3M Infection Prevention Solutions

3M™ Surgical Clippers Bibliography
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 postoperative 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.


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.


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.

<table>
<thead>
<tr>
<th>Incidence of Sternal Wound Infection</th>
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<tbody>
<tr>
<td><strong>Operation</strong></td>
</tr>
<tr>
<td>----------</td>
</tr>
<tr>
<td>CABG</td>
</tr>
<tr>
<td>VR</td>
</tr>
<tr>
<td>VR + CABG</td>
</tr>
<tr>
<td>Others</td>
</tr>
<tr>
<td><strong>Total</strong></td>
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</tbody>
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CABG = coronary artery bypass grafting
VR = valvular replacement


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

<table>
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<th>Total Infections</th>
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<tr>
<td><strong>Discharge</strong></td>
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<tr>
<td>45/1,013 (4.4%)</td>
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*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.


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.

**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.


- 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.


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.


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.


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).

<table>
<thead>
<tr>
<th>Risk Factors for Sternal Wound Infection</th>
<th>Incidence (%)</th>
<th>p Value</th>
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<tbody>
<tr>
<td>Shaving</td>
<td>13/990 (1.3)</td>
<td>0.02</td>
</tr>
<tr>
<td>Clipping</td>
<td>4/990 (0.4)</td>
<td></td>
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</tbody>
</table>
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...

<table>
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<th>Overall Infection Rates*</th>
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<tbody>
<tr>
<td>Hair Removal Method</td>
</tr>
<tr>
<td>PM razor</td>
</tr>
<tr>
<td>AM razor</td>
</tr>
<tr>
<td>PM clipper</td>
</tr>
<tr>
<td>AM clipper</td>
</tr>
<tr>
<td>Total</td>
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* 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, $X^2 = 7.439, p<0.006$).

**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. 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. If hair removal is necessary, it should be done immediately before surgery.


**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.
Cost comparisons

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


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.


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


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.


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.


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.


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.


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


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.


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.


- 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


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


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


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

For more information about the 3M Surgical Clipper Professional 9681 or other 3M Health Care products:

- Contact your local 3M sales representative
- Call the 3M Health Care Customer Helpline at 800-228-3957
- Visit 3M.com/infectionprevention