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Early versus delayed post-operative bathing or showering to prevent wound complications (Review)

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TABLE OF CONTENTS

[Intervention Review]

Early versus delayed post-operative bathing or showering to prevent wound complications

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ABSTRACT

Background

Many people undergo surgical operations during their life-time, which result in surgical wounds. After an operation the incision is closed using stiches, staples, steri-strips or an adhesive glue. Usually, towards the end of the surgical procedure and before the patient leaves the operating theatre, the surgeon covers the closed surgical wound using gauze and adhesive tape or an adhesive tape containing a pad (a wound dressing) that covers the surgical wound. There is currently no guidance about when the wound can be made wet by post-operative bathing or showering. Early bathing may encourage early mobilisation of the patient, which is good after most types of operation. Avoiding post-operative bathing or showering for two to three days may result in accumulation of sweat and dirt on the body. Conversely, early washing of the surgical wound may have an adverse effect on healing, for example by irritating or macerating the wound, and disturbing the healing environment.

Objectives

To compare the benefits (such as potential improvements to quality of life) and harms (potentially increased wound-related morbidity) of early post-operative bathing or showering (i.e. within 48 hours after surgery, the period during which epithelialisation of the wound occurs) compared with delayed post-operative bathing or showering (i.e. no bathing or showering for over 48 hours after surgery) in patients with closed surgical wounds.

Search methods

We searched The Cochrane Wounds Group Specialised Register (30th June 2015); The Cochrane Central Register of Controlled Trials (CENTRAL) (*The Cochrane Library*); The Database of Abstracts of Reviews of Effects (DARE) (The Cochrane Library); Ovid MEDLINE; Ovid MEDLINE (In-Process & Other Non-Indexed Citations); Ovid EMBASE; EBSCO CINAHL; the metaRegister of Controlled Trials (mRCT) and the International Clinical Trials Registry Platform (ICTRP).

Selection criteria

We considered all randomised trials conducted in patients who had undergone any surgical procedure and had surgical closure of their wounds, irrespective of the location of the wound and whether or not the wound was dressed. We excluded trials if they included patients with contaminated, dirty or infected wounds and those that included open wounds. We also excluded quasi-randomised trials, cohort studies and case-control studies.

Data collection and analysis

We extracted data on the characteristics of the patients included in the trials, risk of bias in the trials and outcomes from each trial. For binary outcomes, we calculated the risk ratio (RR) with 95% confidence interval (CI). For continuous variables we planned to calculate the mean difference (MD), or standardised mean difference (SMD) with 95% CI. For count data outcomes, we planned to calculate the rate ratio (RaR) with 95% CI. We used RevMan 5 software for performing these calculations.

Main results

Only one trial was identified for inclusion in this review. This trial was at a high risk of bias. This trial included 857 patients undergoing minor skin excision surgery in the primary care setting. The wounds were sutured after the excision. Patients were randomised to early post-operative bathing (dressing to be removed after 12 hours and normal bathing resumed) (n = 415) or delayed post-operative bathing (dressing to be retained for at least 48 hours before removal and resumption of normal bathing) (n = 442). The only outcome of interest reported in this trial was surgical site infection (SSI). There was no statistically significant difference in the proportion of patients who developed SSIs between the two groups (857 patients; RR 0.96; 95% CI 0.62 to 1.48). The proportions of patients who developed SSIs were 8.5% in the early bathing group and 8.8% in the delayed bathing group.

Authors' conclusions

There is currently no conclusive evidence available from randomised trials regarding the benefits or harms of early versus delayed post-operative showering or bathing for the prevention of wound complications, as the confidence intervals around the point estimate are wide, and, therefore, a clinically significant increase or decrease in SSI by early post-operative bathing cannot be ruled out. We recommend running further randomised controlled trials to compare early versus delayed post-operative showering or bathing.

PLAIN LANGUAGE SUMMARY

Post-operative bathing and showering to prevent wound complications

Many people undergo surgical operations during their life-time. After an operation the surgical wound is closed using stiches, staples, tape (steri-strips) or an adhesive glue. Usually, towards the end of the surgical procedure and before the person leaves the operating theatre, the surgeon covers the closed surgical wound using gauze and adhesive tape, or an adhesive tape containing a pad that covers the surgical wound. This is called a wound dressing. There is currently no guidance about when wounds can be made wet by bathing or showering post-operatively. Early bathing may encourage the person to move about, which is good after most types of surgery. Avoiding post-operative bathing or showering for two to three days may result in the accumulation of sweat and dirt on the body, but early washing of the wound may have a bad effect on healing by irritating the wound and disturbing the healing environment. We reviewed all the available evidence from the medical literature (up to July 2013) on this issue. In particular, we sought information from randomised controlled trials, which, if conducted well, provide the most accurate information.

We identified only one randomised controlled trial. This trial was at high risk of bias, i.e. there were flaws in the way it was conducted that could have given incorrect results.This trial included 857 people undergoing minor skin operations performed at a General Practitioner (GP) surgery. No steri-strips were used in this trial, as the wounds were stitched. The people running the trial used a method similar to the toss of a coin to decide which group participants went into. One group of 415 people was advised to remove the dressing 12 hours after surgery and then to bathe normally, while the other group of 442 people was advised to keep the dressing on for at least 48 hours and then to bathe normally. The only outcome of interest reported in this trial was wound infection. The authors reported no statistically significant difference in the proportion of people who developed wound infection in the two groups (8.5% in the early bathing group and 8.8% in the delayed bathing group).

There is currently no conclusive evidence available from randomised trials about the benefits, or harms, with regard to wound complications of early or delayed post-operative showering or bathing. We recommend further randomised controlled trials to compare early versus delayed post-operative showering or bathing.

