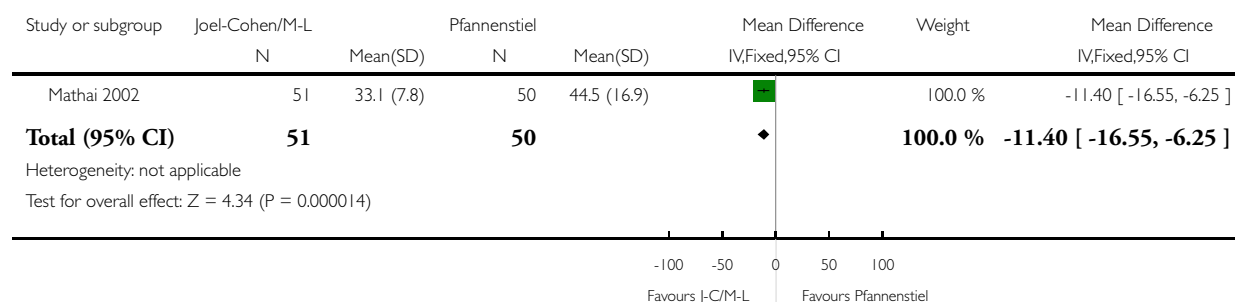


Analysis 1.20. Comparison 1 Joel-Cohen versus Pfannenstiel incision, Outcome 20 Total operative time (minutes).

Review: Abdominal surgical incisions for caesarean section

Comparison: 1 Joel-Cohen versus Pfannenstiel incision

Outcome: 20 Total operative time (minutes)

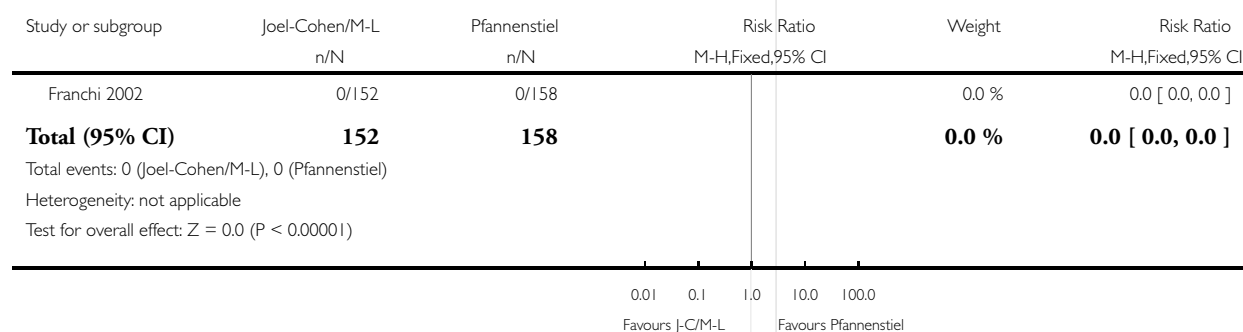


Analysis 1.23. Comparison 1 Joel-Cohen versus Pfannenstiel incision, Outcome 23 Need for re-laparotomy.

Review: Abdominal surgical incisions for caesarean section

Comparison: 1 Joel-Cohen versus Pfannenstiel incision

Outcome: 23 Need for re-laparotomy

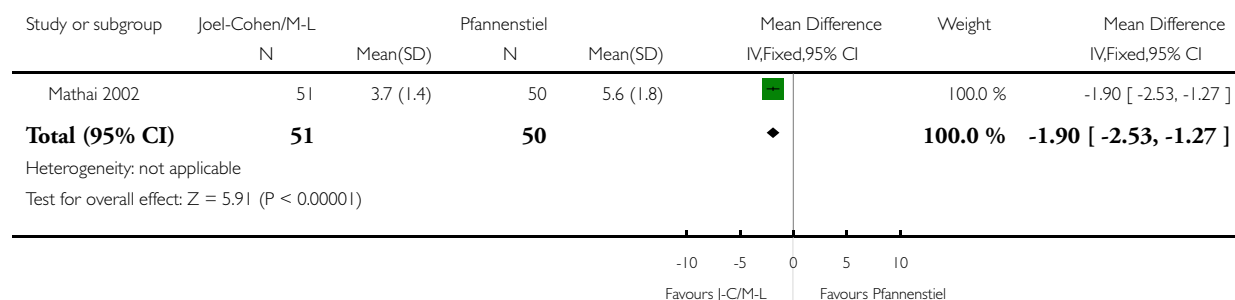


Analysis 1.34. Comparison 1 Joel-Cohen versus Pfannenstiel incision, Outcome 34 Delivery time (minutes).

