Preoperative hair removal to reduce surgical site infection (Review)

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TABLE OF CONTENTS

ABSTRACT .................................................................................................................. 1
PLAIN LANGUAGE SUMMARY ...................................................................................... 2
BACKGROUND ........................................................................................................... 2
OBJECTIVES ............................................................................................................. 3
CRITERIA FOR CONSIDERING STUDIES FOR THIS REVIEW ................................ 3
SEARCH METHODS FOR IDENTIFICATION OF STUDIES ........................................ 3
METHODS OF THE REVIEW ...................................................................................... 4
DESCRIPTION OF STUDIES ....................................................................................... 5
METHODOLOGICAL QUALITY ..................................................................................... 6
RESULTS .................................................................................................................... 7
DISCUSSION ............................................................................................................... 8
AUTHORS’ CONCLUSIONS ......................................................................................... 9
POTENTIAL CONFLICT OF INTEREST ..................................................................... 10
ACKNOWLEDGEMENTS ............................................................................................. 10
SOURCES OF SUPPORT ............................................................................................ 10
REFERENCES ............................................................................................................ 10

TABLES ..................................................................................................................... 12

Characteristics of included studies ............................................................................ 12
Characteristics of excluded studies ............................................................................ 15

ANALYSES ................................................................................................................ 16

Comparison 01. shaving compared with no hair removal ............................................ 16
Comparison 02. cream compared with no hair removal .............................................. 16
Comparison 03. shaving compared with clipping ....................................................... 16
Comparison 04. shaving compared with cream ......................................................... 16
Comparison 05. shaving day before compared with shaving day of surgery .............. 16
Comparison 06. clipping day before compared with clipping day of surgery .......... 16

INDEX TERMS .......................................................................................................... 16

COVER SHEET ............................................................................................................ 17

GRAPHS AND OTHER TABLES ............................................................................... 18

Analysis 01.01. Comparison 01 shaving compared with no hair removal, Outcome 01 wound infection - existence of pus 18
Analysis 02.01. Comparison 02 cream compared with no hair removal, Outcome 01 wound infection existence of pus 19
Analysis 03.01. Comparison 03 shaving compared with clipping, Outcome 01 wound infection - existence of pus 16
Analysis 04.01. Comparison 04 shaving compared with cream, Outcome 01 wound infection existence of pus 16
Analysis 05.01. Comparison 05 shaving day before compared with shaving day of surgery, Outcome 01 wound infection day 15 16
Analysis 05.02. Comparison 05 shaving day before compared with shaving day of surgery, Outcome 02 wound infection day 30 21
Analysis 06.01. Comparison 06 clipping day before compared with clipping day of surgery, Outcome 01 wound infection day 15 23
Analysis 06.02. Comparison 06 clipping day before compared with clipping day of surgery, Outcome 02 wound infection day 30 25
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**Abstract**

**Background**
The preparation of people for surgery has traditionally included the routine removal of body hair from the intended surgical wound site. However, there are studies which claim that pre-operative hair removal is deleterious to patients, perhaps by causing surgical site infections (SSIs), and should not be carried out.

**Objectives**
The primary objective of this review was to determine if routine pre-operative hair removal results in fewer SSIs than not removing hair.

**Search strategy**
The reviewers searched the Cochrane Wounds Group Specialised Register (October 2005), The Cochrane Central Register of Controlled Trials (*The Cochrane Library* Issue 3, 2005), MEDLINE (1966 to 2005), EMBASE (1980 to 2005), CINAHL (1982 to 2005), and the ZETOC database of conference proceedings (1993 to 2005). We also contacted manufacturers of hair removal products.

**Selection criteria**
Randomised controlled trials (RCTs) comparing hair removal with no hair removal, different methods of hair removal, hair removal conducted at different times prior to surgery and hair removal carried out in different settings.

**Data collection and analysis**
Three authors independently assessed the relevance and quality of each trial. Data was extracted independently by one author and cross checked for accuracy by a second author.

**Main results**
Eleven RCTs were included in this review. Three trials involving 625 people compared hair removal using either depilatory cream or razors with no hair removal and found no statistically significant difference between the groups in terms of surgical site infections. No trials were identified which compared clipping with no hair removal. Three trials involving 3193 people compared shaving with clipping and found that there were statistically significantly more SSIs when people were shaved rather than clipped (RR 2.02, 95%CI 1.21 to 3.36). Seven trials involving 1213 people compared shaving with removing hair using a depilatory cream and found that there were statistically significantly more SSIs when people were shaved than when a cream was used (RR 1.54, 95%CI 1.05 to 2.24). No trials were found that compared clipping with a depilatory cream.

One trial compared shaving on the day of surgery with shaving the day before surgery and one trial compared clipping on the day of surgery with clipping the day before surgery; neither trial found a statistically significant difference in the number of SSIs. No trials were found that compared depilatory cream at different times or that compared hair removal in different settings.

**Authors’ conclusions**
The evidence finds no difference in SSIs among patients who have had hair removed prior to surgery and those who have not. If it is necessary to remove hair then both clipping and depilatory creams results in fewer SSIs than shaving using a razor. There is no difference in SSIs when patients are shaved or clipped one day before surgery or on the day of surgery.
PLAIN LANGUAGE SUMMARY

When people are being prepared for surgery removing body hair from the area of the surgical incision may reduce the chance of the surgical site becoming infected.

Traditionally people undergoing surgery have body hair removed from the intended surgical wound site as this is thought to reduce the chance of the surgical site becoming infected. Three methods of hair removal are currently used; shaving with a razor, clipping with clippers and using a cream which dissolves the hair. Removing hair before surgery using a cream results in fewer surgical site infections than shaving. However if it is necessary to remove hair then it is preferable to use clippers rather than shaving with a razor as this results in fewer surgical site infections.

BACKGROUND

The preparation of people for surgery has traditionally included the routine removal of body hair from the intended surgical wound site. Hair is removed as its presence can interfere with the exposure of the incision and subsequent wound, the suturing of the incision and the application of adhesive drapes and wound dressings (Hallstrom 1993; Miller 2001). Hair is also perceived to be associated with a lack of cleanliness and the removal of hair is thought to reduce the risk of surgical site infections (SSIs) (Kumar 2002). However, there are studies which claim that pre-operative hair removal is deleterious, perhaps by causing SSIs, and should not be carried out (Alexander 1983; Court Brown 1981; Horgan 1997).

The Center for Disease Control categorises SSIs as being either superficial incisional, deep incisional or organ/space, and states that the presence of infection should be identified using both clinical and laboratory findings and may include the presence of at least one of the following: pus, pain, tenderness, swelling or redness (Mangram 1999). SSIs are experienced by around 10% of patients in the UK each year (NINSS 2001) and can result in delayed wound healing, increased hospital stays, unnecessary pain and in extreme cases the death of the patient (Emmerson 1996; Plowman 2000).

Three methods of hair removal are currently used; shaving, clipping and chemical depilation. Shaving is the commonest and cheapest method of hair removal. This method uses a sharp blade, held within the head of a razor, which is drawn over the patient’s skin to cut hair close to the surface of the skin.

Clippers use fine teeth to cut hair close to the patient’s skin, leaving a short stubble of usually around one millimetre in length. The heads of clippers can be disposed of or disinfected between patients to minimise the risks of cross infection.

Depilatory creams are chemicals which dissolve the hair itself. This is a slower process than either shaving or clipping as the cream has to remain in contact with the hair for between 5 and 20 minutes. In addition there is a risk of irritant or allergic reactions to the cream and patch tests should be carried out 24 hours before the cream is applied.

