The Journal of Foot & Ankle Surgery 53 (2014) 173–175

Contents lists available at ScienceDirect

The Journal of Foot & Ankle Surgery

journal homepage: www.jfas.org

Incidence of Surgical Site Infection in the Foot and Ankle with Early Exposure and Showering of Surgical Sites: A Prospective Observation

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ARTICLE INFO

Level of Clinical Evidence: 3

Keywords:
complications
dressings
infection
postoperative
sutures

ABSTRACT

The incidence of postoperative surgical site infection (SSI) reported in the published data for foot and ankle surgery has been 1.0% to 5.3%. A variety of interventions have been used before, during, and after surgery to decrease the patient's risk of acquiring an infection at the surgical site. Foot and ankle surgeons often keep the incision site dry and covered until the sutures and pins have been removed, with the goal of preventing a SSI, despite the lack of available published evidence to support this practice. We undertook a prospective observation of 110 elective surgical patients to determine the rate of SSI when early surgical site exposure and showering were allowed. The risk factors for infection were recorded, and a series of logistic regression analyses was performed to determine the associations between the infection rate and early showering. The patients were evaluated at each postoperative appointment for signs of infection. For the present study, mild infection was defined as the subjective presence of erythema and/or swelling beyond that typically expected in the early postoperative period. These cases of presumed or mild SSI were managed with oral antibiotics until they had resolved. Major infection was defined as any infection altering the course of recovery or requiring admission or additional surgery. The overall infection rate was 4.5%, with all infections considered mild. Logistic regression analysis showed that none of the recorded risk factors significantly predicted infection. The results of the present study suggest that early daily showering of a surgical site after foot and ankle surgery will not be significantly associated with an increased risk of infection.

A variety of interventions have been used before, during, and after surgery to decrease the patient's risk of acquiring an infection at the surgical site. Infection prevention protocols have included using antimicrobial soaps preoperatively, applying skin antiseptic for surgical site preparation, sterile draping of the surgical site, barrier gowns and masks worn by the personnel in the operating room, and careful washing and gloving of the surgeon's hands (1). Currently, systemic preoperative antibiotics have also been universally recommended (2). Foot and ankle surgeons often keep the incision site dry and covered until the sutures and pins have been removed, with the goal of preventing surgical site infection (SSI). Sticha et al (3), in 1998, surveyed 495 board-certified foot and ankle surgeons and reported that 98.6% of this group practiced delayed wound exposure and extended wound coverage. Despite this common practice, no published clinical evidence is available to show that keeping the incision site dry will decrease the risk of SSI after foot and ankle surgery (3,4). We recently undertook a systematic review of water exposure of surgical sites that confirmed that early wound exposure and wetting sutures did not increase the risk of infection in postoperative patients undergoing a variety of surgical procedures (4).

Many technical factors and patient health factors influence the development of SSI. We hypothesized that showering a sutured incision or pin site 3 to 5 days after an elective foot or ankle surgery would not increase the risk of infection. We present the SSI rate from a prospective observation of elective surgical patients who were allowed to shower and keep the surgical sites uncovered starting at the first postoperative visit. Our basis for comparison was the

Financial Disclosure: None reported.
Conflict of Interest: None reported.
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http://dx.doi.org/10.1053/j.jfas.2013.12.021

previously published postoperative infection rate for foot and ankle procedures, which has varied from 1.0% to 5.3% (3,5–8).

Patients and Methods

A prospective case series study was conducted from March 2013 to November 2013. The institutional review board of Des Moines University approved the study protocol before beginning patient enrollment and data collection. Additionally, an a priori power analysis was done. Using Cohen's power tables for effect size (9), we conservatively assumed an effect size of 0.5 and wished to achieve 80% power. Therefore, a minimum sample of 64 patients was required. Because we wanted to examine several potential risk factors, we enrolled additional participants.

Consecutive patients undergoing elective foot and ankle surgery were enrolled from the practices of 2 of us (P.D. and M.F.). No preference was given to the suture material type or internal versus external suture techniques. Patients with external Kirschner wires and external fixators were included. The subjects were screened by the primary investigators (PD, MF) for the following exclusion factors: surgery performed for or because of an infection or abscess of the soft tissue or bone, wounds that were not entirely closed primarily at surgery, open fractures, and lacerations. All patients were allowed to shower after their initial postoperative visit. All patients were given instructions on how to care for their surgical site that specifically included showering only and not submerging or soaking the surgical foot.

At each postoperative appointment, the pain level, signs of inflammation, incision and pin status, and patient perceptions of the difficultly with showering the surgical site were recorded. Redness and swelling were subjectively considered to be signs of early infection in each investigator's professional opinion and were treated with oral antibiotics until they had resolved. Both surgeons used a low threshold for the institution of antibiotics to treat, or prevent, infection in their surgical patients. At the first sign of erythema that might have had the potential to be more than postinflammatory rubor, early antibiosis was used. Major infection was considered any infection altering the course of recovery or requiring admission or additional surgery, including significant cellulitis and/or abscess.

