

3M™ Surgical Clipper

Bibliography



3M *Innovation*

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Key concepts

The problem of post-operative 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 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.

The problem of post-operative 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, 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.**

“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 aneurysms, and resections of cardiac tumors.”

Table 1. 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) |
| Other | 188 | 0 |
| Total | 1,980 | 17 (0.86) |

CABG = coronary artery bypass grafting;
VR = valvular replacement.

- **Alexander JW, Fischer JE, Boyajian M, Palmquist J, Morris MJ. The influence of hair-removal methods on wound infections. *Archives of Surgery* 1983; 118:347-352.**

Overall infection rates, and infection rates according to type of operation, were tabulated for 1013 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 |
|----------------|------------------|
| 45/1013 (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's risk of wound infection.”

- **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.**

“Violations of the skin barrier by shaving with a razor has 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.

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

“. . .patients 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.”

- **Alexander JW, Fischer JE, Boyajian M, Palmquist J, Morris MJ. 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 1013 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 as noted in table 2.

Table 2. 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 | 45/1013 (4.4%) | 74/977 (7.6%) |

* Rates are given as fraction of patients with infection, with percentages in parentheses.

Rates were lowest in the AM clipper group (at discharge, $X^2 = 4.894$, $p < .027$; at 30 days, $X^2 = 7.439$, $p < .006$).

- **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; $p = 0.024$).”

The authors concluded that electrical clipping is superior to manual shaving in the prevention of suppurative mediastinitis.

Table 3. Risk Factors for Sternal Wound Infection

| Factor | Incidence (%) | p Value |
|----------|---------------|---------|
| Shaving | 13/990 (1.3) | 0.02 |
| Clipping | 6/990 (0.6) | |

- **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 ($p = .010$) and deep venectomy (vein donor site) wound infections declined from 1.6% to 0.4% ($p = .014$) 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 ($p = .017$).”

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

Timing of hair removal effects 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.**

“The incidence of postoperative wound infection also varies depending on the length of time between the prep and the beginning of the surgery. The infection rates in this study¹ were 3.1% when the prep was performed just before surgery, 7.1% when the prep was performed during the 24 hours before surgery, and 20% when the surgery was performed more than 24 hours before surgery.”

“Other researchers compared the effects of two hair removal methods (e.g., hair removal with a safety razor, electric clippers) on postoperative wound infection rates². Wound infection rates decrease when patients 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 increases³. If hair removal is necessary, it should be done immediately before surgery.”

¹ Seropion Reynolds, “Wound infections after preoperative dep. talory - vs - razor preparation.” 251-254.

² Alexender, Aerni, Plettner, “Development of a safe and effective one-minute preoperative skin preparation,” 1357-1361.

³ Seropion Reynolds, “Wound infections after preoperative dep. talory - vs - razor preparation.” 251-254.

- **Sacred Cow Survey; *OR Manager* 1996; 12(9):1-6.**
“The Association of Operating Room Nurses (AORN) recommends that when done, hair removal should be performed as close to the time of the procedure as possible and outside the room where the operation will be done.”
- **Alexander JW, Fischer JE, Boyajian M, Palmquist J, Morris MJ. 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.” (See Table 2;page 5)

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, Palmquist J, Morris MJ. 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 1013 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.” (See Table 2;page 5)

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 1000 patients treated, a savings of approximately \$270,000 could be realized if the AM clipper method replaced shaving for preoperative hair removal.

“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. *Can J Surg* 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.”

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.

- **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.

- **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.**

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

- **Sacred Cow Survey; *OR Manager* 1996; 12(9):1-6.**

“The Association of Operating Room Nurses (AORN) recommends that when done, hair removal should be performed as close to the time of the procedure as possible and outside the room where the operation will be done.”



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70-2009-3378-9