Shaving and clipping can be carried out in operating theatres, anaesthetic rooms, wards or in peoples’ homes by theatre staff, ward staff, or by patients themselves. Chemical depilation is usually carried out on wards or in the home as it requires more time. Research has suggested however that hair removal should not take place in the operating theatre as loose hair may contaminate the sterile surgical field (Mews 2000). Others have suggested that hair removal should be carried out by skilled personnel to prevent abrasion injuries (Hallstrom 1993; Small 1996).

During the process of shaving, the skin may experience microscopic cuts and abrasions. It is believed that microorganisms can enter and colonise these cuts and contaminate the surgical wound causing post-operative wound infections (Briggs 1997). In addition abrasions may ooze exudates, which may provide a culture medium for microorganisms (Seropian 1971). Since clippers do not come into contact with the patient’s skin they are thought to reduce the risk of cuts and abrasions (Fogg 1999).

A systematic review of preoperative shaving was published in 2002 (Kjonniksen 2002). The search for this review was up until 1999 and included both randomised and observational studies. Evidence for not removing hair was found in observational studies only. Strong evidence was found in support of clipping in preference to shaving. Observational studies supported depilation rather than shaving. Moderate evidence, based on observational studies and a randomised study (though this is not statistically significant) finds that the timing of hair removal should be as close to surgery as possible. The recommendations of the Norwegian Centre for Health Technology Assessment (SMM2000) are based on the findings of this review.

Different hair removal practices are recommended throughout the world. For example, the Centers for Disease Control (CDC) strongly recommends that hair should not be removed preoperatively unless the hair at or around the incision site will interfere with the operation (Mangram 1999). This recommendation differs from the Norwegian Centre for Health Technology Assessment (SMM2000) which states that ‘contrary to the recommendations given by CDC, it is not strongly recommended to avoid preoperative hair removal’. The Norwegian Centre for Health Technology Assessment finds that strong evidence does not exist either...
in favour of, or against, preoperative hair removal. The British Hospital Infection Society Working Party guidelines (HIS 2003) recommend that ‘only the area to be incised needs to be shaved’ and that shaving should be avoided if possible.

If removal of hair is necessary, for example if the surgical site is located in an area covered by thick, dense or long body hair, these three organisations recommend slightly different methods of removal. The CDC guidelines recommend that hair is removed immediately before surgery and preferably with clippers (Man-gram 1999), the Norwegian Centre for Health Technology Assessment guidelines recommend using clippers or cream as close to the surgery as possible (SMM2000) and the Hospital Infection Society Working Party guidelines recommend using cream the day before surgery (HIS 2003).

Having a hairless surgical site may ease surgery, the application of dressings and reduce potential infection as hair is a source of bacteria, but the process of removing hair might cause primary infection because of microscopic cuts to the skin. This review will assess the relative benefits and harms of hair removal, the different methods of hair removal, and the effect of timing.

OBJECTIVES

Primary question
Does pre-operative hair removal result in fewer surgical site infections than not removing hair?

Secondary question
What are the effects of different methods of hair removal on surgical site infection?

Specifically to determine:

- the relative effects of shaving, clipping and depilatory creams compared with each other or no hair removal on SSI rates;
- the effect on SSI rates of hair removal immediately before surgery compared with hair removal undertaken more than four hours before surgery.
- whether or not the clinical setting where the hair is removed affects SSI rates.

SEARCH METHODS FOR IDENTIFICATION OF STUDIES

See: Cochrane Wounds Group methods used in reviews.

We searched the following databases:
Cochrane Wounds Group Specialised Register to October 2005;
The Cochrane Central Register of Controlled Trials (CENTRAL) The Cochrane Library Issue 3, 2005;
MEDLINE 1966 to 2005;
EMBASE 1980 to 2005;
CINAHL 1982 to 2005;
ZETOC database of conference proceedings was also searched from 1993 to 2005.

Types of studies
Randomised controlled trials (RCTs) comparing hair removal by any method (shaving, clipping, cream) with no hair removal; hair removal by any method (shaving, clipping, cream) compared with hair removal by any method (shaving, clipping, cream); hair removal carried out at different times prior to surgery; and hair removal carried out in different settings (e.g. the operating room, compared with the anaesthetic room, the ward, or the home).

Types of participants
Adult people undergoing surgery in a designated operating theatre. It is anticipated that where appropriate studies will be grouped and analysed separately, for example, elective surgery and trauma surgery, surgery carried out on different body sites.

Types of intervention
This review will include comparisons between any of the following:
- no pre-operative hair removal;
- wet shaving;
- dry shaving;
- clipping;
- depilatory creams;
- hair removal in different environments;
- hair removal conducted at different times pre-operatively.

Types of outcome measures
Primary outcome:
Proportions of people who develop post-operative surgical site infections using the CDC definition (see Background).

Secondary outcomes:
Incidence of wound complications such as dehiscence or stitch abscess.
Length of hospital stay.
Financial cost of hair removal method.
5. shav*
6. hair and clip*
7. depilat*
8. (#1 or #2 or #3 or #4 or #5 or #6 or #7)
9. SURGICAL WOUND INFECTION explode all trees (MeSH)
10. WOUND INFECTION single term (MeSH)
11. INFECTION CONTROL explode all trees (MeSH)
12. (wound* near infect*)
13. (surg* near infect*)
14. (surg* near wound*)
15. (surg* near complication*)
16. POSTOPERATIVE COMPLICATIONS explode all trees (MeSH)
17. PREOPERATIVE CARE explode all trees (MeSH)
18. INTRAOPERATIVE CARE explode all trees (MeSH)
19. PERIOPERATIVE CARE explode all trees (MeSH)
20. (perioperative near care)
21. (preoperative near care)
22. (intraoperative near care)
23. (skin near preparation)
24. (#9 or #10 or #11 or #12 or #13 or #14 or #15 or #16 or #17 or #18 or #19 or #20 or #21 or #22 or #23)
25. (#8 and #24)

We searched the bibliographies of all retrieved and relevant publications identified by these strategies for further studies. In addition, we contacted the following manufacturers of hair removal products to obtain information of any unpublished studies; Cardinal Health, Alliance Medical, Hallstar and 3M Health Care Ltd. Both 3M Health Care Ltd and Cardinal Health responded and provided articles on hair removal. All of the articles provided by the manufacturers had already been obtained through the search strategy.

There were no restrictions based on language or date of publication.

METHODOLOGY OF THE REVIEW

Three authors independently assessed the titles and abstracts of potentially relevant studies identified through the search strategy, using the selection criteria. All studies that potentially met the criteria were retrieved in full. If it was unclear from the title or abstract if a study met the criteria or there was a disagreement over the eligibility, the study was retrieved in full. The three authors then decided independently whether or not to include or exclude a study. There were no disagreements regarding inclusion.

Six articles identified through the search strategy were not published in English. These articles were published in Danish (Breiting 1981; Thorup 1985), French (Goeau-Brissonniere), German (Westermann 1979) and Chinese (Wang 1990; Wang 1999). After translation three of these trials (Breiting 1981; Goeau-Brissonniere; Thorup 1985) were eligible for inclusion in the review, two trials (Wang 1990; Wang 1999) were excluded as they did not meet the inclusion criteria and one trial is under assessment while we wait for further information regarding randomisation (Westermann 1979).

Excluded studies along with the reasons for their exclusion are listed in the excluded studies table.