Review: Abdominal surgical incisions for caesarean section

Comparison: 1 Joel-Cohen versus Pfannenstiel incision

Outcome: 34 Delivery time (minutes)

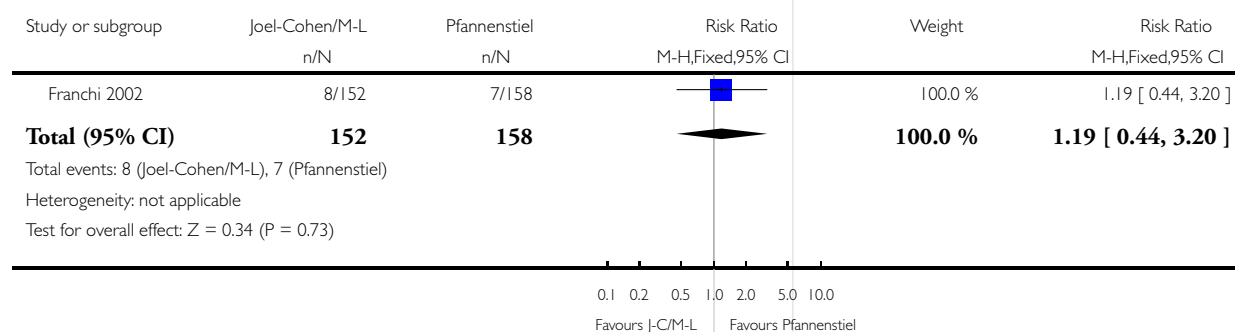


Analysis 1.37. Comparison 1 Joel-Cohen versus Pfannenstiel incision, Outcome 37 Admissions to special care baby unit - all types.

Review: Abdominal surgical incisions for caesarean section

Comparison: 1 Joel-Cohen versus Pfannenstiel incision

Outcome: 37 Admissions to special care baby unit - all types

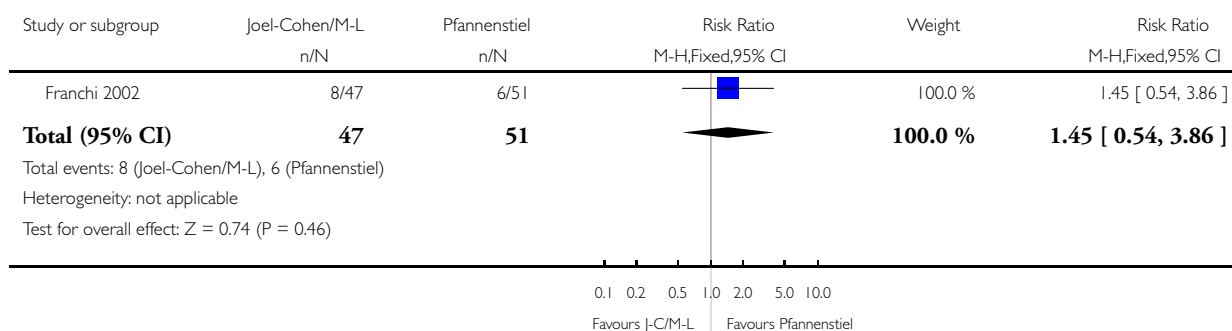


Analysis 1.38. Comparison 1 Joel-Cohen versus Pfannenstiel incision, Outcome 38 Admission to special care baby unit - emergency caesarean section.

