

# Infections in traumatic wounds sutured at a Norwegian Accident and Emergency Department

**BACKGROUND** Different countries have different wound treatment traditions. We have studied the incidence and different factors related to infections in wound injuries sutured at a Norwegian A&E department.

**METHOD** In this prospective study, clinical data were collected on 102 patients with traumatic wound injuries treated with sutures at Bergen Accident and Emergency Department between 30 February 2011 and 30 June 2011. Any wound infections in 97 of these patients at the time of suture removal were assessed and classified according to severity on a scale of grade 0 to grade 4.

**RESULTS** There were no serious infections, but mild clinical wound infections occurred in 15 % of patients: 11 % grade 1 and 4 % grade 2 infections. Patients less than 65 years old had often cut themselves with knives ( $n = 33$ , 37 %), and on their hands ( $n = 60$ , 67 %). Men were most frequently injured at work ( $n = 38$ , 54 %) and women most often at home ( $n = 18$ , 56 %). No statistically significant correlation was found between the incidence of wound infections and the length of the wound, the time elapsed before suturing, the wound's location on the body, contamination or underlying chronic diseases. Two of the three self-inflictors in our study had clinical wound infections. Half of the bacteriological samples from ten of 15 wounds with clinical infection had plentiful growth of *Staphylococcus aureus*. One patient received oral antibiotic treatment for wound infection, and two had local antibiotic treatment.

**INTERPRETATION** Mild clinical infections were found in almost one of six wounds sutured at a Norwegian A&E department. More studies are necessary to provide basic data to enable targeted improvements in wound treatment in the primary healthcare service.

## Introduction

Wound management in different countries is characterised by local traditions and policies. In many countries it is more common to use topical antibiotics and broad spectrum oral antibiotics than it is in Norway (1, 2). Therefore, most studies of traumatic wounds sutured outside hospitals compare the effect of different types of topical antibiotics on wound infections. Wound infection rates vary from 1 % to 31 % (3–7) in these studies.

The definition of infection in sutured lacerations is not used consistently in all studies, making comparisons difficult. It is therefore important to conduct national studies that take into account both local traditions and current science-based guidelines and definitions.

Today, there are good records of infection rates in wounds sutured in hospitals after surgical operations. The percentage of skin infections in operation wounds in Norwegian hospitals varies from 4 % (hip replacements) to 18 % (intestinal operations) (8). Records of this kind provide good background information for making targeted improvements, but are seldom used for traumatic wounds treated outside hospital. Spe-

cial registration forms for this purpose have been developed and validated in the United States (4), but are not used very much as yet.

We are not aware of previously published studies that have looked at the proportion of sutured traumatic wounds treated at Norwegian A&E departments. The purpose of this study was to investigate the prevalence of wound infections at a large Norwegian A&E department.

## Material and method

The study was conducted from 16 February 2011 to 30 June 2011. All patients over 18 years old attending Bergen Accident and Emergency Department (A&E) with a traumatic laceration involving partial or full skin thickness, and an indication for wound closure with sutures, were considered for inclusion. Exclusion criteria were as follows: wounds more than eight hours old (12 hours for the face), bite wounds, deep wounds with additional injuries to bone, tendons, nerves or major vessels, lack of competence to give consent, inability to keep appointment for a subsequent wound inspection, and use of oral antibiotic treatment the week prior to the laceration.

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*The article is based on a student's thesis at the Faculty of Medicine, University of Bergen.*

## MAIN POINTS

Mild infections occurred in 15 % of wounds sutured at a large Norwegian A&E department

Wounds located on the hands and face were most numerous, but had the lowest percentage of infections compared with other parts of the body.

More and larger studies are necessary in order to provide basic data for enabling targeted improvements in wound treatment in the primary healthcare service.