We piloted and used a standardised data extraction form. Two authors independently extracted details from eligible studies onto data extraction forms. The extracted data was cross-checked by a third author. Data extracted included:

Trial data

- method of hair removal used
- use of additional shaving creams or fluid (co-interventions)
- where the hair removal was carried out (for example ward, anaesthetic room, operating theatre)
- when the hair removal was carried out (for example the day before surgery or one hour before surgery)
- type of surgery
- area of the body depilated
- role of the person removing the hair (for example patient, nurse or surgeon)
- number of post-operative SSIs
- number of post-operative wound complications including stitch abscesses, dehiscence or wound breakdown
- length of post-operative hospital stay
- financial cost of hair removal method
- number of people in each group

Quality assessment

- method of randomisation
- allocation concealment
- blinding of outcome assessors to method of hair removal
- patient withdrawals and drop out rates
- use of clear inclusion and exclusion criteria
- duration of follow up
- power of the study
- prior sample size calculations

Data was entered onto Cochrane RevMan 4.2 software and analysed using Cochrane MetaView. Results are presented with 95% confidence intervals. All outcomes are dichotomous and
are reported as relative risk. We examined clinical heterogeneity, looking at the setting of the study, the type of surgery, type of intervention, the sample size and the quality of the study. Before pooling was carried out, we also considered the statistical heterogeneity looking at sample sizes and I^2 values (Higgins 2003). In the presence of statistical heterogeneity but where clinical factors suggested pooling was appropriate then a random-effects model was used. A fixed-effect model was used in the absence of both clinical and statistical heterogeneity.

**DESCRIPTION OF STUDIES**

A total of eleven randomised controlled trials met the inclusion criteria and were included in this review.

**Primary objective:**  
*Does pre-operative hair removal result in fewer surgical site infections than no hair removal?*  
Two trials (Court Brown 1981; Rojanapirom 1992) compared pre-operative hair removal with no hair removal. Court Brown 1981 and Rojanapirom 1992 compared shaving with no hair removal and Court Brown 1981 also compared cream with no hair removal. No studies compared clipping with no hair removal.

**Secondary objectives:**  
*What are the relative effects of shaving, clipping and depilatory creams compared with each other on surgical site infection rates?*  
A total of ten trials addressed this objective. Three trials (Alexander 1983; Balthazar 1983; Ko 1992) compared shaving with clipping. Seven trials (Breiting 1981; Court Brown 1981; Goeau-Brissonniere; Powis 1976; Seropian 1971; Thorup 1985; Thur de Koos 1983) compared shaving with cream.

*What is the effect on surgical site infection rates of hair removal immediately before surgery compared with hair removal more than four hours before surgery?*  
One trial (Alexander 1983) compared clipping the day before surgery with clipping on the day of surgery and also shaving the night before surgery with shaving on the day of surgery.

*What is the effect of hair removal in different clinical settings on surgical site infection rates?*  
No eligible trials compared hair removal in different clinical settings.

**Hair removal product details**

Razors  
Of the ten trials where shaving was evaluated, two trials mentioned using a disposable razor (Court Brown 1981; Thorup 1985), one trial referred to a safety razor (Balthazar 1983) and one trial stated that either a disposable razor or a safety razor with disposable blades was used (Powis 1976). The remaining six trials did not provide descriptions of the razors used.

Four of the ten trials involving shaving gave details of the shaving technique used. Balthazar 1983, Court Brown 1981, Goeau-Brissonniere and Thur de Koos 1983 specified that wet shaves were given. The remaining six trials involving shaving did not specify if the shaving method was wet or dry.

**Depilatory cream**  
All seven trials using depilatory cream provided details of the trade name or active ingredients in the cream. These were as follows:

- Veeto - potassium thioglycollate and calcium hydroxide (Court Brown 1981)
- Ipso - calcium thioglycollate trihydrate, calcium hydroxide and strontium hydroxide (Powis 1976)
- Preprep - calcium thioglycollate and calcium hydroxide (Breiting 1981)
- Pildan - calcium glycolate (Thorup 1985)
- Immac - thioglycolic acid in the form of sodium and calcium (Goeau-Brissonniere)
- Neet - cetyl alcohol, thioglycolic acid (Thur de Koos 1983)
- Calcium thioglycollate, calcium hydroxide, strontium hydroxide (Seropian 1971)

**Clippers**  
Three trials used clippers. Balthazar 1983 used ‘ordinary barbers’ electric clippers’ which were wiped (not sterilised) between people and Ko 1992 used a Remington clipper. Alexander 1983 did not provide any details of the clippers used.

**Type of surgery**

Seven trials were conducted in people undergoing general surgery (Alexander 1983; Balthazar 1983; Court Brown 1981; Powis 1976; Rojanapirom 1992; Thorup 1985; Thur de Koos 1983), one trial involved people having orthopaedic surgery (Breiting 1981), and one trial involved cardiac surgery (Ko 1992). Two trials provided details of the surgical procedures which were not covered by the trial. Goeau-Brissonniere excluded amputations, vaginal, urological and gynaecological procedures and Seropian 1971 excluded burns, skin grafts, proctological, circumcision, abscesses and vaginal surgery.

**Timing of hair removal**

Nine of the eleven trials provided some information regarding when hair removal took place. In two trials this was the evening before surgery (Goeau-Brissonniere; Rojanapirom 1992). In five trials it was a mix of the evening before surgery and the morning of surgery (Alexander 1983; Court Brown 1981; Ko 1992; Powis 1976; Thur de Koos 1983). Only one trial stated that hair removal took place immediately before surgery (Balthazar 1983). One trial (Alexander 1983) compared shaving and clipping the evening before surgery with shaving and clipping on the day of surgery.
Two trials provided details of the method of random sequence generation. Balthazar 1983 and Goeau-Brissonniere used random numbers tables to generate the randomisation sequence. Four trials provided insufficient details regarding the randomisation, only stating that the randomisation was by patient hospital number (Powis 1976; Seropian 1971) bed number (Thur de Koos 1983) and by date of admission (Breiting 1981). The remaining five trials (Alexander 1983; Rojanapirom 1992; Ko 1992; Thorup 1985; Court Brown 1981) did not provide any details of the method of randomisation used.

**Allocation concealment**

Only Alexander 1983 reported the method of allocation concealment, namely sealed envelopes.

**Blinding**

Three trials (Ko 1992; Powis 1976; Thorup 1985) stated that the assessor was unaware of the group allocation status of the patient. Breiting 1981, who stated that the same surgeons removed hair and assessed wounds, made it clear that the assessor were not blinded. The remaining eight trials did not report sufficient information to assess if adequate blinding had been carried out.

**Patient withdrawals and drop out rates**

No trials reported information on patient drop out rates or withdrawals. Court Brown 1981 reported the number of people who died post-operatively and these people were excluded from his study. Thorup 1985 excluded two people whose hair removal had not followed the protocol and one person who was incorrectly registered.

**Use of clear inclusion and exclusion criteria**

Just over half of the trials (Alexander 1983; Balthazar 1983; Court Brown 1981; Goeau-Brissonniere; Rojanapirom 1992; Seropian 1971) reported explicit inclusion or exclusion criteria. These tended to focus on types of surgery to be excluded, for example, proctology, toe amputations and burns. Only Balthazar 1983 stated that people on antibiotics prior to surgery would be excluded and only Rojanapirom 1992 stated that the participants had to be over 12 years old and with no underlying diseases. Goeau-Brissonniere and Seropian 1971 stated that people who did not require hair removal were excluded from the study.

**Duration of follow up**

Five trials (Alexander 1983; Balthazar 1983; Breiting 1981; Court Brown 1981; Ko 1992) followed people after discharge from hospital, assessing them at out-patients’ clinics or by telephone at home. Alexander 1983 did this 30 days post surgery and Court Brown 1981 followed up at 28 days post surgery. Ko 1992 had the most extensive period of follow up. He does not state exactly what his follow up period was but refers to day 84 post surgery. The remaining six trials do not report follow-up periods.