Review: Abdominal surgical incisions for caesarean section

Comparison: 1 Joel-Cohen versus Pfannenstiel incision

Outcome: 38 Admission to special care baby unit - emergency caesarean section

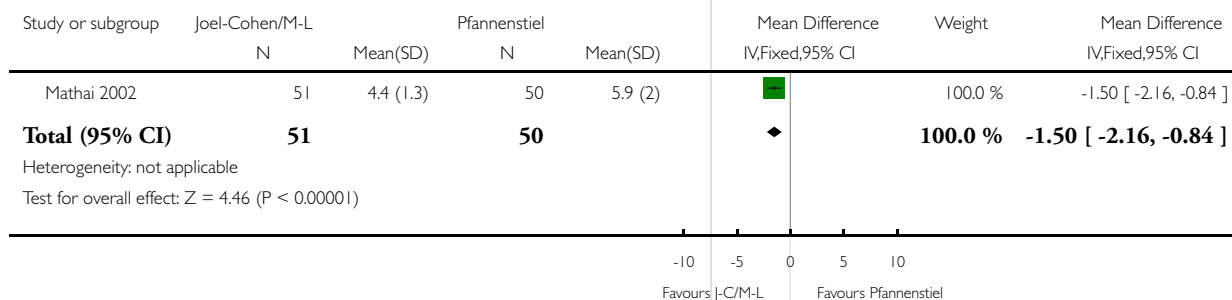


Analysis 1.40. Comparison 1 Joel-Cohen versus Pfannenstiel incision, Outcome 40 Postoperative hospital stay for mother (days).

Review: Abdominal surgical incisions for caesarean section

Comparison: 1 Joel-Cohen versus Pfannenstiel incision

Outcome: 40 Postoperative hospital stay for mother (days)

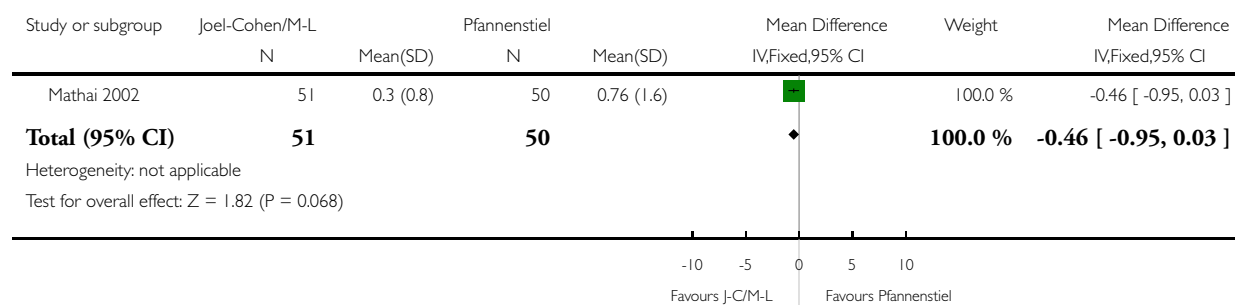


Analysis 1.41. Comparison 1 Joel-Cohen versus Pfannenstiel incision, Outcome 41 Stay in special care nursery (days).

Review: Abdominal surgical incisions for caesarean section

Comparison: 1 Joel-Cohen versus Pfannenstiel incision

Outcome: 41 Stay in special care nursery (days)

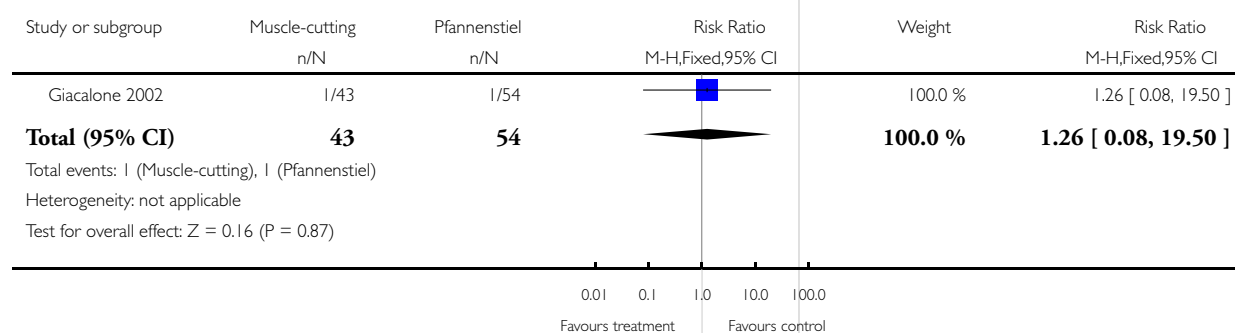


Analysis 2.1. Comparison 2 Muscle-cutting/Maylard versus Pfannenstiel incision, Outcome 1 Postoperative febrile morbidity.

