

# Multidose prophylactic IV antibiotics do not lower the risk of surgical site infection for isolated closed ankle fractures

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## Abstract

**Objectives:** To compare the surgical site infection (SSI) rates in ankle fracture patients receiving either single preoperative intravenous (IV) dose (SD) or multidose 24 hours IV postoperative (MD) perioperative IV antibiotic prophylaxis.

**Design:** Retrospective case-control study.

**Setting:** Level I Trauma Center.

**Patients/Participants:** Three hundred fourteen patients with isolated ankle fractures, OTA classifications 44A1-3, 44B1-3, and 44C1-3, who presented to our institution between January 2012 and June 2016.

**Intervention:** Operative fracture fixation with either the administration of SD or MD perioperative IV antibiotic prophylaxis.

**Main outcome measurements:** SSI.

**Results:** Three hundred fourteen patients met all study criteria. There were 99 patients in the SD group with a mean age of 44.2 years and 215 patients in the MD group with a mean age of 47.7 years. The overall SSI rate was 5.1% in the SD group versus 2.8% in the MD group ( $P = .312$ ). The superficial SSI rate was 2.0% in the SD group versus 1.4% in the MD group not significant (NS). The deep SSI rate was 3.0% in the SD group versus 1.4% in the MD group (NS).

**Conclusion:** The SSI rates in isolated closed ankle fractures receiving either SD or MD perioperative IV antibiotic prophylaxis were similar. Further studies should be considered to help guide the standard of care for perioperative IV antibiotic prophylaxis.

**Level of evidence:** Therapeutic Level III retrospective case-control study.

**Keywords:** ankle fracture, antibiotics, inpatient, outpatient, surgical site infection

## 1. Introduction

Infection in orthopaedic surgery is one of the most dreaded complications. It is associated with prolonged morbidity, disability, and increased mortality. SSI in clean wounds includes incisional and organ space infections. Out of nearly 30 million operations in the United States every year, more than 2% are complicated with SSIs.<sup>[1]</sup> Americans sustain approximately

250,000 ankle fractures per year accounting for roughly 10% of all fractures.<sup>[2]</sup> The majority of patients have good outcomes; however, there are a range of potential complications depending on the severity of the injury and patient comorbidities. Reported SSI rates range from 0% to 32% following ankle fractures.<sup>[3-5]</sup> Meta-analyses of SD versus MD antibiotic use have failed to demonstrate a statistically significant difference in infection rates in the setting of operatively treated long bone fracture.<sup>[6-10]</sup> The duration and dosage of prophylactic IV antibiotics vary, in particular, when comparing the outpatient regimen for patients being discharged immediately after surgery (single preoperative IV dose, SD) versus the inpatient regimen for patients remaining in the hospital postoperatively (multidose 24 hours IV postoperative, MD). The purpose of our study was to compare the SSI rates in ankle fracture patients receiving either SD or MD perioperative IV antibiotic prophylaxis.

## 2. Methods

Following institutional review board approval, we retrospectively reviewed the medical records of 314 patients with isolated ankle fractures and OTA classifications 44A1-3, 44B1-3, and 44C1-3, from January 2012 to June 2016 at our institution. Patient exclusion criteria included age less than 18 years, follow-up less than 3 months, open injury, concomitant fractures, or patients who had received oral antibiotics upon hospital discharge.

Data analysis included demographics, risk factors for SSI (diabetes mellitus, body mass index >30, immunosuppressive

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states, and tobacco), postoperative IV antibiotic regimen, development of SSI (superficial/deep), medical complication rate, length of hospital stay, and length of follow-up. All patients received preoperative antibiotics within 1 hour before incision and tourniquet inflation per our institutional protocols and confirmed in the surgical time-out. Weight-based cefazolin was utilized for all patients unless they had an allergy in which case weight-based clindamycin was utilized. We utilized the US Centers for Disease Control guidelines and defined superficial SSI as those requiring local wound care and oral antibiotics, and deep SSI as those requiring return to operating room for debridement. Medical complications included acute kidney injury, urinary tract infection, gastrointestinal issues, venothromboembolism, pneumonia, and cardiac issues. Univariate analyses were conducted using one-way analysis of variances for continuous data and Chi-square tests of independence and Fisher exact tests for categorical data. The significance level was set at  $P = .05$ . A post-hoc power analysis using a small/moderate effect size demonstrated sufficient power ( $1 - \beta = .87$ ). All analyses were conducted using SPSS version 22.0 (IBM Corp, Armonk, New York).

