Prevalence of Surgical Site Infection in Two Methods of Patients Preoperative Preparation

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Abstract
Surgical site infections are the second most common nosocomial infections. As surgical site infection is the cause of significant mortality and morbidity in patients, recognition of risk factors and routes of decreasing their incidence is of considerable value. In this study, 1383 orthopaedic operations, which were conducted from 1999 to 2000 in Shariati Hospital, were reviewed. There were two groups of patients: In the first group, the patients were shaved on the day before operation and in operating room, after application of betadine 7.5%, the patients were painted with betadine 10% before the operation. In the second group, shaving and painting (without scrub) was done in the operating room just before surgery. The prevalence of surgical site infection in these two groups was recorded. Statistical analysis with T-test and Chi-square methods revealed that although overall surgical site infection prevalence in two groups was the same, but the prevalence of deep infection in group two was significantly lower than that of group one (P<0.01). This difference leads to a decrease in therapeutic cost of approximately 560,000,000 Riyals each year in this country.

Key words: Surgical site infection, shaving, scrub.

Introduction
Since 1865, when Joseph Lister demonstrated the incredible implications of antisepsis in the practice of orthopedic surgery, major surgical procedures were performed with a reasonable expectation of primary wound healing and recovery. Indeed, surgery as we know it today would be impossible in an environment in which infection was likely or, once established, untreatable.

Despite efforts to prevent infection, however, it is estimated that between 500,000 to 920,000 surgical wound infections complicate the approximately 23 million surgical procedures performed annually in the United States.

In other reviews, it is estimated that Surgical Site Infections (SSI) develop in 2 to 5% of the 15 million patients undergoing surgical procedures each year. They account for about 24% of all nosocomial infections, making it the second most common site of nosocomial infections (second only to UTI). These infections prolong hospital stay by an average of 7.4 days. It doubles the mortality rate, too.

By definition, infection affecting the surgical site and occurring within 30 days of the operation, or within one year after implant surgery, is named SSI.
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A widely accepted system of classification of operative sites by the degree of contamination is presented below:

1. **Clean**: These are sites in which no inflammation is encountered and the respiratory, alimentary, genital and urinary tracts are not encroached upon. Operations that follow nonpenetrating trauma should be included in this category.

2. **Clean – Contaminated**: These are sites in which the respiratory, alimentary, genital, or urinary tracts are breached under controlled conditions.

3. **Contaminated**: These include open, fresh accidental wounds with major breaks in sterile technique.

4. **Dirty and infected**: These include old traumatic wounds with retained devitalized tissue, foreign bodies, or focal contamination.

In a study, surgery involving clean, clean-contaminated, contaminated and dirty surgical sites had infection rates of 1.5%, 7.7%, 15.2% and 40%, respectively.

Microbiologically, *Staphylococcus aureus* and coagulase-negative *Staphylococci* are the two common pathogens isolated largely from clean wounds. In other wound types pathogens are often polymicrobial. In the recent years infections involving MRSA (Methicillin Resistant *Staphylococcus Aureus*) or fungi, have become more common because of the increasing number of immunocompromised patients.

Pathogens that cause SSI are required either endogenously (80%) from the patient’s own flora or exogenously (20%) from contact with operating room personnel or the environment.

*S. aureus* and coagulase-negative microorganisms, are inhabitants of skin, and presumably, they are directly inoculated into the operative site during incision or subsequent manipulation.

Cleansing and the use of skin degemming agents during preparation for surgery are currently routinely performed, and they are expected to reduce the surface population of these organisms. Exogenous routes included personnel, surgery team, environment and air have less important roles in SSI.

Risk factors for SSI occurrence include: preoperative admission time, preoperative shaves, length of operation and host factors.

Because of importance of endogenous routes and skin flora, preoperative skin preparation, has an important role in the prevention of SSI. It has been shown that shaving, one day before surgery, can increase the rate of infection.

It has been shown that shaving more than 12 hours before surgery can increase SSI rate up to 7%. Disruptions in the skin barrier caused by razor, permits and increase in colonization or actual invasion with either resident or exogenous microorganisms at the incision site.

The infection rate is greater than 20% when patients were shaved more than 24 hours before surgery. In other studies, patients who were neither shaved nor clipped had the lowest rate of infection. If shaving is necessary, studies suggest that it should be performed immediately before the operation. On the other hand, although microbiologic data exist to confirm that preoperative skin preparation agents do reduce the amount of skin colonization there are no trials to show that this has led to a reduction in the number of surgical infections. Two studies suggest that the usual skin site preparation may be unnecessary.

In this study, we evaluated the rate of infection in the two mentioned methods and compared them with each other.

### Patients and Methods

This retrospective cohort study was carried out on the orthopaedic clean surgeries performed at Shariati hospital in Tehran during 1999 to 2000 period.

Exclusion criteria included:

1. Non-clean wounds
2. Prolonged hospital stay (> 7 days)
3. Underlying disorder (malnutrition, diabetes, etc.)
4. Existence of remote infection
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Preoperative patient preparation has been performed by two different methods on orthopaedic patients. In the first group (Classic method) one day before surgery, the patient is shaved with razor in the ward and then in the operating room the patient is prepared with betadine 7.5% and then painted with betadine 10% and after draping, the operation is started.