SUMMARY OF FINDINGS

Summary of findings for the main comparison. Early versus delayed post-operative bathing and showering

Early versus delayed post-operative bathing and showering

Patient or population: patients with closed post-operative incisions
Setting: primary care
Intervention: early post-operative bathing and showering

Control: delayed post-operative bathing and showering

Outcomes	Illustrative comparative risks* (95% CI)		Relative effect (95% CI)	No of Participants (studies)	Quality of the evidence (GRADE)	Comments
	Assumed risk	Corresponding risk				
	Control (delayed post-operative bathing and showering)	Early post-operative bathing and showering				
Surgical site infection	**88 per 1000**	**85 per 1000** (55 to 131)	**RR 0.96** (0.62 to 1.48)	857 (1 study)	⊕⊝⊝⊝ **very low** [1,2,3,4]	

*The basis for the **assumed risk** is the control group risk in the study. The **corresponding risk** (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).
CI: Confidence interval; **RR:** Risk ratio;

GRADE Working Group grades of evidence
High quality: further research is very unlikely to change our confidence in the estimate of effect
Moderate quality: further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate
Low quality: further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate
Very low quality: we are very uncertain about the estimate

[1] The trial was of high risk of bias
[2] Confidence intervals overlaps 1 and 0.75 or 1.25
[3] The total number of events was fewer than 300
[4] There were too few trials to assess publication bias

BACKGROUND

Description of the condition

Many people undergo surgical operations during their life-time. Worldwide, an estimated 234 million surgical procedures are performed each year (Weiser 2008). The world population in 2008 was approximately 6.7 billion (PRB 2008). This equates to approximately one in every 30 people undergoing a surgical operation each year. In most surgical operations, surgeons make a cut (incision) through the patient's skin and underlying tissue. After the operation, the incision is generally closed using stitches, staples, steri-strips or an adhesive glue, resulting in a closed surgical wound. Wound dressing is widely used irrespective of the nature of the surgery, the setting (for example, primary or secondary care), or the type of patient.

Wounds can be classified in different ways. One accepted classification developed by the National Academy of Sciences/ National Research Council (NAS/NRC) and adopted by the Centers for Disease Prevention and Control (CDC) is to define the wound as clean, clean-contaminated, contaminated, and dirty or infected (Berard 1964; Garner 1986). This classification is shown in Appendix 1.

Towards the end of the surgical procedure, and before the patient leaves the operating theatre, the surgeon usually covers the closed surgical wound using cloth (either gauze and adhesive tape, or an adhesive tape containing a pad that covers the wound); this is called a wound dressing. Wound dressings are classified in a number of ways according to their function (e.g. occlusive, absorbent), type of material (e.g. hydrocolloid, collagen), and the physical form of the dressing (e.g. ointment, film, foam) (Boateng 2008).

Description of the intervention

The intervention of interest is post-operative bathing or showering. This may occur as early as 12 hours post surgery or be delayed for over a week.

How the intervention might work

Post-operative bathing and showering may remove dead skin cells, dirt, micro-organisms and sweat that has collected around the wound edges, and so may reduce risk of infection and promote wound healing. It is also makes the patient more comfortable. Furthermore, early showering or bathing may encourage early mobilisation of the patient, which prevents development of deep vein thrombosis and encourages deep breathing, which can prevent chest infections. Early mobilisation is encouraged after most operations. However, early washing of the surgical wound may affect healing adversely by irritating or macerating the wound and disturbing the healing environment. Exposure to the external environment may also introduce infection.

Although water-proof dressings are available, and dressings can be covered by water-proof material, evidence for whether the original dressing should be retained, or can be removed within 48 hours of surgery, is not clear and this issue is currently being addressed in another Cochrane systematic review (Toon 2013). However, the traditional advice has been to cover the wound with a dressing for a period of at least 48 hours, since this is the period during which epithelialisation of the wound occurs (Lawrence 1998).

Why it is important to do this review

There is currently no guidance regarding when a wound can be made wet by post-operative bathing or showering. Avoiding post-operative bathing or showering for two to three days may result in the accumulation of sweat and dirt on the body. If the patient wants to bathe or shower before two to three days, based on traditional advice, extra precautions are frequently taken to prevent the surgical wound from getting wet. This can be inconvenient, particularly if the wound is on the trunk, rather than the limbs. There has been no previous systematic review assessing the benefit of keeping wounds dry by avoiding post-operative bathing or showering. This systematic review may provide guidance regarding when wounds can be made wet by post-operative bathing or showering.

OBJECTIVES

To compare the benefits (such as potential improvements to quality of life) and harms (potentially increased wound-related morbidity) of early post-operative bathing or showering (i.e. within 48 hours after surgery) compared with delayed post-operative bathing or showering (i.e. no bathing or showering for over 48 hours after surgery) in patients with closed surgical wounds.

METHODS

Criteria for considering studies for this review

Types of studies

We included randomised clinical trials (RCTs) irrespective of blinding, language, publication status or sample size. We excluded quasi-randomised trials (where the methods of allocating participants to a treatment are not strictly random, e.g. allocation by date of birth, day of the week, etc.), cohort studies and case-control studies.

Types of participants

People who had undergone any surgical procedure and had surgical closure of their wounds, irrespective of the location of the wound and irrespective of whether the wound was dressed. We excluded trials that included people with contaminated, dirty or infected wounds, and those that were left with open wounds (when the edges of the wounds are not brought close to each other by sutures, staples, adhesive tapes or tissue glue).

Types of interventions

We included trials comparing early post-operative bathing or showering of surgical wounds within 48 hours of surgery (early group) with no post-operative bathing or showering for at least 48 hours after surgery (delayed group). The timing of the post-operative bathing or showering was the intervention of interest. We considered trials that compared dressed wounds, and also trials that left the wound undressed, as eligible for inclusion provided that the timing of the post-operative bathing or showering differed between the groups. Co-interventions (such as peri-operative antibiotics) were allowed, provided that they were used equally in the intervention groups.

Types of outcome measures

All the early outcomes were measured at 30 days. All the late outcomes were measured at maximal follow-up.

Primary outcomes

1. Wound-related early morbidity.
   a. Superficial surgical site infections (SSI) (superficial SSI or superficial wound infections).
   b. Deep surgical site infection (deep SSI or deep wound infections).
   c. Superficial (partial-thickness) wound dehiscence (separation of sides of the wound).
   d. Complete wound dehiscence (if applicable) (dehiscence of deep fascial layers or structures deeper to the deep fascial layers).
2. Wound-related delayed morbidity.
   a. Incisional hernia (if applicable).
   b. Hypertrophic (raised) scar.
   c. Keloid (raised, enlarged) scar.
3. Patient health-related quality of life.