**Sample size**

The sample sizes of the trials varied. Five small trials had 25 to 50 people in each arm (Breiting 1981 - 52 people two arms; Goeau-Brissonniere - 100 people two arms; Powis 1976 - 92 people two arms; Rojanapirom 1992 - 80 people two arms; Thorup 1985 - 50 people two arms). Four medium size trials had 100 to 250 people in each arm (Balthazar 1983 - 200 people two arms; Court Brown 1981 - 418 people three arms; Seropian 1971 - 406 people two arms; Thur de Koos 1983 - 253 people two arms). The two largest trials had around 500 people in each arm (Alexander 1983 - 1013 people two arms; Ko 1992 - 1980 people two arms).

**Sample size calculations**

No trials reported calculating a required sample size a priori on the basis of a clinically significant effect.

**Outcome measures**

Eleven trials cited post-operative surgical site infection as their outcome measure. Three trials provided a definition of infection; Alexander 1983; Balthazar 1983; Court Brown 1981 defined wound infection as the presence of pus. Ko 1992 defined ‘deep sternal wound infection’ as including at least one of the following: sternal pain; fever, erythema, maternal stability, drainage, warmth or leukocytosis Goeau-Brissonniere and Powis 1976 did not provide a definition of wound infection but graded wound infection on a scale of 0 to 5 with (0) absence (1) redness of suture (2) oedema or redness of scar (3) purulent flow (4) partial breakdown and (5) complete breakdown.

The remaining five trials (Breiting 1981; Rojanapirom 1992; Seropian 1971; Thorup 1985; Thur de Koos 1983) did not give a definition of wound infection. None of the 11 trials specifically referred to definitions of wound infections such as those published by the CDC.

Some trials assessed additional outcomes. One study (Alexander 1983) measured the length of hospital stay for people with deep infections, superficial infections and people with stitch abscesses. Three studies (Alexander 1983; Powis 1976; Thorup 1985) reported to the financial costs of using razors, clippers and cream.

Wound assessment was carried out at varying times. Goeau-Brissonniere and Powis 1976 both assessed at day 2 and day 5 post operatively, Balthazar 1983 at day 5, Thorup 1985 at day 10, Alexander 1983 at day 30 and at patients’ discharge. Court Brown 1981 assessed people daily while they remained on the ward and on day 28, Breiting 1981 assessed at patient discharge and at the 1st outpatient visit, Rojanapirom 1992 at day 2 and day 3 and on the day of suture removal. Ko 1992 states the sternal wound was observed twice daily but does not state when the observations discontinued. Breiting 1981; Seropian 1971 and Thur de Koos 1983 did not report when assessments took place.

**RESULTS**

Results of dichotomous variables are presented as relative risk with 95% confidence intervals (CI).

**Primary objective: Does pre-operative hair removal result in fewer surgical site infections than no hair removal?**

No studies were identified which compared clipping with no hair removal.

**Shaving compared with no hair removal (Analysis 01: 01)**

Two trials involving 358 people (Court Brown 1981; Rojanapirom 1992) compared shaving with no hair removal. Both trials were conducted in abdominal surgery and used observations and swabs to determine infection. Neither trial reported details of the method of randomisation generation, allocation concealment or blinding. 9.6% (17/177) of people who were shaved developed an SSI compared with 6% (11/181) who were not shaved (pooling these two trials using a random effects model gave an RR 1.59 (95%CI 0.77 to 3.27). There is no statistically significant difference between shaving and no hair removal, however the trials are not of high quality, and the comparison is underpowered.

**Depilatory cream compared with no hair removal (Analysis 02: 01)**

One trial (Court Brown 1981) compared cream with no hair removal. This trial was carried out in abdominal surgery, and did not provide details of methods of randomisation generation, allocation concealment or blinding. 7.9% (10/126) of people who had hair removed using depilatory cream acquired an SSI compared with 7.8% (11/141) people who had no hair removed, there were no statistically significant differences between the groups (RR 1.02; 95% CI 0.45 to 2.31).

**Secondary objective: What are the relative effects of shaving, clipping and depilatory creams on surgical site infection?**

No studies were identified which compared clipping with hair removal using a depilatory cream.

**Shaving compared with clipping to reduce surgical site infection (Analysis 03: 01)**

Three trials were included where people were shaved or clipped prior to surgery (Alexander 1983; Balthazar 1983; Ko 1992), the type of surgery was predominantly clean, such as hernia repair and cardiac surgery. No trials reported full details of the randomisation, allocation and blinding. Balthazar 1983 gave some details regarding the randomisation, Alexander 1983 used sealed envelopes and Ko 1992 stated that the assessors were blinded to the group allocation status. 2.8% (46/1627) of people who were shaved prior to surgery developed an SSI compared with 1.4% (21/1566) of people who were clipped prior to surgery. The trials involved similar types of surgery and were pooled using a fixed effects model (I² = 0%) giving an RR = 2.02 (95% CI 1.21 to 3.36). This difference was statistically significant and shows that people are more likely to develop an SSI when they are shaved than when they are clipped prior to surgery.

**Shaving compared with cream to reduce surgical site infection (Analysis 04: 01)**

Seven trials involving 1213 people (Breiting 1981; Court Brown 1981; Goeau-Brissonniere; Powis 1976; Seropian 1971; Thur de Koos 1983; Thorup 1985) were included. Most trials included a mix of surgical procedures within the one trial. There was variation with respect to the timing of outcome assessment, three studies did not report at what point the outcome assessment was made, two assessed at day 2 and day 5, one at day 10, and one trial daily whilst on the ward and at day 28. The data used in this analysis is that of the latest reported wound assessment. The trials were of variable quality, whilst two trials undertook blinded outcome assessment (Powis 1976; Thorup 1985) one trial reported that outcome assessors were not blinded (Breiting 1981) the remaining trials did not report clearly. Overall 10% (65/670) of people who were shaved acquired an SSI compared with 7% (38/543) of people who had hair removed with a depilatory cream. The trials were pooled using a fixed effects model (I² = 0%) and gave a RR 1.54 (95% CI 1.05 to 2.24) which shows that people are more likely to develop an SSI when they are shaved with a razor rather than having hair removed using a depilatory cream.

**Secondary objective: What is the effect on surgical site infection rates of hair removal immediately before surgery compared with hair removal more than four hours before surgery?**

**Shaving on the day of surgery compared with shaving one day preoperatively (Analyses 05: 01 and 05:02).**

One study (Alexander 1983) compared shaving on the day of surgery with shaving one day preoperatively in 537 people undergoing elective clean surgery. SSIs were measured on day 15 (Analysis 05:01) and at 30 days (Analysis 05:02). Fifteen days post operatively 5.1% (14/271) of people shaved the day before surgery developed an SSI compared with 6.5% (17/266) who were shaved.
the day of surgery. The relative risk (0.81, 95% CI 0.41 to 1.61) showed no statistically significant difference between the groups with respect to risk of developing SSI. At 30 days post operatively, 8.8% (23/260) of people shaved the day before surgery developed an SSI compared with 10% (26/260) who were shaved the day of surgery. The relative risk (0.88, 95% CI 0.52 to 1.51) showed no statistically significant difference between the groups with respect to risk of developing SSI.

Clipping on the day of surgery compared with clipping one day preoperatively (Analyses 06:01 and 06:02).

One study (Alexander 1983) involving 476 people undergoing elective clean surgery, compared clipping on the day of surgery with clipping one day preoperatively. SSIs were measured on day 15 (Analysis 06:01) and at 30 days (Analysis 06:02). 4% (10/250) of people clipped one day preoperatively developed an SSI compared with 1.7% (4/226) of people clipped on the day of surgery (RR 2.26, 95% CI 0.72 to 7.11). This difference is not statistically significant. At 30 days post operatively, 7.4% (18/241) of people clipped one day preoperatively developed an SSI compared with 3.2% (7/216) of people clipped on the day of surgery (RR 2.30, 95% CI 0.98 to 5.41). This difference is not statistically significant.