**Table 1** Factors recorded at the first consultation

| Patient factors    | Wound factors   | Treatment factors   |
|--------------------|---|---|
| Age                | Size  | Disinfection, cleansing of wounds or revision before suturing |
| Gender             | Location  | Number of sutures   |
| Chronic disease    | Hours before treatment at A&E                                       | Local or oral antibiotics                                     |
| Regular medication | Contamination with foreign material (soil, gravel, rust or similar) |   |
| Pregnancy          | Injury mechanisms, including object causing the injury and location |   |

Patients coming for treatment at night were often influenced by alcohol or other stimulants, reducing their competence to give their consent for participation in the study and to keep appointments for subsequent wound inspection and removal of stitches. Therefore, we chose to include only patients treated during the daytime and evening. Because of time constraints, the inclusion period was restricted to 4.5 months. Strength calculations were not performed ahead of the initiation of the study.

Wound management and treatment of infections was in accordance with normal clinical practice at Bergen A&E, according to the department's own method book, which is based on the Norwegian A&E

Manual (9). Acute wound injuries were cleansed with sterile saline. Intact skin around the wound was disinfected with chlorhexidine/alcohol and covered with sterile sheets before suturing. Injuries contaminated with foreign material were mechanically cleansed with sponges or sterile brushes. Necrotic tissue was revised before suturing.

Suturing was performed by the physician on call. Individual sutures were used with a thickness depending on the location of the injury and wound size. The thinnest suture material, with thickness 5-0, was used for the face, and was removed after five days. On the back and on body locations with tension, thicker suture material (3-0 or 4-0)

were used, and stitches were removed after 12–14 days. Sutures in other places on the body were removed after 10 days. Non-resorbable monofilament nylon (Ethilon) was used. Lacerations less than two cm in length, with little diastasis and little tension in the tissues around the injury, adapted with tape or tissue glue. These injuries were therefore not included in the study.

We used a semi-structured questionnaire with both cross-setting and free text. Patient Information about patient factors were filled in by the patient him- or herself at the first consultation at Bergen A&E. The attending doctor, nurse or both filled in wound and treatment factors at this consultation (Table 1).

Patients were given an appointment for removal of stitches at Bergen A&E. A specific examination for wound infection was made at this check-up. The doctor used an internationally applied and validated classification system (3, 4) to grade the infection as follows:

0 – no sign of infection.

1 – simple pus pockets in stitches (pustules/suture abscesses) and possibly redness with a radius of less than 1 cm.

2 – redness/swelling around wound with a radius of 1 cm or more (cellulitis).

3 – red stripe and/or tender lymph nodes (lymphangitis/lymphadenitis).

4 – fever and chills (systemic symptoms).

According to the study protocol, a bacteriological test with resistance determination was to be taken in case of clinical signs of wound infection (i.e. infection grade 1 or higher).