Statistical Analysis

A series of descriptive statistics and frequencies were computed to determine the sample characteristics and overall infection rate. Logistic regression analyses were performed to determine the associations between the known risk factors and the likelihood of infection.

Results

Data were collected from 111 consecutive patients from March 2013 to November 2013. One patient was excluded from the data analysis because the patient did not shower when instructed to do so. This resulted in 110 patients included for the analysis. The mean participant age was 46.91 ± 19.48 years. Of the 110 patients, 34 (31%) were male and 76 (69%) were female. The sample included 21 current smokers (19.1%) and 10 patients with diabetes (9.1%). The overall infection rate was 4.5% (n = 5). The infection rate for patients with external pins was 1.8% (n = 2), and the infection rate for the patients without external pins was 2.7% (n = 3). All infections were considered minor and were treated with oral antibiotics as the only therapy. No patient discontinued showering despite having increased redness and being prescribed an oral antibiotic. None of the patients expressed logistical issues with showering their surgical site, and they were subjectively accepting of this practice. The observations recorded during the study period are listed in Table 1.

A series of logistic regression analyses demonstrated that none of the recorded participant risk factors significantly predicted infection. Participant age, diabetic status, smoking status, the presence of other risk factors, incision length, and the number of pins were all nonsignificantly associated with the likelihood of developing an infection ($p > .15$ for all). In addition, we examined several characteristics present at the first postoperative visit, including postoperative pain, edema, erythema, and drainage. None of these variables predicted the likelihood of infection ($p > .8$ for all). No significant association was found between suture type and the development of SSI (Table 2).

Table 1
Patient and surgical site characteristics (N = 110 patients)

Characteristic	Mean ± Standard Deviation	Range
Age (y)	46.9 (19.4)	11–88
Incision length (cm)	8.0 (4.1)	1–19
Interval until showering (d)	4.1 (1.4)	3–9
Interval until suture removal (d)	22.1 (7.1)	4–45
Interval until pin removal (d)	36.4 (8.4)	19–58
Interval until discharge (d)	42.1 (9.4)	27–77

Discussion

The purpose of the present study was to evaluate the basis of recommending that surgical sites be kept dry during the course of healing after elective foot and ankle surgery. The reported incidence of SSI after foot and ankle surgery has been 1.0% to 5.3% (3,5–8). The infection rate for the present study was 4.5%. No deep infections, no infections requiring incision and drainage, and no infections requiring alternate therapies or changes to the postoperative course developed. In addition, all 5 patients treated with oral antibiotics for presumed early infection continued to shower for the remainder of the observation period. The results of the present study suggest that early and continued water exposure of surgical sites with a shower at an average of 4 days after elective foot and ankle surgery does not pose an increased risk of SSI.

Although our infection rate was 4.5%, all the infections were mild, as defined in the "Patients and Methods" section, with both surgeons using a low threshold for the institution of antibiotics to treat, or prevent, infection in patients who subjectively had greater than normal erythema. At the first sign of erythema that might have had the potential to be more than normal postinflammatory rubor, early antibiosis was used. The incidence of major infection, as defined in the present study, which changed the outcome or necessitated additional surgical care or discontinuance of treatment, was 0%. All patients treated with antibiotics responded favorably to the oral antibiotics. In all cases, whether antibiotics were given or not, the patients continued to shower their surgical site throughout the observation period. These findings provide a strong argument against water exposure being a provocative factor in the development of SSI.

In our 17 patients with external pins, the infection rate was 1.8%. The presence of external pins has generally been thought to be a significant risk factor for infection if exposed to moisture. The present series found no difference in the infection rate between that for the overall patient group of 4.5% (n = 5) and that for the subset with pins of 1.8% (n = 2, $p < .5$). Just as with all surgical complications, the cause of infection at pin sites will be multifactorial. Our findings have

Table 2
Logistic regression analyses testing association between each variable and likelihood of infection after surgery (N = 110 patients)

Variable	β ± SE	Wald	OR	*p* Value	95% CI of OR
Age	0.01 ± 0.03	0.15	1.01	.70	0.96–1.06
Diabetes	0.98 ± 1.17	0.70	2.67	.40	0.27–26.48
Smoker	0.06 ± 1.15	0.00	1.06	.96	0.11–10.02
Other risk factors	0.06 ± 1.15	0.00	1.06	.96	0.11–10.02
Incision length	−0.10 ± 0.12	0.64	.91	.42	0.71–1.15
Suture type	0.17 ± 0.56	0.10	1.19	.76	0.40–3.53
Pins	1.39 ± 0.96	2.11	4.00	.15	0.62–25.98
PO1 pain	−0.05 ± 0.24	0.04	.95	.83	0.60–1.51
PO1 edema	−1.53 ± 0.91	2.85	.22	.09	0.04–1.28

Abbreviations: CI, confidence interval; OR, odds ratio; PO1, first postoperative visit; SE, standard error.
Diabetes, smoker, other risk factors, PO1 pain, and PO1 edema coded as 0 (not present) or 1 (present); suture type coded 0 (absorbable), 1 (nonabsorbable), or 2 (combination).

indicated that water exposure is not a major determinant of SSI. We believe that the surgical technique, tissue handling, and stability play a far larger role in the development of postoperative infection than does water exposure.