Secondary objective: What is the effect of hair removal in different settings on surgical site infection rates?

No trials were found that compared hair removal in different settings.

DISCUSSION

Objectives

Trials which compared hair removal with no hair removal prior to surgery, using either razors or a depilatory cream, demonstrated no statistically significant difference in SSI between the comparison groups. Current evidence suggests that patients who do not have hair removed are just as likely to develop SSIs as patients having hair removed using razors or depilatory cream, although this comparison is underpowered and we cannot confidently exclude a worthwhile benefit. It is not possible to make any statements regarding the comparison of clipping with no hair removal as no trials making this comparison were identified. This review does not support the recommendations of the CDC (Mangram 1999) or the Hospital Infection Society (HIS 2003) who strongly recommend that shaving should be avoided unless completely necessary. While the earlier systematic review (Kjonniksen 2002) and the Norwegian Centre for Health Technology Assessment (SMM2000) state that no strong evidence exists either in favour or against preoperative hair removal.

When considering different methods of removing hair a comparison of clippers with razors found that fewer SSIs developed when clippers were used. This finding is statistically significant and supports the recommendations of the CDC (Mangram 1999) and The Norwegian Health Technology Assessment (SMM2000).

Using depilatory cream for hair removal resulted in significantly fewer SSIs than using razors (7 trials). There were no trials comparing the relative effects of clipping with depilatory cream. This evidence supports the recommendations of the Hospital Infection Society (HIS 2003) that depilatory cream should be used as an alternative to shaving.

There appears to be no difference in the number of SSIs when patients are shaved or clipped on the day of surgery compared with shaving or clipping one day preoperatively, however each of these comparisons involved only 500 participants. There were no trials comparing the use of depilatory cream on the day of surgery or one day preoperatively. RCT evidence does not support the CDC recommendations (Mangram 1999) and the Norwegian Health Technology Assessment (SMM2000) who advocate hair removal immediately before surgery. It is not possible to support or refute the recommendations of the Hospital Infection Society (HIS 2003) who recommend using depilatory cream the day before surgery.

No trials were included in the review which evaluated the effect on SSIs of hair removal in different clinical settings.

Comparison with earlier systematic review

The search strategy for the previous systematic review (Kjonniksen 2002) covered the period up to 1999 and the review included 9 RCTs and 12 observational studies. (Observational studies included controlled studies, quasi-experimental studies and non-experimental observational studies). A comparison between the review undertaken by Kjonniksen 2002 review and this review revealed discrepancies in seven studies. Kjonniksen 2002 classified the study by Seropian 1971 as an observational study due to uncertainties regarding randomisation. Seropian 1971 states that people were randomised to two groups (shaving and cream) but reports data for people who were excluded from the study and did not have hair removed as a third group. This review includes data from the two groups who were subject to the randomisation procedure and excluded data relating to people who were not randomised (Seropian 1971). Kjonniksen 2002 describes the study by Westermann 1979 as non randomised, however we have made attempts to contact the authors for clarification on the status of the study and until this has been obtained the study is classified as awaiting assessment. Kjonniksen 2002 includes Hoe 1985 as a randomised study but attributes this study less importance due to design methods. This review did not include the Hoe 1985 study as people within the non shaving group were shaved if necessary and therefore there is contamination. Kjonniksen 2002 did not identify studies by Breitling 1981 and Thorup 1985 which are RCTs included in this review. Kjonniksen 2002 describes the Powis 1976 study as irrelevant as it only includes a limited number of people. This review includes the study by Powis 1976.
Methodological quality of the studies

Eleven eligible RCTs were included in this review. The methodological quality and the reporting of methods of most of these trials were poor. None of the trials were identified as being of high quality. Most of the trials did not provide sufficient details of the process of randomisation or allocation to allow us to judge their validity. Similarly, the study setting and timing of hair removal relative to surgery were often poorly reported. The identity of the outcome assessor and the timing of assessment were often not clear. Most of the trials (Alexander 1983; Balthazar 1983; Breitg 1981; Court Brown 1981; Goeau-Brissonniere; Rojanapirom 1992; Thorup 1985; Thur de Koois 1983) provided information on the sex and age of the people allowing baseline comparisons to be made.

Outcome measures

While all trials reported SSI as their primary objective their assessment of infection was mixed. None of the eleven trials specifically referred to definitions of SSIs such as those published by the CDC, though five trials did use the National Research Councils’ classification for operative wounds.

More than half the trials used bacterial swabs and a visual assessment to determine infection, while the remaining trials used visual assessment only. Some trials did not state when the assessments were carried out. Though there was little parity among the trials which did provide details. Though most stated that assessment was carried out at patient discharge, this was not defined as a number of post-operative days.

Future trials need to use an accepted definition of SSIs, a standard test for SSIs and conduct a complete follow up of people for SSIs.

The sample size of trials needs to be larger to allow clinically important differences to be detected.

Limitations of trials

All trials included in this review had limitations. Reporting of the trial design was usually poor in that most authors did not provide details of the method of generating the randomisation sequence, the method of allocation concealment and whether blinding of outcome assessors was undertaken. Review authors should consider contacting trial authors as a matter of routine to obtain further information on trial design. Accepted definitions of wound infection could have been referred to in the trials and wounds assessed during a follow up period.

Publication bias

Six articles were identified in languages other than English and required translations, three of these were included in the review. Two of the four manufacturers contacted provided details of trials, though all of these studies had already been identified through searching the databases. Three studies (Powis 1976; Seropian 1971; Thorup 1985) acknowledged companies for providing the depilatory cream used in their trials.

Authors’ conclusions

Implications for practice

The review finds insufficient evidence for an effect of pre operative hair removal on rates of SSIs and of the relative effects of shaving and depilation. There is no research comparing hair removal using clippers with no hair removal.

If it is necessary to remove hair then both clipping and depilatory cream result in fewer SSIs than shaving with a razor. No trials have compared clipping with depilatory cream.

There is insufficient evidence on the rates of SSIs when patients are shaved or clipped the day before or on the day of surgery. There is no research involving the timing of hair removal using a depilatory cream.

There is no research to indicate whether the place of hair removal (e.g. operating theatre, anaesthetic room or ward area) affects SSI rates.

Implications for research

• Trials comparing hair removal with no hair removal using razors, depilatory cream and clippers are needed.
• Trials comparing depilatory cream with razors and depilatory cream with clippers are needed.
• Trials comparing hair removal using clippers, razors and depilatory cream at different times prior to surgery are needed.
• Trials comparing different settings for hair removal (operating theatre, anaesthetic room, ward, patient’s home) are needed.
• Trials need to be conducted in non clean surgery where infection rates are higher.
• The sample size of trials needs to be larger to allow clinically important differences to be detected.
• Trials need to provide details of randomisation, allocation concealment and blinding.
• Trials need to use an internationally accepted definition of SSIs - for example Centers for Disease Control
• Wounds need to be assessed at agreed times and should continue to be assessed after patient discharge.
• Length of hospital stay and wound complications should be included as outcome assessments.
ACKNOWLEDGEMENTS

The authors would like to thank Nicky Cullum, Andrea Nelson, David Margolis, Marie Westwood, Vicky Whittaker and Sally Bell-Syer for their comments on this review.

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Internal sources of support

• No sources of support supplied

REFERENCES

References to studies included in this review

Alexander 1983 {published data only}

Balthazar 1983 {published data only}

Breiting 1981 {published data only}

Court Brown 1981 {published data only}

Goeau-Brissonniere {published data only}

Ko 1992 {published data only}

References to studies excluded from this review

Almersjo 1967
Bekar 2001

Bird 1984

Braun 1995

Clarke 1983

Cruse 1973

Fraser 1978

Hallstrom 1993

Hoe 1985

Horgan 1997
Horgan MA, Piatt JH. Shaving the scalp may increase the rate of infection in CSF shunt surgery. *Pediatric Neurosurgery* 1997;26:180–4.