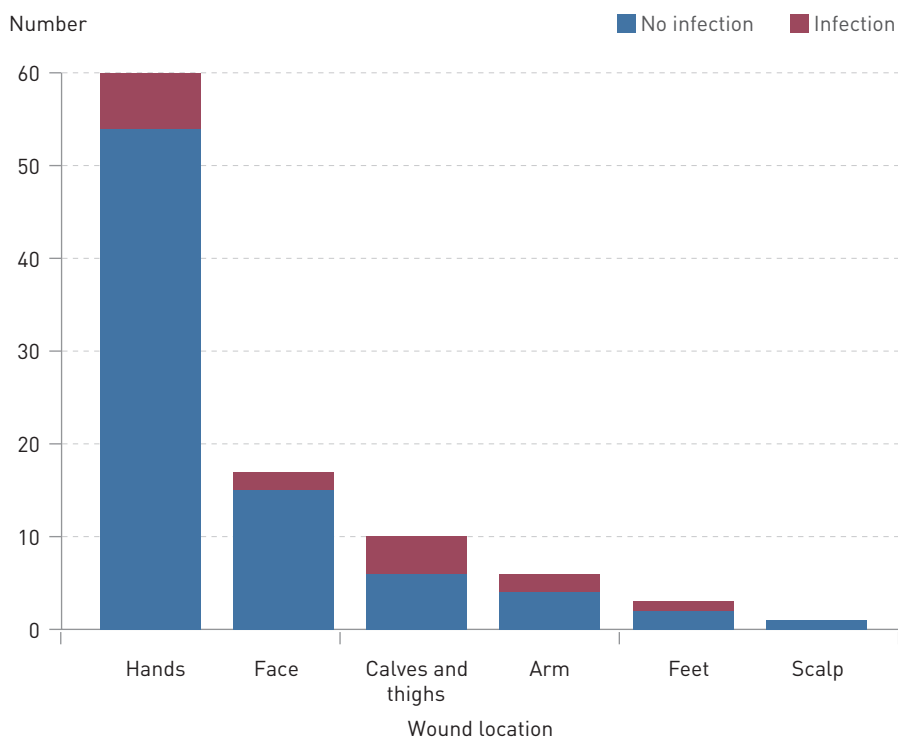
If the registration form was inadequately completed, we searched in the electronic patient journal (EPJ) of the enrolled patient for supplemental data concerning the current wound injury. If patients did not keep appointments for removal of stitches, we contacted them by phone and graded any wound infection on the basis of the information provided by the patient.

The data from the questionnaires were recorded and processed using SPSS statistical software version 17. Descriptive statistics were used to describe the injuries. A significance level of 5% was chosen ( $p < 0.05$ ). We used the Pearson chi-square test in cross tables to compare the groups, and Fisher's exact test when one or more cells contained fewer than five patients.

The study was approved by the Regional Ethics Committee West (REK Vest).

## Results

During the study period 103 patients fulfilled the inclusion criteria. One patient did not want to participate. Therefore, 102 patients were included, 70 men and 32 women. The



**Figure 1** Number of infections by body location in 97 wounds sutured at Bergen A&E from February to June 2011

mean age was 37.7 years (range 18–87 years). The wounds were 2.4 hours old on average (range 0.5 to 10 hours). The average wound length specified by the doctor or nurse was 3.0 cm (range 1–13 cm). The average number of sutures per patient was 4.1 (range 1–11). One patient's laceration was also adapted with subcutaneous absorbable sutures.

Approximately one in three had knife injuries. Three of the injuries were due to self-mutilation, one to violence, and the rest to accidents. Seventy-two had tried to cleanse and bandage the wounds before contacting the emergency department. Forty-six patients had wounds contaminated with foreign matter. Most wounds were located on the hands and face (Figure 1). Eight had a chronic disease and/or used regular medication that could influence the risk of wound infections or complications (diabetes, immunosuppressive or anti-coagulant treatment, or the like).

Most patients under 65 years old had knife injuries ( $n = 33$ , 37%) on their hands ( $n = 60$ , 67%), while most of the older patients hurt themselves on asphalt/stair/stone ( $n = 4$ , 50%) and in the face ( $n = 5$ , 63%). Men were more often injured at work ( $n = 38$ , 54%) and women more frequently at home ( $n = 18$ , 56%). Significantly more men than women were injured at work ( $p < 0.0001$ ).

Six patients were prescribed preventive oral antibiotic therapy after suturing, but none was treated with topical antibiotics.

Sutures were removed on average 10.5 days later (range 5–15 days). Eighty-two patients came to have stitches removed at Bergen A&E and any wound infections were assessed and graded. Twenty patients did not come, but we had phone interviews with 15 of them, on average 15 weeks (range 4–34 weeks) after suturing. We were unable to obtain information on the remaining five patients. Overall, we recorded 15 infections among the 97 sutured wound injuries (15%) that we were able to evaluate, three of which were described by the patients themselves in phone interviews.