We accepted the definitions used by the trial authors for the outcomes. We have presented the 'Summary of findings' table for all available primary outcomes (Schünemann 2011).

Secondary outcomes

1. Length of hospital stay (includes hospital stay due to any adverse events, such as falls related to early post-operative showering).
2. Number of dressing changes.
3. Number of hospital visits/home visits for dressing changes.
4. Number of patients requiring additional antibiotic therapy (i.e. antibiotic treatment prescribed because of infection in addition to the prophylactic antibiotics that the patient receives).

Search methods for identification of studies

Electronic searches

For the first update of this review we searched the following electronic databases to identify reports of relevant RCTs in June 2015:

- The Cochrane Wounds Group Specialised Register (searched 30th June 2015);
- The Cochrane Central Register of Controlled Trials (CENTRAL) (*The Cochrane Library* 2015, Issue 5);
- Ovid MEDLINE (2014 to June Week 3 2013);
- Ovid MEDLINE (In-Process & Other Non-Indexed Citations, June 29, 2015);
- Ovid EMBASE (2014 to 2015 June 29);
- EBSCO CINAHL (2014 to 30 June 2015).

CENTRAL search strategy:
#1 MeSH descriptor Baths explode all trees
#2 (bath* or shower*):ti,ab,kw
#3 (#1 OR #2)
#4 MeSH descriptor Surgical Wound Infection explode all trees
#5 MeSH descriptor Surgical Wound Dehiscence explode all trees
#6 (surg* NEAR/5 infect*):ti,ab,kw
#7 (surg* NEAR/5 wound*):ti,ab,kw
#8 (surg* NEAR/5 site*):ti,ab,kw
#9 (surg* NEAR/5 incision*):ti,ab,kw
#10 (surg* NEAR/5 dehisc*):ti,ab,kw
#11 (wound* NEAR/5 dehisc*):ti,ab,kw
#12 (wound NEXT complication*):ti,ab,kw
#13 (#4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12)
#14 (#3 AND #13)

The search strategies for Ovid MEDLINE, Ovid EMBASE and EBSCO CINAHL can be found in Appendix 2. We combined the Ovid MEDLINE search with the Cochrane Highly Sensitive Search Strategy for identifying randomised trials in MEDLINE: sensitivity- and precision-maximising version (2008 revision) (Lefebvre 2011). We combined the EMBASE search with the Ovid EMBASE filter developed by the UK Cochrane Centre (Lefebvre 2011).We combined the CINAHL searches with the trial filters developed by the Scottish Intercollegiate Guidelines Network (SIGN 2013). We did not restrict studies with respect to language, date of publication or study setting.

We searched the *metaRegister of Controlled Trials* (mRCT) (http://www.controlled-trials.com/mrct/) and the ICTRP (International Clinical Trials Registry Platform) portal maintained by the World Health Organization (http://apps.who.int/trialsearch/). The meta-register includes the ISRCTN Register and NIH ClinicalTrials.gov Register among other registers. The ICTRP portal includes these trial registers along with trial registry data from a number of countries.

Searching other resources

We searched the references of the identified trials to identify further relevant trials.

Data collection and analysis

We performed the systematic review following instructions in the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2011a).

Selection of studies

Two review authors (CT and KG) identified trials for inclusion independently by going through the titles and abstracts of the search results. We obtained the full text of any reference with the potential to meet the inclusion criteria based on the titles and abstracts. We made the final selection for inclusion based on the full text. In addition, another author (RR) searched the literature in general to identify further trials. We have listed the excluded studies with the reasons for their exclusion. We resolved any differences through discussion.

Data extraction and management

Two review authors (CT and KG) independently extracted the following data using a standardised template.

1. Year and language of publication.
2. Country.
3. Year of conduct of the trial.
4. Inclusion and exclusion criteria.
5. Type of operation (clean, clean-contaminated operation).
6. Site of operation (trunk versus limbs).
7. Number of participants in intervention and control.
8. Details of intervention and control.
9. Details of the dressing.
10. Peri-operative antibiotic use.

11. Outcomes (as described above).
12. Risk of bias (as described below).
13. Evidence of trial funding and source.

Where multiple reports existed for a trial, we planned to examine all the reports for information. We sought clarification for any unclear or missing information by contacting the authors of the individual trials. If there was any doubt about whether the trials shared the same participants - completely or partially (by identifying common authors and centres) - we planned to contact the study authors of the trials to check whether the trial report had been duplicated. We resolved any differences in opinion through discussion amongst the review authors.

Assessment of risk of bias in included studies

We followed instructions in the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2011b). According to empirical evidence (Kjaergard 2001; Moher 1998; Schulz 1995; Wood 2008), trials judged to be at high risk of bias may generate biased estimates of treatment effect relating to benefit or harm. We assessed the risk of bias of the trial according to the following domains:

Sequence generation

1. Low risk of bias: the method used was either adequate (e.g. computer-generated random numbers, table of random numbers) or unlikely to introduce confounding.
2. Uncertain risk of bias: there was insufficient information to assess whether the method used was likely to introduce confounding.
3. High risk of bias: the method used was improper and likely to introduce confounding.

Allocation concealment

1. Low risk of bias: the method used was unlikely to induce bias on the final observed effect (e.g. central allocation).
2. Uncertain risk of bias: there was insufficient information to assess whether the method used was likely to induce bias on the estimate of effect.
3. High risk of bias: the method used (e.g. open random allocation schedule) was likely to induce bias on the final observed effect.

Blinding of participants and personnel

It would be impossible to blind participants for this intervention. So, we planned to classify patient-reported outcomes such as quality of life as being at high risk of bias, as these are subjective outcomes and a patient's belief may influence their reporting. However, it is possible to blind the healthcare providers. So, we decided to consider outcomes that were not reported by patients as follows.

1. Low risk of bias: blinding was performed adequately, or the outcome measurement was not likely to be influenced by lack of blinding.
2. Uncertain risk of bias: there was insufficient information to assess whether the type of blinding used was likely to induce bias on the estimate of effect.
3. High risk of bias: no blinding or incomplete blinding, and the outcome or the outcome measurement was likely to be influenced by lack of blinding.