Ilankovan 1992

KJonniksen 2002

Korfali 1994

Kumar 2002

Le Roux 1975

Lui 1984

Masterson 1984

McIntyre 1994

Mehta 1988

Menendez Lopez 2004

Menendez Lopez 2004

Miller 2001

Mishriki 1990

Moro 1996

Ratanalert 1999

Scherpereel 1993

Sellick 1991

Sheinberg 1999

Siddique 1998

Small 1996
Characteristics of included studies

<table>
<thead>
<tr>
<th>Study</th>
<th>Alexander 1983</th>
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<tr>
<td>Methods</td>
<td>Patients randomised to group by drawing sealed envelopes. Sealed envelopes. No information regarding blinding of assessors</td>
</tr>
<tr>
<td>Participants</td>
<td>Patients having elective clean surgery</td>
</tr>
<tr>
<td>Interventions</td>
<td>Clipping day before surgery versus clipping day of surgery. Shaving day before surgery versus shaving day of surgery.</td>
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### Characteristics of included studies (Continued)

<table>
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<th>Outcomes</th>
<th>Wound infection checked at discharge and 30 days post discharge</th>
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<tbody>
<tr>
<td>Notes</td>
<td></td>
</tr>
<tr>
<td>Allocation concealment</td>
<td>A – Adequate</td>
</tr>
</tbody>
</table>

#### Study: Balthazar 1983
- **Methods**: Patients randomised using random numbers tables. No information regarding blinding of assessors
- **Participants**: Patients having elective inguinal hernia repair
- **Interventions**: Shaving versus clipping
- **Outcomes**: Wound infection assessed at day 5 post operation and 2 weeks post operation
- **Notes**: Allocation concealment B – Unclear

#### Study: Breiting 1981
- **Methods**: Patients randomised by hospital admission date. Assessors were not blinded
- **Participants**: Patients having elective surgery on lower legs
- **Interventions**: Shaving versus cream
- **Outcomes**: Superficial and deep infections assessed at discharge and outpatient visit
- **Notes**: Allocation concealment B – Unclear

#### Study: Court Brown 1981
- **Methods**: Details of randomisation not given - 'patients randomly allocated'. No information regarding blinding of assessors
- **Participants**: Patients having abdominal surgery
- **Interventions**: Shaving versus cream versus nothing
- **Outcomes**: Wound infection assessed daily and at 28 days post operation
- **Notes**: Allocation concealment B – Unclear

#### Study: Goeau-Brissonniere
- **Methods**: Patients randomised using random numbers tables. No information regarding blinding of assessors
- **Participants**: Patients having elective surgery, excluding amputation, vaginal, proctology, urology and gynaecology
- **Interventions**: Shaving versus cream
- **Outcomes**: Wound infection assessed at day 2 and day 5 post operation
- **Notes**: Allocation concealment B – Unclear

#### Study: Ko 1992
- **Methods**: Details of randomisation not given - 'patients prospectively randomised'. Assessor unaware of patients group allocation status
- **Participants**: Patients having cardiac bypass surgery
- **Interventions**: Clipping versus shaving
Characteristics of included studies (Continued)

<table>
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<th>Study</th>
<th>Methods</th>
<th>Participants</th>
<th>Interventions</th>
<th>Outcomes</th>
<th>Notes</th>
<th>Allocation concealment</th>
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<td>Powis 1976</td>
<td>Patients randomised by hospital number. Assessor unaware of patients group allocation status</td>
<td>Patients having general surgery</td>
<td>Shaving versus cream</td>
<td>Wound infection assessed at day 2 and day 5</td>
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<td>B – Unclear</td>
</tr>
<tr>
<td>Rojanapirom 1992</td>
<td>Details of randomisation not given - 'patients were randomly divided'. No information regarding blinding of assessors</td>
<td>Patients having appendicectomy</td>
<td>Shaving versus no hair removal</td>
<td>Wound infection assessed at 2 days and 3 days post operation</td>
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<td>B – Unclear</td>
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<tr>
<td>Seropian 1971</td>
<td>Patients randomised by hospital number. No information regarding blinding of assessors</td>
<td>Patients having surgery excluding - endoscopy, burns, oral surgery, proctology, abscesses, vaginal surgery</td>
<td>Cream versus shaving.</td>
<td>Wound infection. Time of assessment not given</td>
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<td>B – Unclear</td>
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<td>Thorup 1985</td>
<td>Details of randomisation not given - 'patients were randomised'. Assessor unaware of patients group allocation status</td>
<td>Patients having inguinal hernia repair</td>
<td>Shaving versus cream</td>
<td>Wound infection assessed immediately post operation and day of suture removal</td>
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<td>Thur de Koos 1983</td>
<td>Patients randomised by bed number. No information regarding blinding of assessors</td>
<td>Patients having thoracic, abdominal, vascular, head and neck surgery</td>
<td>Shaving versus cream</td>
<td>Wound infection. Time of assessment not given</td>
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### Characteristics of excluded studies

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<td>Bekar 2001</td>
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<tr>
<td>Bird 1984</td>
<td>Not a randomised controlled trial</td>
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<td>Braun 1995</td>
<td>Not a randomised controlled trial</td>
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<tr>
<td>Clarke 1983</td>
<td>Not a randomised controlled trial</td>
</tr>
<tr>
<td>Cruse 1973</td>
<td>Not a randomised controlled trial</td>
</tr>
<tr>
<td>Fraser 1978</td>
<td>Study explored infection in urine rather than wounds</td>
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<tr>
<td>Hallstrom 1993</td>
<td>Not a randomised controlled study</td>
</tr>
<tr>
<td>Hoe 1985</td>
<td>Patients were randomised to shaved and not shaved groups. However, some of the patients in the not shaved group were shaved if their incision was in a hairy area. These patients were still included in the study and still presented as being in the not shaved group.</td>
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<tr>
<td>Horgan 1997</td>
<td>Study explores shunts rather than hair removal</td>
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<tr>
<td>Ilankovan 1992</td>
<td>Infection rates were not an outcome</td>
</tr>
<tr>
<td>Kjonniksen 2002</td>
<td>A systematic review</td>
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<td>Korfali 1994</td>
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<td>Kumar 2002</td>
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<tr>
<td>Le Roux 1975</td>
<td>Not a randomised controlled trial</td>
</tr>
<tr>
<td>Lui 1984</td>
<td>The trial includes a mix or randomised and non randomised patients. Patients in the no- hair removal group had hair cropped.</td>
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<tr>
<td>Masterson 1984</td>
<td>Not a randomised controlled trial</td>
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<tr>
<td>McIntyre 1994</td>
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<tr>
<td>Mehta 1988</td>
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<tr>
<td>Menendez 2004</td>
<td>Measured post operative infection in urine rather than in wounds</td>
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<tr>
<td>Menendez Lopez 2004</td>
<td>Measured post operative infections in urine rather than in wounds</td>
</tr>
<tr>
<td>Miller 2001</td>
<td>Not a randomised controlled trial</td>
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<td>Mishriki 1990</td>
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<td>Scherpereel 1993</td>
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<td>Sellick 1991</td>
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<td>Sheinberg 1999</td>
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<td>Small 1996</td>
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<tr>
<td>Stephens 1966</td>
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<tr>
<td>Vestal 1952</td>
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<tr>
<td>Viney 1992</td>
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<td>Wang 1990</td>
<td>Patients were allocated, not randomised</td>
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Characteristics of excluded studies (Continued)