Review: Abdominal surgical incisions for caesarean section

Comparison: 2 Muscle-cutting/Maylard versus Pfannenstiel incision

Outcome: 1 Postoperative febrile morbidity

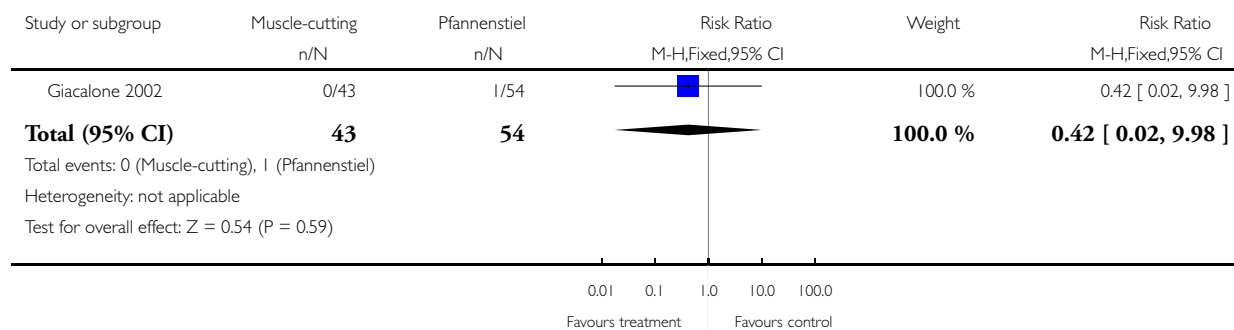


Analysis 2.12. Comparison 2 Muscle-cutting/Maylard versus Pfannenstiel incision, Outcome 12 Blood transfusion.

Review: Abdominal surgical incisions for caesarean section

Comparison: 2 Muscle-cutting/Maylard versus Pfannenstiel incision

Outcome: 12 Blood transfusion

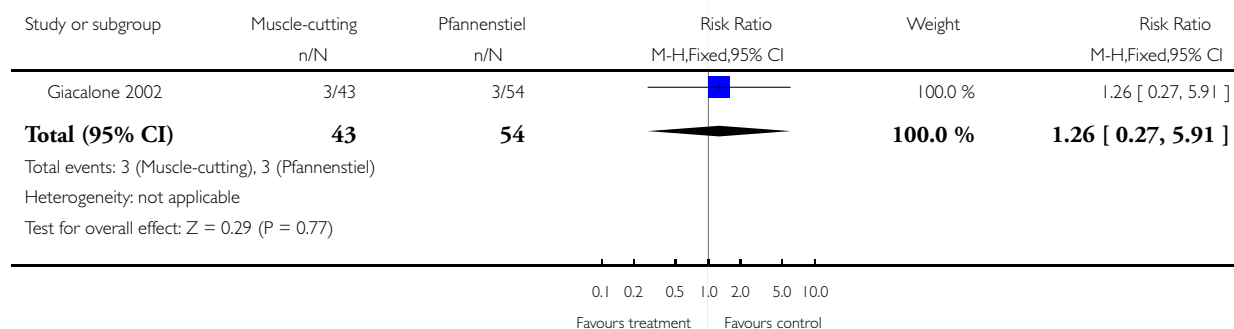


Analysis 2.13. Comparison 2 Muscle-cutting/Maylard versus Pfannenstiel incision, Outcome 13 Wound infection as defined by trial authors.

