Fracture-Related Infection: The Impacts of Smoking on Patient Outcomes

Zuhair J. Mohammed[1], Evan G. Gross[1], Karen J. Carter[1], Elizabeth M. Benson[1], Gerald McGwin[1], Alexander Mihas[1], Austin C. Atkins[1], Clay A. Spitler[1], Joey P. Johnson[1]
[1]University of Alabama at Birmingham, Birmingham, AL
zuhair.j.mohammed@gmail.com

Disclosures: Zuhair J. Mohammed (N), Evan G. Gross (N), Karen J. Carter (N), Elizabeth M. Benson (N), Gerald McGwin (N), Alexander Mihas (N), Austin C. Atkins (N), Clay A. Spitler (N), Joey P. Johnson (N)

INTRODUCTION: Smoking negatively impacts bone metabolism, which may lead to increased risk of fracture, fracture nonunion, and postoperative infection. While previous studies have investigated the impact of smoking on the incidence of fracture-related infection (FRI), there is a paucity of literature comparing the patient presentation, hospital course characteristics, or postoperative outcomes of smoking versus non-smoking patients with FRI. We sought to understand how smoking status impacts patient presentation, treatment course, and fracture resolution in patients with FRI.

METHODS: We performed a single-institution retrospective analysis of all patients undergoing reoperation for FRI from January 2013 to April 2021. Data including patient demographics, original fracture characteristics, infection presentation, hospital course characteristics, and post-infection outcomes were collected via review of the electronic medical record. Patients were grouped based on current smoker versus non-smoker status and their hospital course and postoperative outcomes were compared.

RESULTS SECTION: A total of 301 patients, comprised of 155 (51.5%) current smokers and 146 (48.5%) non-smokers, undergoing FRI reoperation were included. Compared to non-smokers, current smokers were younger at the time of FRI reoperation (41.7 years vs. 49.5 years, $p < 0.001$), had lower mean BMI (27.2 vs. 32.0, $p < 0.001$), had a lower prevalence of diabetes mellitus (12.9% vs. 25.3%, $p = 0.008$), and were more likely male (69.0% vs. 56.2%, $p = 0.024$). On univariate analysis, current smokers had a higher proportion of methicillin-resistant Staphylococcus aureus (MRSA) infection (29.7% vs. 19.2%, $p = 0.044$), a lower proportion of Staphylococcus epidermidis infection (11.0% vs. 19.9%, $p = 0.037$), a higher risk of radiographic nonunion at 6 months following index fracture surgery (74.1% vs. 60.8%, $p = 0.018$), and higher risk of sinus tracts at FRI presentation (38.0% vs. 22.6%, $p = 0.004$) compared to non-smokers. On multivariable analysis, smoking remained an independent risk factor for sinus tract development at FRI presentation (OR 2.66, $p = 0.008$) and radiographic nonunion at 6 months following index fracture surgery (OR 2.00, $p = 0.034$).

DISCUSSION: Among patients who develop FRI, current smoking status is associated with a higher proportion of MRSA infections and higher incidence of fistula or sinus tract formation and radiographic nonunion. Changes in bone metabolism resulting from the molecular impacts of smoking and nicotine usage can help explain some of the risks noted.

SIGNIFICANCE/CLINICAL RELEVANCE: This is one of the first studies to examine the specific risks and outcomes in fracture-related infections in smokers, building upon previous work examining infections after operative fixation and prosthetic joint infections.

REFERENCES:

1. Makihara K, Takegami Y, Tokutake K, et al. Risk factors for fracture-related infection after open reduction and internal fixation of proximal humerus fractures: A multicenter retrospective study of 496 fractures (TRON group study). Injury. 2022;53(7):2573-2578. doi:10.1016/j.injury.2022.05.022
2. Trampuz A, Zimmerli W. Diagnosis and treatment of infections associated with fracture-fixation devices. Injury. 2006;37 Suppl 2:S59-66. doi:10.1016/j.injury.2006.04.010
3. Meng H, Xu B, Xu Y, Niu H, Liu N. Incidence and risk factors for surgical site infection following volar locking plating (VLP) of unstable distal radius fracture (DRF). J Orthop Surg. 2022;17(1):549. doi:10.1186/s13018-022-03440-7
4. Moriarty TF, Metsemakers WJ, Morgenstern M, et al. Fracture-related infection. Nat Rev Dis Primer. 2022;8(1):67. doi:10.1038/s41572-022-00396-0

IMAGES AND TABLES:

FRI outcomes	Current smokers (n = 155)	Non-smokers (n = 146)	p-value
Time from initial fracture surgery to infection presentation, mean ± SD (days)	714.1 ± 1556.4	539.7 ± 1023.3	0.270
MRSA infection	46 (29.7%)	28 (19.2%)	**0.044**
MSSA infection	31 (20.0%)	19 (13.0%)	0.122
Staphylococcus epidermidis infection	17 (11.0%)	29 (19.9%)	**0.037**
Radiographic nonunion at 6 months following index fracture surgery	106 (74.1%)	93 (60.8%)	**0.018**
Sinus tract at FRI presentation	59 (38.0%)	33 (22.6%)	**0.004**
Wound dehiscence at FRI presentation	52 (33.6%)	42 (28.8%)	1.000
Purulent drainage at FRI presentation	96 (61.9%)	84 (57.5%)	0.481
Implant exchange due to FRI	68 (49.6%)	74 (58.3%)	0.175
Amputation due to FRI	15 (9.9%)	12 (8.3%)	0.690

Table 3. Univariate analysis comparing risk factors and outcomes of current smokers versus non-smokers