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<td>Winfield 1986</td>
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<tr>
<td>Winston 1992</td>
<td>Not a randomised controlled trial</td>
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<tr>
<td>Zentner 1987</td>
<td>Not a randomised controlled trial</td>
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**AN A L Y S E S**

Comparison 01. shaving compared with no hair removal

<table>
<thead>
<tr>
<th>Outcome title</th>
<th>No. of studies</th>
<th>No. of participants</th>
<th>Statistical method</th>
<th>Effect size</th>
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<tbody>
<tr>
<td>01 wound infection - existence of pus</td>
<td>2</td>
<td>358</td>
<td>Relative Risk (Random) 95% CI</td>
<td>1.59 [0.77, 3.27]</td>
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Comparison 02. cream compared with no hair removal

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<thead>
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<th>Outcome title</th>
<th>No. of studies</th>
<th>No. of participants</th>
<th>Statistical method</th>
<th>Effect size</th>
</tr>
</thead>
<tbody>
<tr>
<td>01 wound infection existence of pus</td>
<td>1</td>
<td>267</td>
<td>Relative Risk (Fixed) 95% CI</td>
<td>1.02 [0.45, 2.31]</td>
</tr>
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Comparison 03. shaving compared with clipping

<table>
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<tr>
<th>Outcome title</th>
<th>No. of studies</th>
<th>No. of participants</th>
<th>Statistical method</th>
<th>Effect size</th>
</tr>
</thead>
<tbody>
<tr>
<td>01 wound infection - existence of pus</td>
<td>3</td>
<td>3193</td>
<td>Relative Risk (Fixed) 95% CI</td>
<td>2.02 [1.21, 3.36]</td>
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Comparison 04. shaving compared with cream

<table>
<thead>
<tr>
<th>Outcome title</th>
<th>No. of studies</th>
<th>No. of participants</th>
<th>Statistical method</th>
<th>Effect size</th>
</tr>
</thead>
<tbody>
<tr>
<td>01 wound infection existence of pus</td>
<td>7</td>
<td>1213</td>
<td>Relative Risk (Fixed) 95% CI</td>
<td>1.54 [1.05, 2.24]</td>
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Comparison 05. shaving day before compared with shaving day of surgery

<table>
<thead>
<tr>
<th>Outcome title</th>
<th>No. of studies</th>
<th>No. of participants</th>
<th>Statistical method</th>
<th>Effect size</th>
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<tbody>
<tr>
<td>01 wound infection day 15</td>
<td>1</td>
<td>537</td>
<td>Relative Risk (Fixed) 95% CI</td>
<td>0.81 [0.41, 1.61]</td>
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<tr>
<td>02 wound infection day 30</td>
<td>1</td>
<td>520</td>
<td>Relative Risk (Fixed) 95% CI</td>
<td>0.88 [0.52, 1.51]</td>
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Comparison 06. clipping day before compared with clipping day of surgery

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<tr>
<th>Outcome title</th>
<th>No. of studies</th>
<th>No. of participants</th>
<th>Statistical method</th>
<th>Effect size</th>
</tr>
</thead>
<tbody>
<tr>
<td>01 wound infection day 15</td>
<td>1</td>
<td>476</td>
<td>Relative Risk (Fixed) 95% CI</td>
<td>2.26 [0.72, 7.11]</td>
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<tr>
<td>02 wound infection day 30</td>
<td>1</td>
<td>457</td>
<td>Relative Risk (Fixed) 95% CI</td>
<td>2.30 [0.98, 5.41]</td>
</tr>
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</table>

**I N D E X T E R M S**

Medical Subject Headings (MeSH)

*Hair Removal [adverse effects; methods]; Preoperative Care; Randomized Controlled Trials; Surgical Wound Infection [etiology; prevention & control]; Time Factors*
Preoperative hair removal to reduce surgical site infection

Title
Preoperative hair removal to reduce surgical site infection

Authors
Tanner J, Woodings D, Moncaster K

Contribution of author(s)
JT wrote the protocol, screened citations for eligibility, arranged translations, contacted authors, checked extracted data, entered data into RevMan and wrote the review. KM commented on the protocol, screened citations for eligibility, extracted data, contacted manufacturers and commented on the review. DW commented on the protocol, screened citations for eligibility, extracted data and commented on the review.

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2003/2
Review first published
2006/2
Date of most recent amendment
24 May 2006
Date of most recent SUBSTANTIVE amendment
21 April 2006

What's New
Information not supplied by author

Date new studies sought but none found
Information not supplied by author

Date new studies found but not yet included/excluded
Information not supplied by author

Date new studies found and included/excluded
05 October 2005

Date authors' conclusions section amended
21 April 2006

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CD004122

Editorial group
Cochrane Wounds Group

Editorial group code
HM-WOUNDS
Analysis 01.01. Comparison 01 shaving compared with no hair removal, Outcome 01 wound infection - existence of pus

Review: Preoperative hair removal to reduce surgical site infection  
Comparison: 01 shaving compared with no hair removal  
Outcome: 01 wound infection - existence of pus

<table>
<thead>
<tr>
<th>Study</th>
<th>n/N</th>
<th>n/N</th>
<th>Relative Risk (Random)</th>
<th>Weight (%)</th>
<th>Relative Risk (Random)</th>
<th>95% CI</th>
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<tr>
<td>Court Brown 1981</td>
<td>17/137</td>
<td>11/141</td>
<td>1.59 [0.77, 3.27]</td>
<td>100.0</td>
<td>1.59 [0.77, 3.27]</td>
<td></td>
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<tr>
<td>Rojanapirom 1992</td>
<td>0/40</td>
<td>0/40</td>
<td>Not estimable</td>
<td>0.0</td>
<td>Not estimable</td>
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<tr>
<td>Total (95% CI)</td>
<td>177</td>
<td>181</td>
<td>1.59 [0.77, 3.27]</td>
<td>100.0</td>
<td>1.59 [0.77, 3.27]</td>
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</tr>
</tbody>
</table>

Total events: 17 (shaving), 11 (no shaving)  
Test for heterogeneity: not applicable  
Test for overall effect z=1.26  p=0.2
### Analysis 02.01. Comparison 02 cream compared with no hair removal, Outcome 01 wound infection existence of pus

**Review:** Preoperative hair removal to reduce surgical site infection  
**Comparison:** 02 cream compared with no hair removal  
**Outcome:** 01 wound infection existence of pus

<table>
<thead>
<tr>
<th>Study</th>
<th>cream n/N</th>
<th>no hair removal n/N</th>
<th>Relative Risk (Fixed) 95% CI</th>
<th>Weight (%)</th>
<th>Relative Risk (Fixed) 95% CI</th>
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<tbody>
<tr>
<td>Court Brown 1981</td>
<td>10/126</td>
<td>11/141</td>
<td>1.02 [0.45, 2.31]</td>
<td>100.0</td>
<td></td>
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<tr>
<td>Total (95% CI)</td>
<td>126</td>
<td>141</td>
<td></td>
<td>100.0</td>
<td>1.02 [0.45, 2.31]</td>
</tr>
</tbody>
</table>

Total events: 10 (cream), 11 (no hair removal)  
Test for heterogeneity: not applicable  
Test for overall effect z=0.04  p=1

![Graph showing comparison between cream and no hair removal](image)
### Analysis 03.01. Comparison 03 shaving compared with clipping, Outcome 01 wound infection - existence of pus

**Review:** Preoperative hair removal to reduce surgical site infection  
**Comparison:** 03 shaving compared with clipping  
**Outcome:** 01 wound infection - existence of pus

