

3M Infection Prevention Solutions

3M™ Surgical Clippers Bibliography

Surgical Clippers



Key concepts

The problem of postoperative infection can contribute to patient morbidity and mortality, increased length of hospital stay, and higher treatment costs. Preoperative manual skin shaving damages skin, contributing to an increased risk of postoperative infection.

Studies comparing methods of preoperative hair removal show that clipping reduces infection rate compared to shaving. Timing of the hair removal affects infection rate. Cost comparisons of clipping versus shaving are also favorable. If hair removal is required, professional recommendations endorse the use of a clipper or depilatory for preoperative hair removal.

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The problem of postoperative infection

Surgical infections can complicate and prolong a patient's post-operative recovery time, contribute to prolonged hospital stay and higher treatment costs, and can contribute to patient mortality. The articles below highlight rates of infection associated with various surgical procedures.

Sellick JA, Stelmach M, Mylotte JM. Surveillance of surgical wound infections following open heart surgery. *Infection Control and Hospital Epidemiology*. 1991; 12(10):591–596.

While the overall risks of (open heart) surgery currently are low, wound infection remains one of the potentially serious complications. Previous studies have focused on serious infections of the sternotomy wound and mediastinum with rates of these infections ranging from 0.5% to 3.4% in most series.

Ko W, Lazenby WD, Zelano JA, et al. Effects of shaving methods and intraoperative irrigation on suppurative mediastinitis after bypass operations. *Annals of Thoracic Surgery*. 1992; 53:301–305.

To investigate the effects of the hair removal methods and intraoperative irrigation on suppurative mediastinitis after cardiopulmonary bypass operations, 1,980 consecutive adult patients over a 2-year period were prospectively randomized to manual shaving versus electrical clipping of hair before the skin incision.

Shaving was performed on the night before the elective operations and on the operating table for the emergency cases.

The operations included coronary artery bypass graftings, valvular replacements, combinations of coronary artery bypass grafting and valvular replacement, repairs of thoracic aneurisms, and resections of cardiac tumors.

Incidence of Sternal Wound Infection		
Operation	No. of Patients	Infection (%)
CABG	1,497	12 (0.80)
VR	150	3 (2.0)
VR + CABG	144	2 (1.39)
Others	188	0
Total	1,980	17 (0.86)

CABG = coronary artery bypass grafting
VR = valvular replacement

Alexander JW, Fischer JE, Boyajian M, et al. The influence of hair-removal methods on wound Infections. *Archives of Surgery*. 1983;118(3):347–352.

Overall infection rates, and infection rates according to type of operation, were tabulated for 1,013 surgical patients at discharge and at 30-day follow-up (for those patients available for follow-up). Patients' hair was removed by means of a clipper or a razor either the night before surgery or the morning of surgery. Surgical procedures included:

- vascular
- thoracic
- intestine, pancreas, or liver
- transplant related
- splenectomy
- cholecystectomy
- hernia
- tubal ligation, TAH-appendectomy
- neurosurgery
- mastectomy
- miscellaneous surgeries

Total Infections	
Discharge	30-day Follow-up
45/1,013 (4.4%)	74/977 (7.6%)
*The point of this article is that AM clipping resulted in the lowest infection rate at discharge, 4/226 (1.8%).	
*Rates are given as fraction of patients with infection, with percentages in parentheses.	

Manual skin shaving damages skin

Preoperative hair removal using a razor damages the skin, making the site vulnerable to microorganism colonization and wound contamination. The articles below support the view that manual skin shaving damages skin.

Jepsen OB, Bruttomesso KA. The effectiveness of preoperative skin preparations: An integrative review of the literature. *AORN Journal*. 1993; 58:477–484.

Even the most expertly performed shaves result in unseen epidermal cuts and nicks. Shaving can provide entries for resident and transient microorganisms on the epidermis and hair shafts and can increase the patient risk of wound infection.

Ko W, Lazenby D, Zelano JA, et al. Effects of shaving methods and intraoperative irrigation on suppurative mediastinitis after bypass operations. *Annals of Thoracic Surgery*. 1992;53:301–305.

Violations of skin barrier by shaving with a razor have been implicated as a cause of bacterial wound contamination and has been associated with increased wound infection in elective general surgical operations.

Manual skin shaving with a razor has been shown to cause microscopic breakage in the epithelial barrier, leading to bacterial contamination of the surgical wound.