In the second group, the patient is shaved immediately before surgery in the operation room with electrical clipper and then painted with spraying of betadine 10% - alcohol solution and after draping the operation is started. Other conditions were the same.

**Figure-3:** The Sexual Distribution of cases with and without Shaving (+S, -S), (P=0.12)

**Figure-1:** The Frequency of Type of Surgery In Patients With and Without Wound Infection (P=0.04)

**Figure-4:** Type of Surgery in Patients with and without Shaving

**Figure-2:** The Age Average in Patients with Shaving (+S) and without Shaving (-S), (P=0.12)

**Figure-5:** The frequency of Wound Sepsis with Shaving (+S) and without Shaving (-S) Methods (P=0.78)
All patients without exclusion criteria were entered into the study. The occurrence of infection (superficial and deep) was inspected in the postoperative period till one year postoperatively.

Results
The study was carried out on 1383 patients who did not have exclusion criteria. The overall infection rate (superficial and deep) was 3.47%. Superficial and deep infection rates were 2.5% and 0.94% respectively. From other points, the overall infection rate was 1.63% in elective surgery and 5.55% in trauma surgery. (Fig-1)

Statistical analysis revealed no significant difference in age, sex and type of surgery (elective or trauma) (Fig. 2, 3, 4).

Surgical site infection was the same in two groups, (Fig. 5) but the rate of deep infection in group 2 was significantly lower than that of group 1 (Fig. 5) (P<0.01) although the difference in superficial infection was not statistically significant (Fig. 7). On the other hand in the infected patients the trauma surgery was significantly higher compared to that of elective surgery, (Fig. 1)

Discussion
It has been shown that surveillance and infection rate report, decrease surgical site infection in surgical wards. The lack of such studies in orthopaedic patients motivated us to investigate about it in the recent 3 years.

As noted previously, the overall infection prevalence in these patients was 3.47%. In the literature, depending on the study, this value varies significantly, but it has been reasonably estimated to be between 2 to 5%. Thus, the overall infection rate of this study is approximately similar to that reported in the literature.

From other points, superficial and deep wound infection rates were 2.5% and 0.94% respectively. Deep infection in the clean surgery should be less than 1 to 2%. On the other hand, elective patients became infected in 1.63% of cases and this value was 5.55% for trauma surgery. High infection rate for trauma surgery makes it reasonable that trauma surgery should not be a true clean surgery. The causes might be as follows:

1. In these patients, soft tissue contusion, multiorgan involvement and low immunity level make them vulnerable to infection.
2. Preoperative host factors control (such as remote infection control, balance of nutrition and electrolytes, etc) are not as ready and accessible as elective patients.
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3. These patients need frequent admission in intensive care units and then are rapidly colonized with gram-negative and resistance strains of bacteria. Orthopedic surgery most frequently is delayed until stabilization of general condition and discharge from ICU, when the risk of infection is highest. Thus, it should not be forgotten that orthopaedic surgery in multitrauma patients could be done without any delay.

In the comparison of the two different preoperative methods, mentioned above, 1383 patients were included, of them 780 cases were operated in group 1 and 603 in group 2. Comparison of these two groups showed no significant statistical differences in age, sex and surgical procedures. (Figure 2,3,4) and this means that the two groups were matched.

Overall infection rate was 3.59% in group 1 and 3.32% in group 2. The difference was not statistically significant (Fig. 5). When the infection was divided into superficial and deep, it was estimated that deep infection was significantly lower in group 2 in comparison with the classic group (P=0.01, Fig. 6). In other words, deep infection rate was 1.54% and 0.17% in groups 1 and 2, respectively. (12 cases of deep infection in group 1 and only 1 case in group 2). The superficial infection rate was the same in both groups. (Fig. 7)

Preoperative shaving with razor the day before surgery, with the creation of skin abrasion and microflora colonization, not only increases the likelihood of SSI, but also necessitates time-consuming steps of scrubbing with Betadine 7.5% without any protective effect on SSI prevention. Bringing about a heavy cost on the therapeutic budget of our country.

It is estimated that, preparation of the patient with the first method costs 30210 Riyals in each patient. On the other hand, each 10 minutes consumed for scrubbing the patient, costs approximately 300,000 Riyals for the operating court and the personnel, summing up 330210 Riyals. According to published data from Ministry of health's research deputy, in the year 2000, 1300000 operations were performed in public section in Iran. As we know, 30% of therapeutic load of the country goes to private sector, rising the figure to 1700000 operations per year, resulting in an annual cost of 560,000,000,000 Riyals in whole country.

By other means, by increasing the hospital stay, each wound sepsis results in 11600 Riyals increase in patients' costs each day and the newer antibiotics and laboratory tests that will be needed for eradication of infection plus the indirect social and psychological costs will add to the total cost. By annihilating the need for costly procedures and decreasing the rate of wound infection, the saving amount can be directed to other deprived areas in health sector.

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References
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