Eleven (11%) wounds were classified as grade 1 infections, four (4%) as grade 2 infections and none were grade 3 or grade 4 infections. One patient with a grade 1 infection in a finger received oral antibiotic treatment with dicloxacillin after the sutures had been removed. Two patients, with grade 1 and grade 2 infections respectively, received topical antibiotics (bacitracin and fusidic acid ointment). The remaining patients received no antibiotic treatment. Wounds on the hands and face had the lowest percentage of infections, with 10% ( $n = 6$ ), and 12% ( $n = 2$ ) respectively. The percentages of infections in wounds on the upper and lower limbs exclu-

ding hands were higher, 33% ( $n = 2$ ) and 38% ( $n = 5$ ) respectively (Figure 1). There was no significant difference in infection risk between wounds located on the face and head as compared with the extremities (Table 1).

Three patients had wounds caused by self-harm. Two of these developed grade 2 infections.

Bacteriological samples were taken from ten of the 15 wounds with a clinical infection. In two samples we found only growth of normal skin flora and in two there was no bacterial growth. In five there was abundant growth of *Staphylococcus aureus*, and in the sixth gram negative rods. Determination of the resistance of the yellow staphylococci revealed resistance to penicillin in four out of five. We also looked for differences in infection rates between wounds that were sutured three hours after the injury and wounds that were sutured later, but found no significant difference (Table 2). Nor was there any difference between wounds classified as clean or contaminated before wound management. Similarly, there was no significant correlation between the risk of wound infection and the patient's age, sex, or the presence of chronic diseases. Of the six patients who received prophylactic oral antibiotic therapy after suturing because of initially contaminated wounds, one patient developed a grade 1 clinical infection. However, the bacteriological test showed no growth of bacteria.

## Discussion

This is the first Norwegian study to examine clinical wound infections in sutured traumatic wounds treated in a large A&E department. More than 33,000 lacerations are sutured in a primary healthcare setting each year in Norway (10). Applying an internationally used definition and severity grading, we have found that 15% of patients developed wound infections, but none of them were serious. In studies from the US and the UK, which used the same wound infection classification (3, 4), the proportion of infections varied between 3.5% and 18% percent. However, both local and oral prophylactic antibiotic therapy was used more often than in Norway.

In one study (4), patients who received topical antibiotics had the lowest infection rate (4.5%), while those without antibiotics had an infection rate of 18%. This percentage is closer to our finding.

In our study, 6% of patients received prophylactic oral antibiotic treatment, while this was given to 14% in a study from the United States (3). In this study, an infection rate of 3.5% was found. However, almost half of the patients had been through phone interviews, and the injury was not defined as

**Table 2** Percentage of wound infections by patient gender, age and wound factors in 97 wounds sutured at Bergen A&E from February to June 2011

| Variables                         | Number of wounds | Percentage of wound infections (95% CI) |
|-----------------------------------|------------------|---|
| <b>Gender</b>                     |                  |   |
| Female                            | 32               | 25 (9–41)                               |
| Male                              | 65               | 11 (3–19)                               |
| <b>Age</b>                        |                  |   |
| < 65 years                        | 89               | 16 (8–23)                               |
| ≥ 65 years                        | 8                | 13 (0–42)                               |
| <b>Time from injury to suture</b> |                  |   |
| < 3 hours                         | 67               | 18 (9–28)                               |
| ≥ 3 hours                         | 30               | 10 (0–21)                               |
| <b>Length of wound</b>            |                  |   |
| < 3 cm                            | 40               | 18 (5–30)                               |
| ≥ 3 cm                            | 57               | 14 (5–23)                               |
| <b>Contaminated wounds</b>        |                  |   |
| No                                | 51               | 14 (4–24)                               |
| Yes                               | 46               | 17 (6–29)                               |
| <b>Chronic disease</b>            |                  |   |
| No                                | 89               | 15 (7–22)                               |
| Yes                               | 8                | 25 (0–64)                               |
| <b>Wound location</b>             |                  |   |
| Face/head                         | 17               | 12 (0–29)                               |
| Limbs                             | 80               | 16 (8–25)                               |

a wound infection unless the patient had received oral antibiotic treatment.