Clipping reduces infection rate compared to shaving

The use of clippers for preoperative hair removal has been shown to reduce infection rates compared to infection rates in surgical patients who were shaved. The articles below present comparative data on infection rates in surgical patients whose incision sites were clipped rather than shaved.

Tanner J, Norrie P, Melen K. Preoperative hair removal to reduce surgical site infection. *Cochrane Database of Systematic Reviews*. 2011;(11):CD004122.

- Three trials (1,343 participants) that compared shaving to clipping showed significantly more surgical site infections (SSI) associated with shaving (RR 2.09, 95% CI 1.15 to 3.80).
- When it is necessary to remove hair, the existing evidence suggests that clippers are associated with fewer SSIs than razors.
- If hair has to be removed to facilitate surgery or the application of adhesive dressings, clipping rather than shaving appears to result in fewer SSIs.

Alexander JW, Solomkin JS, Edwards MJ. Updated recommendations for control of surgical site infections. *Annals of Surgery*. Jun 2011;253(6):1082–1093.

When it is deemed by the surgeon that hair should be removed, shaving should never be used. Clipping the hair with care to avoid skin damage seems to be the most satisfactory method. Most studies support hair removal done immediately before operation.

Dellinger EP, Hausmann SM, Bratzler DW, et al. Hospitals collaborate to decrease surgical site infections. *The American Journal of Surgery*. Jul 2005;190(1):9–15.

Shaving the surgical site increases the rate of surgical site infection, particularly for clean cases and particularly when it is done earlier than immediately prior to operation.

Jepsen OB, Bruttomesso KA. The effectiveness of preoperative skin preparations: An integrative review of the literature. *AORN Journal*. 1993;58:477–484.

...[P]atients whose hair is shaved with a razor have a 2.5% infection rate; patients whose hair is clipped have a 1.7% infection rate. Patients whose hair is shaved with an electric razor have a 1.4% infection rate and patients whose hair is not shaved or clipped have a 0.9% infection rate.

Ko W, Lazenby WD, Zelano JA, Isom OW, Krieger KH. Effects of shaving methods and intraoperative irrigation on suppurative mediastinitis after bypass operations. *Annals of Thoracic Surgery*. 1992;53:301–305.

The overall incidence of suppurative mediastinitis was 0.86% (17/1,980). The infectious rate was significantly higher in the manually shaven (13/990) than in the electrically clipped patients (4/990) with an odds ratio of 3.25 (95% confidence interval, 1.11 to 9.32; $p=0.024$).

Risk Factors for Sternal Wound Infection

Factor	Incidence (%)	p Value
Shaving	13/990 (1.3)	0.02
Clipping	4/990 (0.4)	

Alexander JW, Fischer JE, Boyajian M, et al. The influence of hair-removal methods on wound infections. *Archives of Surgery*. 1983;118:347–352.

The influence of preoperative shaving vs. clipping on wound infection rate was studied in 1,013 patients undergoing elective operations at a single hospital. Surgical procedures included: vascular; thoracic; intestine, pancreas, or liver; transplant related; splenectomy; cholecystectomy; hernia; tubal ligation; TAH-appendectomy; neurosurgery; mastectomy; or miscellaneous surgeries. Patients were prospectively randomized to be either shaved or clipped the night before or the morning of operation. Hair was removed by one of four methods and the presence of infection was noted at hospital discharge and at a 30-day follow-up...

Overall Infection Rates*		
Hair Removal Method	Discharge	30-day Follow-up
PM razor	4/271 (5.2%)	23/260 (8.8%)
AM razor	17/266 (6.4%)	26/260 (10.0%)
PM clipper	10/250 (4.0%)	18/241 (7.5%)
AM clipper	4/226 (1.8%)	7/216 (3.2%)
Total	45/1,013 (4.4%)	74/977 (7.6%)

* Rates given as fraction of patients with infection, with percentages in parentheses.
 Rates were lowest in the AM clipper group (at discharge, $X^2 = 4.894, p < 0.027$; at 30 days, $X^2 = 7.439, p < 0.006$).

Sellick JA, Stelmach M, Mylotte JM. Surveillance of surgical wound infections following open heart surgery. *Infection Control and Hospital Epidemiology* 1991; 12(10):591–596.

Participants: All adults undergoing open heart surgery in 1988 and 1989.

Intervention: Changed from razor preoperative hair removal to clipper preoperative hair removal in January 1989.