Blinding of outcome assessors

1. Low risk of bias: blinding was performed adequately, or the outcome measurement was not likely to be influenced by lack of blinding.
2. Uncertain risk of bias: there was insufficient information to assess whether the type of blinding used was likely to induce bias on the estimate of effect.
3. High risk of bias: no blinding or incomplete blinding, and the outcome or the outcome measurement was likely to be influenced by lack of blinding.

Incomplete outcome data

1. Low risk of bias: the underlying reasons for missing data were unlikely to make treatment effects depart from plausible values, or proper methods were employed to handle missing data.
2. Uncertain risk of bias: there was insufficient information to assess whether the missing data mechanism in combination with the method used to handle missing data was likely to induce bias on the estimate of effect.
3. High risk of bias: the crude estimate of effects would clearly be biased due to the underlying reasons for missing data, and the methods used to handle missing data were unsatisfactory (e.g. complete case estimate).

Selective outcome reporting

1. Low risk of bias: the trial protocol was available and all of the trial's pre-specified outcomes that are of interest in the review have been reported; or, if the trial protocol was not available, all the primary outcomes in this review were reported.
2. Uncertain risk of bias: there was insufficient information to assess whether the magnitude and direction of the observed effect were related to selective outcome reporting.
3. High risk of bias: not all of the trial's pre-specified primary outcomes were reported.

We considered trials that we classified as being at low risk of bias, in all the above domains, for a specific outcome as being low bias-risk trials for that outcome. We considered the other trials to be high bias-risk trials.

Measures of treatment effect

For binary outcomes, we planned to calculate the risk ratio (RR) with 95% confidence interval (CI). Risk ratio calculations do not include trials in which no events occurred in either group, whereas risk difference (RD) calculations do. We planned to report the risk difference if the results using this association measure were likely to be interpreted differently from risk ratio. For continuous variables we planned to calculate the mean difference (MD) for outcomes such as hospital stay and standardised mean difference (SMD) with 95% CI for quality of life (where different assessment scales might be used). For count data outcomes such as dressing changes, we planned to calculate the rate ratio (RaR) with 95% CI. We planned to use RevMan 5 software for performing these calculations.

Unit of analysis issues

The unit of analysis was the patient who had the surgical operation that resulted in the closed wound.

Dealing with missing data

We planned to perform an intention-to-treat analysis whenever possible (Newell 1992). We planned to impute data for binary outcomes using various scenarios such as best-best scenario, worst-worst scenario, best-worst scenario, and the worst-best scenario (Gurusamy 2009). In the best-best scenario, all participants with missing data for outcomes would be considered not to have developed a complication. In the worst-worst scenario all participants with missing data would be considered to have developed a complication. In the best-worst scenario, participants with missing data in the intervention group would be considered not to have developed a complication while those in the control group would be considered to have developed a complication. In the worst-best scenario, participants with missing data in the intervention group would be considered to have developed a complication while those in the control group would be considered not to have developed a complication.

For continuous outcomes, we planned to use the available-case analysis where intention-to-treat analysis was not possible. We planned to impute the standard deviation from P values according to instructions in the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2011c), and to use the median for the meta-analysis when the mean was not available. Where it was not possible to calculate the standard deviation from the P value or the confidence intervals, we planned to impute the standard deviation as the highest standard deviation in the other trials included under that outcome, fully recognising that this form of imputation decreases the weight of the study for calculation of mean differences and biases the effect estimate towards no effect in case of standardised mean difference (Higgins 2011d).

Assessment of heterogeneity

We planned to assess heterogeneity by visual inspection of forest plots, by Chi^2 test with significance set at P value 0.10, and by the I^2 statistic (Higgins 2002). We planned to use the following Cochrane guidelines for interpretation of I^2.

- 0% to 40%: might not be important;
- 30% to 60%: may represent moderate heterogeneity;
- 50% to 90%: may represent substantial heterogeneity;
- 75% to 100%: considerable heterogeneity.

We planned to assess the influence of co-interventions such as the presence of dressing and peri-operative antibiotics, which may have an effect on the outcomes by subgroup analysis.

Assessment of reporting biases

We planned to use visual asymmetry on a funnel plot to explore reporting bias in the presence of at least 10 trials (Egger 1997; Macaskill 2001). We also planned to perform the linear regression approach described by Egger 1997 to determine the funnel plot asymmetry.

Data synthesis

In the absence of clinical heterogeneity, we planned to perform meta-analyses using the software package RevMan 5 (RevMan 2011), and following the recommendations of The Cochrane Collaboration (Deeks 2011). We planned to use both random-effects model (DerSimonian 1986), and fixed-effect model (DeMets 1987), meta-analyses. In case of discrepancy between the two models, we planned to report both results; otherwise we planned to report the results of the fixed-effect model. We planned to use the generic inverse method to combine the rate ratios for count data outcomes.

Summary of findings

We have presented the 'Summary of findings' table for all the reported primary outcomes (Schünemann 2011).

Subgroup analysis and investigation of heterogeneity

We had planned to perform the following subgroup analyses.

1. Trials with low risk of bias compared with trials with high risk of bias (for the specific outcome). We considered trials classified as being at low risk of bias in all the above domains for a specific outcome as being low bias-risk trials for that outcome.
2. Based on the location of the incision (trunk versus limb).
3. Based on whether the surgery is considered clean or clean-contaminated (Appendix 1).
4. Based on whether the wound was covered or exposed.
5. Based on whether the patients received any prophylactic peri-operative antibiotics.

Sensitivity analysis

We performed a sensitivity analysis by imputing missing data for binary outcomes using various scenarios such as best-best scenario, best-worst scenario, worst-best scenario and worst-worst scenario (Gurusamy 2009). We planned to perform a sensitivity analysis by excluding the trials in which the mean and the standard deviation were imputed.