### 3. Results

Three hundred fourteen patients met all study criteria (Table 1). There were 99 patients in the SD group with a mean age of 44.2 years and 215 patients in the MD group with a mean age of 47.7 years. The overall SSI rate was 5.1% in the SD group versus 2.8% in the MD group ( $P = .312$ ). The superficial SSI rate was 2.0% in the SD group versus 1.4% in the MD group (NS). The deep SSI rate was 3.0% in the SD group versus 1.4% in the MD group (NS). The groups were similar with regard to risk factors for infection (smoking, diabetes mellitus, obesity, and medical complications). Patients in the MD group were more likely to be female ( $P = .028$ ) and they had a longer stay in hospital ( $P < .001$ ). There was a trend for more bimalleolar fractures in the MD group ( $P = .067$ ).

### 4. Discussion

Considerable evidence suggests that antibiotics may be used excessively in the prevention and treatment of SSIs.<sup>[11,12]</sup> Antimicrobial prophylaxis reduces the risk of SSIs and may reduce the danger of other types of infectious complications. Timing of prophylaxis is crucial to success, yet antibiotics are often administered at the wrong time or for too long, with implications for the cost of patient care. More principled use of antibiotics is likely to benefit the treatment of future surgical patients.<sup>[11–14]</sup> An increasing number of surgical procedures are being performed on an outpatient basis, including many fracture cases. Therefore, further studies are warranted to help elucidate best practices for responsibly decreasing the risk of SSI while not overutilizing antibiotics and potentially causing individual patient complications or contributing to more widespread bacterial resistance.

According to a Cochrane review (21 randomized, controlled studies), IV antibiotic prophylaxis reduces the incidence of deep infection from 4.3% to .4%.<sup>[10]</sup> The concentration of antibiotics in circulation reaches its maximum level 20 minutes after the dosing. Therefore, antibiotics should be administered 30 minutes before the surgical incision. There is no consensus on the appropriate duration of prophylaxis—several meta-analyses have been conducted to compare the effect of SD versus MD

**Table 1**

**Descriptive comparisons, single dose versus multidose; N = 314.**

	Single-dose only n=99	Multidose n=215	Statistical significance
Gender (% male)	56.6%	43.3%	$\chi^2 = 4.816$ $P = .028$
Age mean years (standard deviation)	44.2 (17.3)	47.7 (19.2)	$P = .346$
Smoking status (%)			
Former	10.1%	10.7%	$P = .807$
Current	26.3%	29.4%	
Never	63.6%	59.8%	
Body mass index (%)			
<30	62.0%	62.9%	$P = .882$
≥30	38.0%	37.1%	
Diabetic (%)	9.1%	12.6%	$P = .370$
Length of stay mean days (standard deviation)	2.3 (2.3)	4.1 (3.7)	$t = .5379$ $P < .001$
Fracture type count (%)			
Medial malleolus	1 (1.0%)	8 (3.7%)	$P = .067$
Lateral malleolus	12 (12.2%)	26 (12.1%)	
Bimalleolar	28 (28.6%)	90 (42.1%)	
Trimalleolar	40 (40.8%)	69 (32.2%)	
Posterior malleolus	1 (1.0%)	3 (1.4%)	
Other	16 (16.3%)	18 (8.4%)	
Infection rate count (%)			
Overall infection	5 (5.1%)	6 (2.8%)	$P = .312$
Superficial infection	2 (2.0%)	3 (1.4%)	
Deep infection	3 (3.0%)	3 (1.4%)	
Medical complications (%)	7.2%	6.1%	$P = .711$

treatment, without conclusion. It has been estimated that a total of 25,000 patients are needed to show the superiority of either of the treatment options. According to a recent study, single dosing is more cost-effective than multiple dosing in infection prophylaxis of closed long bone fractures.<sup>[6]</sup>

Infection after operative treatment of ankle fractures is a challenging problem. To our knowledge, there has not been a study comparing the SSI rates in ankle fracture patients receiving either SD or MD perioperative IV antibiotic prophylaxis. The SSI rates in isolated closed ankle fractures receiving either SD or MD perioperative IV antibiotic prophylaxis were similar in our study of well-matched comparative groups.

The strengths of the study include single-center study, infection rate that was consistent with previously published studies, well-powered, isolated fracture, and similar patient groups. The major limitation of our study is the retrospective nature and all inherent associated limitations, including incomplete documentation and records for excluded cases. Although the groups were similar with regard to injury and treated by the same group of surgeons, there might be a difference in the surgical approaches utilized that was not recognized (i.e., more dual approaches). Also, the surgical times were not accurately recorded in all cases and could not be analyzed. In addition, some of the SD groups were admitted to the hospital for over 24 hours before undergoing surgical fixation (thus explaining the length of stay in this group). The inclusion in the SD versus MD group was multifactorial and not randomized. Also, we did not elucidate any specific untoward antibiotic reactions.

In conclusion, the SSI rates in isolated closed ankle fractures receiving either SD or MD perioperative IV antibiotic prophylaxis are similarly low. Further studies should be considered to help guide standard of care for perioperative IV antibiotic prophylaxis.

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