Results: Deep sternotomy wound infections decreased significantly from 1.2% in 1988 to 0.2% in 1989 ($p = 0.010$) and deep venectomy (vein donor site) wound infections declined from 1.6% to 0.4% ($p = 0.014$) during the same time period. Incisional wound infection rate did not change. The percentage of gram-negative organisms causing wound infections decreased from 56.3% in 1988 to 34.7% in 1989 ($p = 0.017$).

Conclusion: Preoperative hair removal using a clipper appears to have decreased the risk of deep wound infection compared with razor preparation.

We conclude that electrical clipping is superior to manual shaving in the prevention of suppurative mediastinitis.

Timing of hair removal affects infection rate

Just as shaving is a factor in increased risk of infection, so is timing of the hair removal. Infection rates are lower when hair removal is performed immediately prior to the surgical procedure. The following articles support the concept of hair removal just before surgery.

Jepsen OB, Bruttomesso KA. The effectiveness of preoperative skin preparations: An integrative review of the literature. *AORN Journal*. 1993;58:477–484.

Other researchers compared the effects of two hair removal methods (e.g., hair removal with a safety razor, electric clippers) on postoperative wound infection rates.² Wound infection rates decrease when patient's hair is clipped the morning of surgery ...the timing of hair removal has a direct influence on infection rates, which tend to increase as the time between hair removal and surgery increases.¹ If hair removal is necessary, it should be done immediately before surgery.

1. Seropian R, Reynolds BM, "Wound infections after preoperative depilatory versus razor preparation." *American Journal of Surgery*. 1971;121(3):251–254.

2. Alexander JW, Aerni S, Plettner JP. "Development of a safe and effective one-minute preoperative skin preparation." *Archives of Surgery*. 1985;120(12):1357–1361.

Alexander JW, Fischer JE, Boyajian M, et al. The influence of hair-removal methods on wound infections. *Archives of Surgery*. 1983;118:347–352.

The AM clipper method was associated with significantly fewer infections than were [PM clipper, or AM/PM razor], both at discharge and at 30-day follow-up.

Cost comparisons

While definitive studies comparing the product costs and the additional hospitalization and treatment costs associated with post-operative infections are not available, the articles below support the concept that clipping is more cost-effective than shaving.

Alexander JW, Fischer JE, Boyajian M, et al. The influence of hair-removal methods on wound infections. *Archives of Surgery*. 1983;118:347–352.

The influence of preoperative shaving vs. clipping on wound infection rate was studied in 1,013 patients undergoing elective operations at a single hospital. Patients were prospectively randomized to be either shaved or clipped the night before or the morning of operation.

The AM clipper method was associated with significantly fewer infections than were [PM clipper, or AM/PM razor], both at discharge and at 30-day follow-up.

By calculating the average additional hospital stay associated with treatment of infection associated with other types of hair removal, the authors concluded that for each 1,000 patients

treated, a savings of approximately \$270,000 could be realized if the AM clipper method replaced shaving for preoperative hair removal. The use of clippers for preoperative hair removal has been shown to reduce infection rates compared to infection rates in surgical patients who were shaved. The articles below present comparative data on infection rates in surgical patients whose incision sites were clipped rather than shaved.

Assuming that at least half of surgical patients have hair removed, if preoperative shaving were abandoned in favor of hair removal by AM clipper or depilatory, the annual savings in the United States could be more than \$3 billion.

Hamilton HW, Hamilton KR, Lone FJ. Preoperative hair removal. *Canadian Journal of Surgery*. 1977;20:269–275.

The cost of using clippers was reported by Hamilton et al. to be less than half that of using a razor and 11 times less than using a depilatory.

Health economics evidence statements

National Institute for Health and Clinical Excellence (NICE). *Surgical Site Infection: Prevention and Treatment of Surgical Site Infection*. National Collaborating Centre for Women's and Children's Health (UK). London: Oct 2008.

There is evidence from the literature that the use of razors to remove patients' hair prior to surgery is not cost-effective.

Evidence from a decision-analytic model showed that the use of electric clippers for preoperative hair removal was cost-effective when compared with no hair removal, shaving using razors, or depilatory cream. The use of electric clippers was not only found to generate more quality-adjusted life years (QALYs) but was also found to be less expensive than these two interventions.

***How-to Guide: Prevent Surgical Site Infections*. Cambridge, MA: Institute for Healthcare Improvement; 2012. (Available at www.ihl.org). SSI Prevention: Four Components of Care, Component 2: Appropriate Hair Removal.**

When hair must be removed to safely perform the procedure, it should never occur with a razor. It is preferable to use clippers rather than shaving with a razor as this results in fewer surgical site infections.