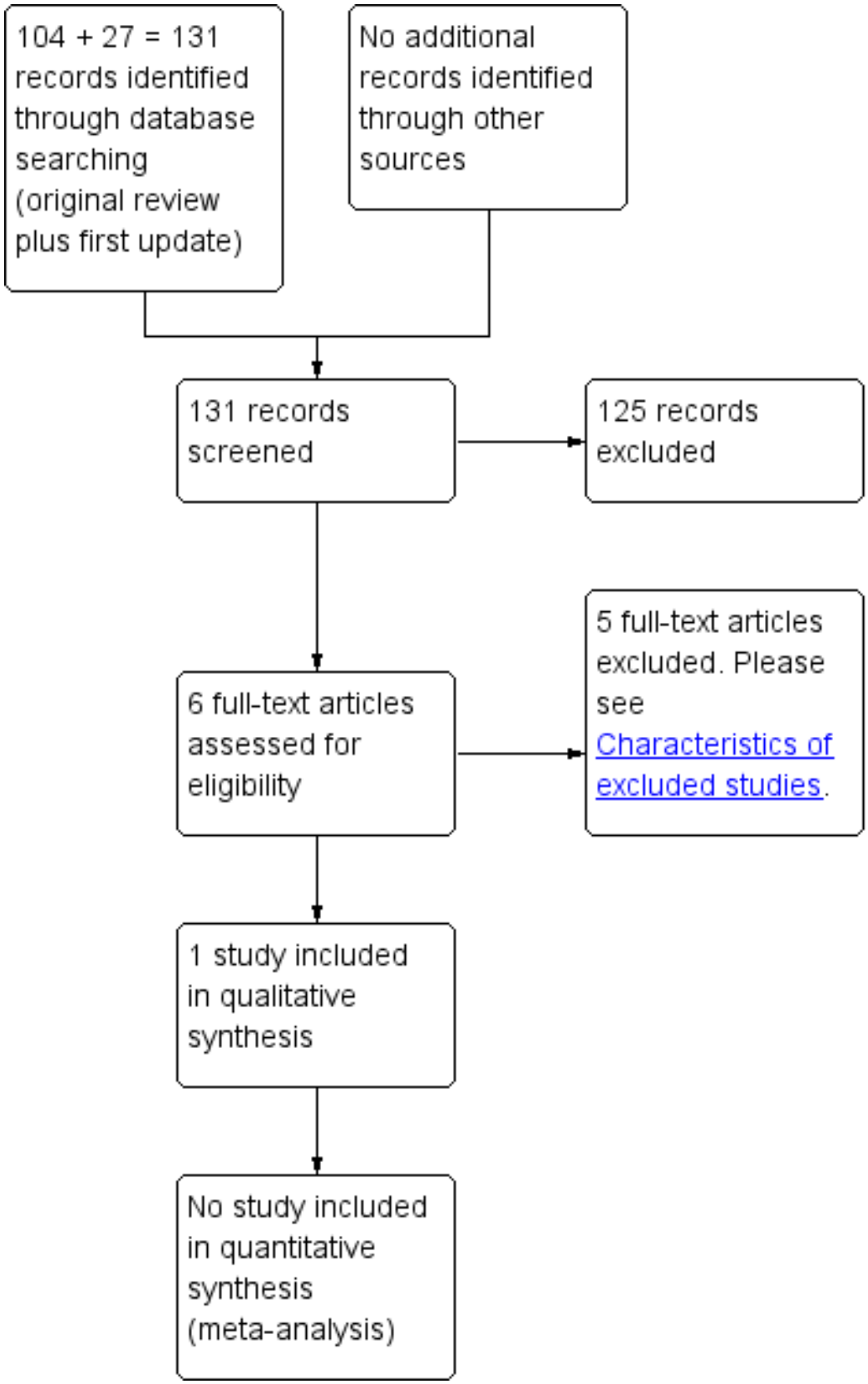
RESULTS

Description of studies

Results of the search

We identified a total of 131 unique references through searches detailed above. We excluded 125 irrelevant references by going through titles and abstracts, leaving six references for full assessment. We obtained full texts for these six references. Five references were excluded for the reasons outlined in the "Characteristics of excluded studies" table.This left one trial for inclusion in this review (Heal 2006). No further trials were identified by searching the references of the included trial. The reference flow is shown in Figure 1.

Figure 1. Reference flow



Included studies

(See "Characteristics of included studies" table.)

A total of 870 participants, who received minor skin incisions in a primary care setting, took part in this trial. Wounds were sutured after the excision. Thirteen participants were lost to follow-up. Of the remaining 857 participants, 415 were randomised to the early bathing group (dressing removal at 12 hours followed by normal bathing), and the remaining 442 were randomised to the delayed bathing group (dressing to be retained for a minimum of 48 hours followed by normal bathing) (Heal 2006).

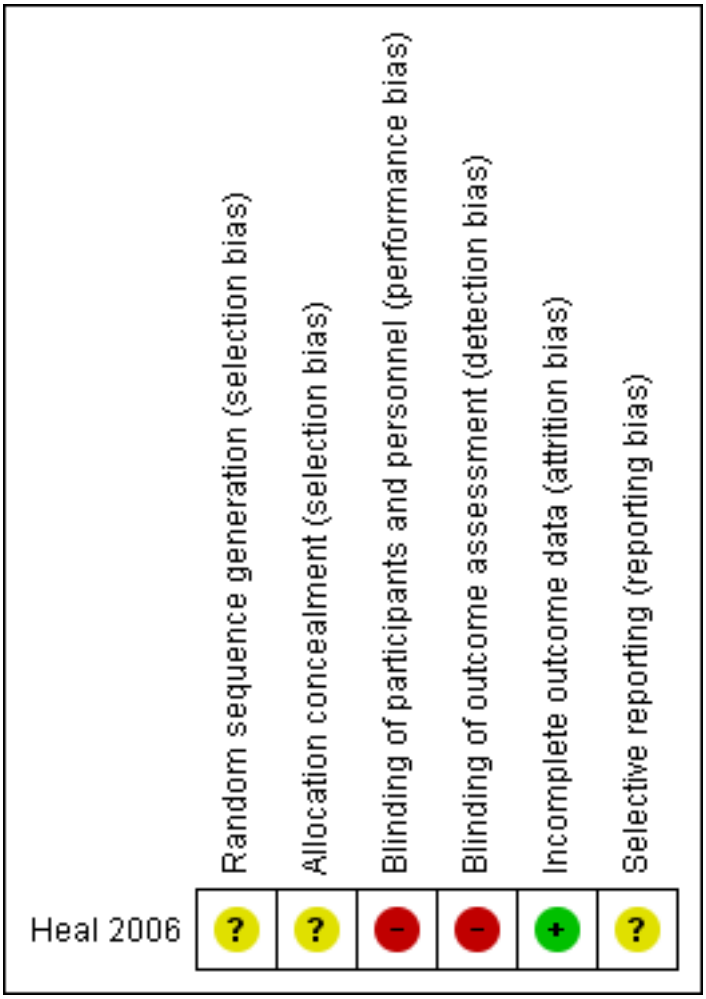
Excluded studies

Please see Characteristics of excluded studies. Of the excluded studies, two were not randomised studies (Betts 2006; Neues 2000). Two were quasi-randomised studies (Riederer 1997; Voorhees 1982). In one trial, showering was allowed at least after three days in both groups (Betts 2006). So, both groups in this trial belonged to the delayed group as defined in this review.