Review: Abdominal surgical incisions for caesarean section

Comparison: 2 Muscle-cutting/Maylard versus Pfannenstiel incision

Outcome: 13 Wound infection as defined by trial authors

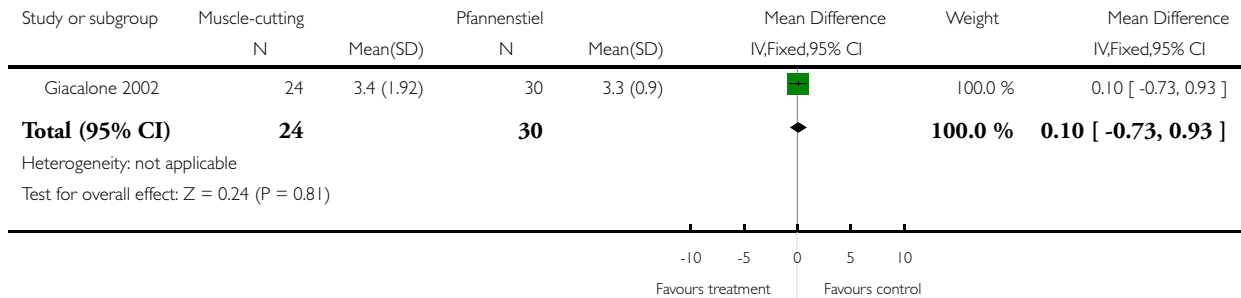


Analysis 2.24. Comparison 2 Muscle-cutting/Maylard versus Pfannenstiel incision, Outcome 24 Long-term complication - physical test at 3 months (Janda).

Review: Abdominal surgical incisions for caesarean section

Comparison: 2 Muscle-cutting/Maylard versus Pfannenstiel incision

Outcome: 24 Long-term complication - physical test at 3 months (Janda)

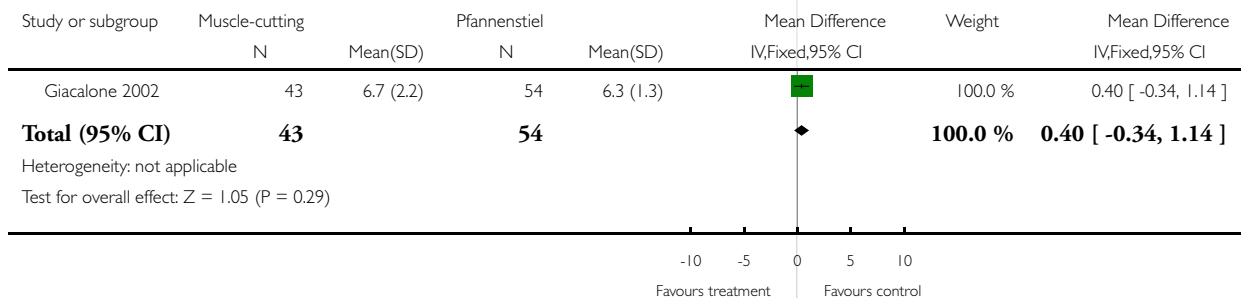


Analysis 2.40. Comparison 2 Muscle-cutting/Maylard versus Pfannenstiel incision, Outcome 40 Postoperative hospital stay for mother (days).

Review: Abdominal surgical incisions for caesarean section

Comparison: 2 Muscle-cutting/Maylard versus Pfannenstiel incision

Outcome: 40 Postoperative hospital stay for mother (days)



WHAT'S NEW

Last assessed as up-to-date: 6 November 2006.

28 August 2008	Amended	Converted to new review format.
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HISTORY

Protocol first published: Issue 4, 2003

Review first published: Issue 1, 2007

CONTRIBUTIONS OF AUTHORS

M Mathai produced the first draft of the protocol and performed the first data extraction and analysis of the final review. GJ Hofmeyr revised the drafts, independently assessed trials for inclusion, and checked the data extraction.

DECLARATIONS OF INTEREST

Matthews Mathai is the author of one of the included trials.

INDEX TERMS

Medical Subject Headings (MeSH)

Abdominal Wall [*surgery]; Cesarean Section [*methods]; Randomized Controlled Trials as Topic

MeSH check words

Female; Humans; Pregnancy