The use of clippers has been found to be the best method in many hospitals, as depilatory creams can cause skin reactions. Staff must be trained in the proper use of clippers because an untrained user can damage the skin. If hair must be removed preoperatively, it is generally recommended that this not occur in the operating room itself, as loose hairs are difficult to control.

Professional recommendations

Despite a body of literature demonstrating the superiority of hair clipping, some hospitals and physicians are finding it difficult to move away from the practice of the preoperative shave. The articles below demonstrate the professional support for a change in this practice of shaving.

Mangram AJ, Horan TC, Pearson ML, et al. Guideline for Prevention of Surgical Site Infection, 1999. *Journal of Infection Control*. April 1999;27(2):97–134.

The CDC rates clipping immediately before the operation as a preferred method of hair removal with a Category IA ranking. Category I recommendations... are those recommendations that are viewed as effective by HICPAC and experts in the fields of surgery, infectious diseases, and infection control. Both Category IA and IB recommendations are applicable for, and should be adopted by all healthcare facilities.

National Institute for Health and Clinical Excellence (NICE). *Surgical Site Infection: Prevention and Treatment of Surgical Site Infection*. National Collaborating Centre for Women's and Children's Health (UK). London: Oct 2008.

If hair has to be removed, use electric clippers with a single-use head on the day of surgery. Do not use razors for hair removal, because they increase the risk of surgical site infection.

Clinical Care Improvement Strategies: Preventing Surgical Site Infections. Joint Commission Resources, Inc., Joint Commission on Accreditation of Healthcare Organizations; eBook, 2010; pp 19. Sidebar 2-1: National Patient Safety Goal Requirement for Preventing Surgical Site Infections, Elements of Performance for NPSG.07.05.01, Practice 8.

When hair removal is necessary, use clippers or depilatories.
Note: Shaving is an inappropriate hair removal method.

Recommended Practices for Preoperative Patient Skin Antisepsis. In: AORN Preoperative Standards and Recommended Practices. Denver, CO. Association of periOperative Registered Nurses, 2009:550.

Recommendation IV.b.2. If the presence of hair will interfere with the surgical procedure and removal is in the best interest of the patient... hair should be clipped using a single-use electric or battery-operated clipper, or a clipper with a reusable head that can be disinfected between patients. Clipping hair the morning of surgery has resulted in fewer surgical site infections than shaving or clipping the day before surgery.

Centre for Healthcare-Related Infection Surveillance and Prevention (CHRISP), Queensland Health, Australia. *Signal Infection Surveillance Manual Section 4*, October 2008, pg. 8.

Where possible, surgery without hair removal is preferable unless the hair at or around the incision site will interfere with the operation. Clipping with electric clippers is the preferred method of hair removal and should be done as close as practical to the time of surgery, preferably immediately before the operation.

Government of Western Australia Department of Health, Western Australia (WA) Safety and Quality Investment for Reform (SQuIRe) Implementation Guide, 2007.

- It is inappropriate to remove surgical site hair by shaving
- It is appropriate to remove surgical site hair with clippers or depilatory
- It is appropriate not to remove surgical site hair

Sherertz RJ, Streed SA, Gledhill KS. Surgical site infections. In *APIC Infection Control and Applied Epidemiology*. St. Louis, MO: Mosby;1996:11-1 to 11-5.

Depilatory or clipping in preference to shaving for hair removal at operative site.

Sellick JA, Stelmach M, Mylotte JM. Surveillance of surgical wound infections following open heart surgery. *Infection Control and Hospital Epidemiology*. 1991;12(10):591–596.

Study results have prompted the American College of Surgeons to recommend either no hair removal or morning-of-surgery hair clipping at the surgical site.

Changes that result in improvement

How-to Guide: Prevent Surgical Site Infections. Cambridge, MA: Institute for Healthcare Improvement; 2012. (Available at www.ihl.org) SSI Prevention: Four Components of Care, Component 2: Appropriate Hair Removal.

Hundreds of hospital teams across the United States have developed and tested process and system changes that allowed them to improve performance on the appropriate hair removal measure.

Some of these changes are:

- Ensure adequate supply of clippers and train staff in proper use
- Use reminders (such as signs and posters)
- Educate patients not to self-shave preoperatively
- Remove all razors from the entire hospital
- Work with the purchasing department so that razors are no longer purchased by the hospital

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- Contact your local 3M sales representative
- Call the 3M Health Care Customer Helpline at 800-228-3957
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