Risk of bias in included studies

The only trial in included in this review was at high risk of bias. The individual domains are shown in Figure 2.

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



Effects of interventions

See: **Summary of findings for the main comparison** Early versus delayed post-operative bathing and showering

Only one trial (870 participants) was included in this review (Heal 2006), and the only outcome it reported was the proportion of participants who developed an SSI.

Surgical site infection

There was no significant difference in the proportion of participants who developed SSI between the early post-operative bathing group and the delayed post-operative bathing group (RR 0.96; 95% CI 0.62 to 1.48) (Analysis 1.1). Approximately 8.5% of the participants belonging to the early post-operative bathing group and 8.8% participants belonging to the delayed post-operative group developed SSI Summary of findings for the main comparison.

Additional information

Since this was the only trial included in the review, the choice between a fixed-effect and random-effects model and the assessment of heterogeneity did not apply, and we did not perform

any subgroup analysis. Calculating the risk difference (RD -0.00; 95% CI -0.04 to 0.03) did not alter the conclusions. Sensitivity analysis of different methods of imputing the missing outcome data showed no change in the interpretation of results, showing that the missing data did not affect the conclusions (Analysis 1.2).

Reporting bias

We did not perform a funnel plot analysis because of the inclusion of only one trial in this review.

DISCUSSION

Summary of main results

This review compared early versus delayed showering and bathing in the prevention of post-operative wound complications. There was only one trial identified for inclusion in this review (Heal 2006). This trial included participants in the primary care setting, who presented to a participating general practitioner for a minor skin excision. The participants in the early bathing group removed the dressing within 12 hours and bathed normally, while the participants in the delayed bathing group retained the dressing for at least 48 hours before bathing normally. The only outcome of interest for the review reported in this trial was SSI. Approximately, 8.5% in the early bathing group and 8.8% of participants in the delayed bathing group developed SSI. The trial authors used CDC criteria when assessing SSIs. The authors did not find any significant difference in the proportion of participants who developed SSI. However, the trial was powered to measure a difference of 5% in the SSI proportions and not to measure smaller differences such as the statistically non-significant 0.3% difference that occurred. The confidence intervals overlapped 0.75 and 1.25 (i.e. a relative risk reduction of 25% or an absolute reduction of 2.2%) which means that one cannot rule out a clinically significant difference in the proportion of participants who developed the infection between the groups based on the sample size in the trial. So, we appear to have lack of evidence of effect rather than lack of effect.

In the secondary care setting, the proportion of participants who develop SSIs varies, depending upon various factors, but on average about 2.5% develop SSI (Steinberg 2009). Approximately 8% of participants in the trial included for this review developed SSI (Heal 2006). This may be due to under-reporting of SSI in the secondary care setting. Irrespective of the reason for the difference in the proportion of patients who develop SSIs between the primary care and secondary care settings, it may be even more difficult to identify clinically relevant reduction in SSIs in the secondary setting. However, other wound complications that are unlikely to occur in the primary care setting, such as wound dehiscence and incisional hernias, may occur more frequently in the secondary care setting, which makes it easier to power studies (requiring fewer number of participants to identify important differences between the group) in a secondary care setting for the same alpha and beta errors. Whichever setting is chosen for future trials, it will be important to measure patient-reported quality of life.

Overall completeness and applicability of evidence

The findings of this review are applicable only to patients undergoing minor skin incisions in the primary care setting and not to patients undergoing other procedures in a primary care setting, or any procedure in a secondary care setting. The wounds were sutured after the excisions and so this review is applicable only in patients in whom sutures were used and not in those steri strips are used.

Quality of the evidence

The overall quality of the evidence was very low as shown in Summary of findings for the main comparison.

Potential biases in the review process

Although we performed a thorough review of published literature and current trials, it is possible that some trial authors conducted relevant trials in the pre-trial registration era and did not report the results.

Agreements and disagreements with other studies or reviews

This is the first review on this topic. The authors of the trial concluded that wounds can be uncovered and allowed to get wet in the first 48 hours after minor skin excision without increasing the incidence of infection (Heal 2006). We are more cautious in our conclusion and state that there is currently no evidence to support either early post-operative bathing, or showering, or delayed post-operative bathing, or showering, because clinically significant increases or decreases in SSIs cannot be ruled out.

AUTHORS' CONCLUSIONS

Implications for practice

There is currently no conclusive evidence available from randomised controlled trials (RCTs) for the benefits or harms of early versus delayed post-operative showering or bathing in the prevention of wound complications, as the confidence intervals around the point estimate are wide in the one included trial, and therefore a clinically significant increase or decrease in surgical site infection by early post-operative bathing cannot be ruled out.

Implications for research

We recommend further RCTs to compare early versus delayed showering or bathing post-operatively in different types of clean and clean-contaminated surgeries involving closed surgical wounds. Such trials should include short-term and long-term wound related complications (at least one year), patient health-related quality of life assessments and resource utilisation (such as cost of dressing changes and treatment of wound related complications).