One of our patients received oral antibiotic treatment because of an infection detected at the time of removing the stitches. None of our patients received topical antibiotics as preventive treatment, but two received topical antibiotics because of a diagnosed wound infection. This is in accordance with Norwegian national guidelines for antibiotic therapy in general practice, which recommend restrictive use of local antibiotics (11).

We used a clinical severity classification of sutured wound infections. This classification has been validated in American studies (3, 4), but not in a Norwegian translation or under Norwegian conditions. It is difficult to distinguish between normal inflammation around sutures and grade 1 wound infection. Centers for Disease Control and Prevention in the USA, which monitor hospital infections, do not recommend calling pustules or mild redness around sutures infections (12). However, in three patients with these symptoms (grade 1 infection) we had abundant growth of *Staphylococcus aureus* from the wound edges, while in two other patients only normal skin flora were present. The latter may well be attributable to sampling not being done properly, but this finding may also represent a sterile, non-infectious, local inflammation. Although bacterial growth does not necessarily have to be present to indicate a clinical wound infection, a total of six of these patients had abundant growth of potentially pathogenic bacteria stemming from the wound edges. Estimating the actual number of wound infections is still somewhat uncertain, in view of the fact that two had normal skin flora, two lacked bacterial growth and bacteriological tests were not conducted on five of them.

We found that significantly more men than women acquired lacerations at work, which seems natural since men more often have craft occupations where tools are used. This is also consistent with the finding that younger men more often have knife-cuts on their hands.

In previous studies a higher infection rate has been demonstrated in wounds that are deep, wide and long, with jagged edges, visible contamination or foreign material, and in wounds in the elderly and in diabetics (13–15). In our study, there was no significant correlation between the wound length, length of time before the wound was sutured, location on the body or contamination and the incidence of wound infection. This may be because our study material was too small for any differences to be detected.

Following recommendations in previous textbooks and procedure manuals, we did not include lacerations on the face and head that were more than 12 hours old and other wound locations more than eight hours old (9, 16). Within these time frames, we assessed whether there were different infection rates in wounds that were sutured within three hours or after more than three hours, but we found no such difference. Recent literature and review articles question whether the current time frames advised for primary closure of traumatic wounds are adequately documented. The time limits before suture for suturing certain types of

traumatic wounds could probably be extended without increasing the risk of infections (10, 17).

The wound injuries investigated in our study are characterised by the fact that they were treated during the daytime or evening. Patients with lacerations in need of treatment at night were excluded. This probably resulted in under-representation of traumatic wound types caused by violence and under the influence of alcohol or other stimulants.

Twenty of 102 patients did not come to have their stitches removed at Bergen A&E, but we managed to contact 15 of them by phone. Although the author asked for objective signs of wound infection, the facts that the assessment of infection relied on the patients self-reported findings and that the phone interviews took place after the removal of stitches are weaknesses.

Another weakness of the study is the small number of participants. This has made it difficult to detect significant differences.

### Conclusion

In this study we identified clinical wound infections in almost one of six wounds sutured at our emergency clinic. Bacteriological samples were taken from two-thirds of them, and abundant growth of penicillin-resistant *Staphylococcus aureus* was detected in half of these samples.

Acute wound treatment is performed extensively at emergency clinics and at general practitioners' offices. As with the surgical disciplines, it is important for the primary healthcare service to keep records and conduct analyses of wound injuries and treatment results.

Our study is limited in scope. However, it would be desirable to have similar, but preferably larger and more robust Norwegian studies assessing outcomes after wound treatment in general practice and emergency clinics. Background data of this kind are important for providing a basis for making improvements in and if necessary applying corrective measures to our wound management.

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### Litteratur

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Received 2 December 2013, first revision submitted 3 June 2014, accepted 11 March 2015. Editor: Sigurd Høye.