<table>
<thead>
<tr>
<th>Study</th>
<th>shaving</th>
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<th>Weight (%</th>
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<tr>
<td></td>
<td>n/N</td>
<td>n/N</td>
<td>95% CI</td>
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<td>95% CI</td>
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<td>01 shaving versus clipping at any time</td>
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<tr>
<td>Alexander 1983</td>
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<td>14/476</td>
<td></td>
<td>68.0</td>
<td>1.96 [ 1.06, 3.64 ]</td>
</tr>
<tr>
<td>Balthazar 1983</td>
<td>2/100</td>
<td>1/100</td>
<td></td>
<td>4.6</td>
<td>2.00 [ 0.18, 21.71 ]</td>
</tr>
<tr>
<td>Ko 1992</td>
<td>13/990</td>
<td>6/990</td>
<td></td>
<td>27.5</td>
<td>2.17 [ 0.83, 5.68 ]</td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>1627</td>
<td>1566</td>
<td></td>
<td>100.0</td>
<td>2.02 [ 1.21, 3.36 ]</td>
</tr>
</tbody>
</table>

Total events: 46 (shaving), 21 (clipping)  
Test for heterogeneity chi-square=0.03 df=2 p=0.99 I² =0.0%  
Test for overall effect z=2.71 p=0.007
Comparison 04 shaving compared with cream, Outcome 01 wound infection existence of pus

Review: Preoperative hair removal to reduce surgical site infection
Comparison: 04 shaving compared with cream
Outcome: 01 wound infection existence of pus

<table>
<thead>
<tr>
<th>Study</th>
<th>shaving n/N</th>
<th>cream n/N</th>
<th>Relative Risk (Fixed)</th>
<th>Weight (%)</th>
<th>Relative Risk (Fixed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>O1 wound infection at patient discharge</td>
<td>0/29</td>
<td>0/23</td>
<td>Not estimable</td>
<td>0.0</td>
<td>Not estimable</td>
</tr>
<tr>
<td>Breiting 1981</td>
<td>17/137</td>
<td>10/126</td>
<td>26.2</td>
<td>1.56</td>
<td>[0.74, 3.29]</td>
</tr>
<tr>
<td>Court Brown 1981</td>
<td>11/49</td>
<td>9/51</td>
<td>22.2</td>
<td>1.27</td>
<td>[0.58, 2.80]</td>
</tr>
<tr>
<td>Goeau-Brissonniere</td>
<td>12/46</td>
<td>9/46</td>
<td>22.7</td>
<td>1.33</td>
<td>[0.62, 2.86]</td>
</tr>
<tr>
<td>Powis 1976</td>
<td>14/249</td>
<td>11/157</td>
<td>3.1</td>
<td>8.83</td>
<td>[1.17, 66.47]</td>
</tr>
<tr>
<td>Seropian 1971</td>
<td>10/137</td>
<td>9/116</td>
<td>24.6</td>
<td>0.94</td>
<td>[0.40, 2.24]</td>
</tr>
<tr>
<td>Thorup 1985</td>
<td>1/23</td>
<td>0/24</td>
<td>1.2</td>
<td>3.13</td>
<td>[0.13, 73.01]</td>
</tr>
<tr>
<td>Thur de Koos 1983</td>
<td>10/137</td>
<td>9/116</td>
<td>24.6</td>
<td>0.94</td>
<td>[0.40, 2.24]</td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>670</td>
<td>543</td>
<td>100.0</td>
<td>1.54</td>
<td>[1.05, 2.24]</td>
</tr>
</tbody>
</table>

Total events: 65 (shaving), 38 (cream)
Test for heterogeneity chi-square=4.67 df=5 p=0.46 I² =0.0%
Test for overall effect z=2.23 p=0.03
### Analysis 05.01. Comparison 05 shaving day before compared with shaving day of surgery, Outcome 01 wound infection day 15

**Review:** Preoperative hair removal to reduce surgical site infection

**Comparison:** 05 shaving day before compared with shaving day of surgery

**Outcome:** 01 wound infection day 15

<table>
<thead>
<tr>
<th>Study</th>
<th>shaving day before n/N</th>
<th>shaving on the day n/N</th>
<th>Relative Risk (Fixed)</th>
<th>Weight (%)</th>
<th>Relative Risk (Fixed)</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alexander 1983</td>
<td>14/271</td>
<td>17/266</td>
<td></td>
<td></td>
<td>100.0</td>
<td>0.81 [ 0.41, 1.61 ]</td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>271</td>
<td>266</td>
<td></td>
<td></td>
<td>100.0</td>
<td>0.81 [ 0.41, 1.61 ]</td>
</tr>
</tbody>
</table>

Total events: 14 (shaving day before), 17 (shaving on the day)

Test for heterogeneity: not applicable

Test for overall effect $z=0.61$  $p=0.5$
Analysis 05.02. Comparison 05 shaving day before compared with shaving day of surgery, Outcome 02 wound infection day 30

Review: Preoperative hair removal to reduce surgical site infection
Comparison: 05 shaving day before compared with shaving day of surgery
Outcome: 02 wound infection day 30

<table>
<thead>
<tr>
<th>Study</th>
<th>shaving day before</th>
<th>shaving day of surg</th>
<th>Relative Risk (Fixed)</th>
<th>Weight</th>
<th>Relative Risk (Fixed)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n/N</td>
<td>n/N</td>
<td>95% CI (% 95% CI)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alexander 1983</td>
<td>23/260</td>
<td>26/260</td>
<td>100.0 0.88 [0.52, 1.51]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>260</td>
<td>260</td>
<td>100.0 0.88 [0.52, 1.51]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total events: 23 (shaving day before), 26 (shaving day of surg)
Test for heterogeneity: not applicable
Test for overall effect $z=0.45$, $p=0.7$
### Analysis 06.01. **Comparison 06 clipping day before compared with clipping day of surgery, Outcome 01 wound infection day 15**

Review: Preoperative hair removal to reduce surgical site infection  
Comparison: 06 clipping day before compared with clipping day of surgery  
Outcome: 01 wound infection day 15

<table>
<thead>
<tr>
<th>Study</th>
<th>Clipping day before n/N</th>
<th>Clipping on the day n/N</th>
<th>Relative Risk (Fixed) 95% CI</th>
<th>Weight (%)</th>
<th>Relative Risk (Fixed) 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alexander 1983</td>
<td>10/250</td>
<td>4/226</td>
<td>2.26 [0.72, 7.11]</td>
<td>100.0</td>
<td>2.26 [0.72, 7.11]</td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>250</td>
<td>226</td>
<td></td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

Total events: 10 (clipping day before), 4 (clipping on the day)  
Test for heterogeneity: not applicable  
Test for overall effect z=1.40 $p=0.2$

![Favours treatment vs Favours control graph]
## Analysis 06.02. Comparison 06 clipping day before compared with clipping day of surgery, Outcome 02 wound infection day 30

**Review:** Preoperative hair removal to reduce surgical site infection  
**Comparison:** clipping day before compared with clipping day of surgery  
**Outcome:** wound infection day 30

<table>
<thead>
<tr>
<th>Study</th>
<th>clipping day before</th>
<th>clipping day of surg</th>
<th>Relative Risk (Fixed)</th>
<th>Weight (%)</th>
<th>Relative Risk (Fixed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alexander 1983</td>
<td>18/241</td>
<td>7/216</td>
<td>2.30 (0.98, 5.41)</td>
<td>100.0</td>
<td>2.30 (0.98, 5.41)</td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>241</td>
<td>216</td>
<td></td>
<td>100.0</td>
<td>2.30 (0.98, 5.41)</td>
</tr>
</tbody>
</table>

Total events: 18 (clipping day before), 7 (clipping day of surg)  
Test for heterogeneity: not applicable  
Test for overall effect $z=1.92$ $p=0.06$