ACKNOWLEDGEMENTS

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CHARACTERISTICS OF STUDIES

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

Heal 2006

Methods	Randomised clinical trial
Participants	Country: Australia Number randomised: 870 Post-randomisation drop-outs: 13 (1.5%) Revised sample size: 857 Average age: 56 years Male:female numbers: 457 (51.8%): 413 (48.2%)

Heal 2006 *(Continued)*

	Inclusion criteria: People who presented to a participating general practitioner for a minor skin excision Exclusion criteria: 1. Excisions on the face 2. Taking oral antibiotics 3. Immediate clinical indication for oral or topical antibiotics post-operatively 4. On immunosuppressive drugs 5. Lacerations 6. A flap, or 2-layer procedure 7. Excision of a sebaceous cyst
Interventions	Participants were randomly assigned to 2 groups Group 1: Early post-operative bathing or showering (n = 415), dressing to be removed within 12 hours and normal bathing resumed (420 participants were randomised. Five participants were excluded because of loss to follow-up) Group 2: Delayed post-operative bathing or showering (n = 442), dressing to be retained for at least 48 hours, then removed, and normal bathing to resume (450 participants were randomised. Eight participants were excluded because of loss to follow-up) Other details: Wounds were sutured in both groups and both groups were asked not to use antiseptic washes or soaps Dressing type: melolin and tape
Outcomes	SSI
Notes	We attempted to contact the authors in January 2013 Source of funding: quote: "Research was funded by a novice research scholarship from the primary health care research and development fund. The authors' work is independent of this funding" Declaration of interests: none

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote: "After agreeing to participate, patients were randomised by picking a ball out of a hat" Comment: The number of balls in the hat, whether the patient blindfolded, and whether the researcher involved in this process aware of the clinical details about the patient before ball was picked were not reported. All these may influence the randomisation process
Allocation concealment (selection bias)	Unclear risk	Quote: "After agreeing to participate, patients were randomised by picking a ball out of a hat" Comment: The number of balls in the hat, whether the patient blindfolded, and whether the researcher involved in this process aware of the clinical details about the patient before ball was picked were not reported. All these may influence the randomisation process
Blinding of participants and personnel (performance bias) All outcomes	High risk	Quote: "No blinding took place"
Blinding of outcome assessment (detection bias)	High risk	Quote: "No blinding took place"

Heal 2006 *(Continued)*

All outcomes		
Incomplete outcome data (attrition bias) All outcomes	Low risk	Quote: "A total of 13 patients were eventually lost to follow-up" Comment: imputation using different scenarios did not alter the conclusions. This shows that the missing data did not affect the conclusions of the study
Selective reporting (reporting bias)	Unclear risk	Comment: the trial protocol was not available and all the primary outcomes of this review were not reported in this trial

Abbreviation
SSI = surgical site infection

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

Study	Reason for exclusion
Betts 2006	Comment on a report
Fraser 1976	Shower or bathing allowed after 3 days in the trial's early intervention group, but, according to the definitions used in this review, both groups belong to the delayed group
Neues 2000	Before and after study
Riederer 1997	Quasi-randomised study (alternate allocation)
Voorhees 1982	Quasi-randomised study (allocation by social security number)

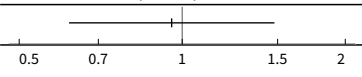
DATA AND ANALYSES

Comparison 1. Early versus delayed post-operative bathing and showering

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Surgical site infection	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
2 Surgical site infection (sensitivity analysis)	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
2.1 Best-best scenario	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
2.2 Best-worst scenario	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
2.3 Worst-best scenario	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
2.4 Worst-worst scenario	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]

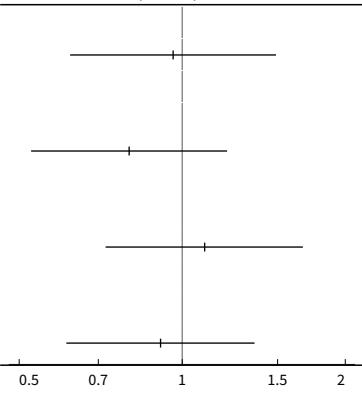
Analysis 1.1. Comparison 1 Early versus delayed post-operative bathing and showering, Outcome 1 Surgical site infection.

Study or subgroup	Early bathing n/N	Delayed bathing n/N	Risk Ratio M-H, Fixed, 95% CI	Risk Ratio M-H, Fixed, 95% CI
Heal 2006	35/415	39/442		0.96[0.62,1.48]



Analysis 1.2. Comparison 1 Early versus delayed post-operative bathing and showering, Outcome 2 Surgical site infection (sensitivity analysis).

Study or subgroup	Early bathing n/N	Delayed bathing n/N	Risk Ratio M-H, Fixed, 95% CI	Risk Ratio M-H, Fixed, 95% CI
1.2.1 Best-best scenario				
Heal 2006	35/420	39/450		0.96[0.62,1.49]
1.2.2 Best-worst scenario				
Heal 2006	35/420	47/450		0.8[0.53,1.21]
1.2.3 Worst-best scenario				
Heal 2006	40/420	39/450		1.1[0.72,1.67]
1.2.4 Worst-worst scenario				
Heal 2006	40/420	47/450		0.91[0.61,1.36]



APPENDICES

Appendix 1. Classification of surgical wounds

Clean wound

- Uninfected operative wounds
- No inflammation is encountered
- Respiratory, alimentary, genital or uninfected urinary tracts are not entered
- Primarily closed

Clean-contaminated wound

- Respiratory, alimentary, genital or urinary tract is entered under controlled conditions
- Without unusual contamination
- No evidence of infection or major break in sterile technique is encountered

Contaminated wound

- Open, fresh accidental wounds or operations with major breaks in sterile technique or gross spillage from the gastrointestinal tract or incisions in which acute, non-purulent inflammation is encountered

Dirty wound

(Continued)

- Old traumatic wounds with retained devitalised tissue or those that involve existing clinical infection or perforated viscera (i.e. the organisms causing post-operative infection were present in the operative field before the operation)

Appendix 2. Search strategies for Ovid MEDLINE, Ovid EMBASE and EBSCO CINAHL

Ovid MEDLINE

1 exp Baths/ (3957)
2 (bath* or shower*).tw. (36625)
3 or/1-2 (38425)
4 exp Surgical Wound Infection/ (26607)
5 exp Surgical Wound Dehiscence/ (5878)
6 (surg* adj5 infect*).tw. (16779)
7 (surg* adj5 wound*).tw. (9236)
8 (surg* adj5 site*).tw. (9649)
9 (surg* adj5 incision*).tw. (5636)
10 (surg* adj5 dehisc*).tw. (510)
11 (wound* adj5 dehisc*).tw. (2472)
12 wound complication*.tw. (2608)
13 or/4-12 (62103)
14 3 and 13 (172)
15 randomized controlled trial.pt. (336449)
16 controlled clinical trial.pt. (85145)
17 randomized.ab. (239415)
18 placebo.ab. (134484)
19 clinical trials as topic.sh. (162409)
20 randomly.ab. (172076)
21 trial.ti. (103449)
22 or/15-21 (778802)
23 (animals not (humans and animals)).sh. (3688338)
24 22 not 23 (717732)
25 14 and 24 (42)