We found 3 recent published studies specifically considering the infection rate after foot and ankle surgery. In 1983, Miller (8) reported a 20-year history of 1,841 patients who had undergone foot surgery and reported a gross infection rate of 2.2%. The vast majority of the infections were mild and responded to local treatment and required no additional surgical care. No specific details of the postoperative management were given beyond a bandage change at 48 hours and again at 10 days. Miller (8) reported that most infections occurred more than 2 weeks after surgery. Hugar et al (6), in 1990, reported an infection rate for 138 patients of 1.35% for clean foot and ankle surgery. Infection was diagnosed by positive microbiologic culture, and the postoperative care was not specified. In 1998, Sticha et al (3) noted an infection rate of 1.0% in 100 patients allowed early exposure to water.

The results from our study failed to show a significant association between the infection rate and the incision length, patient age, a diagnosis of diabetes, smoking status, the presence of external fixation, or the suture material type used after elective foot and ankle surgery ($p > .5$). These results indicate that keeping surgical sites bandaged and avoiding water exposure were not provocative factors in the development of SSI even when patients had other health risk factors. Also, the presence of external pins and external nonabsorbable suture material did not affect the overall SSI rate in our group of patients.

Although a randomized, prospective, comparative study would be desirable to draw a stronger association between the infection rates with early and delayed water exposure, our design was affected by practicality. Just as with many surgical studies, we were limited by our personal bias of performing the procedures we believed, through training and experience, were in the patient's best interest. Because of our longstanding practice of early surgical site exposure, we made the decision to not include a dry surgical site control group. In our historical experience, we have recognized a high level of patient satisfaction with being able to shower early and found this to be one of the many benefits. Therefore, we did not believe it would be best for our patients or practice to include a dry surgical control group. This certainly affected our ability to draw direct conclusions. Nevertheless, the results from our case series compared with the historical published SSI rates make a compelling argument for the safety of early wound exposure.

We considered using the historical rate of SSI in foot and ankle surgery as our control for the present study. When evaluating previous studies reporting SSI, the variation in study design and lack of detailed statistical data reporting prevented a meta-analysis, which would have been necessary for an accurate calculation of the historical infection rate across these studies. Thus, simply reporting our SSI rate and discussing the rate compared with that from other published reports was more appropriate.

In conclusion, our results have shown a 4.5% rate of minor SSI and no major infections in 110 patients who were allowed to shower at a mean of 4 days after elective foot and ankle surgery. These data compared favorably with the historical infection rate after foot and ankle surgery. The results of the present study have shown that no basis exists for instructing a patient to keep sutured surgical incisions dry during the healing process.

References

1. Mangram AJ, Horan TC, Pearson ML, Silver LC, Jarvis WR. Guideline for prevention of surgical site infection: Hospital Infection Control Practices Advisory Committee. Infect Control Hosp Epidemiol 20:250–278, 1999.
2. Classen DC, Evans RS, Pestotnil SL, Hormn SD, Menlove RL, Burke JP. The timing of prophylactic administration of antibiotics and the risk of surgical-wound infection. N Engl J Med 326:281–286, 1992.
3. Sticha RS, Swiriduk D, Wertheimer SJ. Prospective analysis of postoperative wound infections using an early exposure method of wound care. J Foot Ankle Surg 37: 286–291, 1998.
4. Dayton P, Feilmeier M, Sedberry S. Does postoperative showering or bathing of a surgical site increase the incidence of infection? A systematic review of the literature. J Foot Ankle Surg 52:612–614, 2013.
5. Wukich DK, McMillen RL, Lowery NJ, Frykberg RG. Surgical site infections after foot and ankle surgery: a comparison of patients with and without diabetes. Diabetes Care 34:2211–2213, 2011.
6. Hugar DW, Newman PS, Hugar RW, Spencer RB, Salvino K. Incidence of postoperative infection in a free-standing ambulatory surgery center. J Foot Surg 29: 265–267, 1990.
7. Donley BG, Philbin T, Tomford JW, Sferra JJ. Foot and ankle infections after surgery. Clin Orthop Relat Res 391:162–170, 2001.
8. Miller WA. Postoperative wound infection in foot and ankle surgery. Foot Ankle 4: 102–104, 1983.
9. Cohen J. *Statistical Power Analysis for the Behavioral Sciences*, ed 2, Lawrence Erlbaum Associates, New Jersey, 1988.