Ovid EMBASE

1 exp bath/ (6289)
2 (bath* or shower*).tw. (47427)
3 or/1-2 (49522)
4 exp surgical infection/ (21898)
5 exp wound dehiscence/ (8738)
6 (surg* adj5 infect*).tw. (23054)
7 (surg* adj5 wound*).tw. (11816)
8 (surg* adj5 site*).tw. (13403)
9 (surg* adj5 incision*).tw. (7890)
10 (surg* adj5 dehisc*).tw. (656)
11 (wound* adj5 dehisc*).tw. (3215)
12 wound complication*.tw. (3353)
13 or/4-12 (73526)
14 3 and 13 (213)
15 Randomized controlled trials/ (19909)
16 Single-Blind Method/ (16360)
17 Double-Blind Method/ (113205)
18 Crossover Procedure/ (34922)
19 (random$ or factorial$ or crossover$ or cross over$ or cross-over$ or placebo$ or assign$ or allocat$ or volunteer$).ti,ab. (1169094)
20 (doubl$ adj blind$).ti,ab. (137016)
21 (singl$ adj blind$).ti,ab. (12796)
22 or/15-21 (1220635)
23 animal/ (1798609)
24 human/ (13718400)
25 23 not 24 (1346855)

26 22 not 25 (1180734)
27 14 and 26 (34)

EBSCO CINAHL

S27 S14 and S26
S26 S15 or S16 or S17 or S18 or S19 or S20 or S21 or S22 or S23 or S24 or S25
S25 MH "Quantitative Studies"
S24 TI placebo* or AB placebo*
S23 MH "Placebos"
S22 TI random* allocat* or AB random* allocat*
S21 MH "Random Assignment"
S20 TI randomi?ed control* trial* or AB randomi?ed control* trial*
S19 AB (singl* or doubl* or trebl* or tripl*) and AB (blind* or mask*)
S18 TI (singl* or doubl* or trebl* or tripl*) and TI (blind* or mask*)
S17 TI clinic* N1 trial* or AB clinic* N1 trial*
S16 PT Clinical trial
S15 MH "Clinical Trials+"
S14 S3 and S13
S13 S4 or S5 or S6 or S7 or S8 or S9 or S10 or S11 or S12
S12 TI wound complication* OR AB wound complication*
S11 TI wound* N5 dehisc* OR AB wound* N5 dehisc*
S10 TI surg* N5 dehisc* OR AB surg* N5 dehisc*
S9 TI surg* N5 incision* OR AB surg* N5 incision*
S8 TI surg* N5 site* OR AB surg* N5 site*
S7 TI surg* N5 wound* OR AB surg* N5 wound*
S6 TI surg* N5 infect* OR AB surg* N5 infect*
S5 (MH "Surgical Wound Dehiscence")
S4 (MH "Surgical Wound Infection")
S3 S1 or S2
S2 TI (bath* or shower*) OR AB (bath* or shower*)
S1 (MM "Bathing and Baths")

Appendix 3. Databases searched for the original review

For the original version of this review, in July 2013 we searched the following electronic databases to identify reports of relevant RCTs:

- The Cochrane Wounds Group Specialised Register (searched 3 July 2013);
- The Cochrane Central Register of Controlled Trials (CENTRAL) (The Cochrane Library 2013, Issue 6);
- The Database of Abstracts of Reviews of Effects (DARE) (The Cochrane Library 2013, Issue 6);
- Ovid MEDLINE (1946 to June Week 3 2013);
- Ovid MEDLINE (In-Process & Other Non-Indexed Citations, July 02, 2013);
- Ovid EMBASE (1974 to 2013 Week 26);
- EBSCO CINAHL (1982 to 28 June 2013).

WHAT'S NEW

Date	Event	Description
10 July 2015	New citation required but conclusions have not changed	No new studies identified, conclusions remain unchanged
10 July 2015	New search has been performed	First update, new search

CONTRIBUTIONS OF AUTHORS

Clare Toon developed the review, completed the first draft, performed part of the writing or editing of the review, made an intellectual contribution and approved the final version prior to submission.

Sidhartha Sinha: developed the protocol, completed the first draft, performed part of the writing or editing of the protocol, made an intellectual contribution and approved the final review version prior to submission.
Brian Davidson conceived the review question, secured funding, made an intellectual contribution, advised on the review and approved the final version prior to submission.
Kurinchi Gurusamy: conceived the review question, developed and coordinated the protocol, secured funding, completed the protocol and co-ordinated the review. Completed and edited the first draft review, made an intellectual contribution, advised on the review, approved the final version prior to submission and is guarantor for the review. Screened the citations for the first update and approved the updated review prior to submission.

Contributions of editorial base

Susan O'Meara, Editor: Advised on methodology, interpretation and content. Edited the review and approved the review for submission.
Sally Bell-Syer: co-ordinated the editorial process. Advised on methodology, interpretation and content. Edited the review and the updated review.
Ruth Foxlee: designed the search strategy, provided the search results and edited the search methods section.
Rachel Richardson: edited the review.

DECLARATIONS OF INTEREST

Clare Toon: none declared.
Sidhartha Sinha: none declared.
Brian Davidson: none declared.
Kurinchi Gurusamy: none declared.

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DIFFERENCES BETWEEN PROTOCOL AND REVIEW

None.

INDEX TERMS

Medical Subject Headings (MeSH)

Bandages; Baths [adverse effects] [*methods]; Minor Surgical Procedures [adverse effects]; Postoperative Care [adverse effects] [*methods]; Quality Improvement; Quality of Life; Randomized Controlled Trials as Topic; Surgical Wound Infection [*complications] [epidemiology] [prevention & control]; Sutures; Time Factors; Wound Healing

MeSH check words

Humans