Non-tobacco Nicotine Dependence and Postoperative Complications Following Operative Fixation of Tibial Shaft Fractures: A Retrospective Cohort Analysis

Alexander N Berk, Maislin C Bogart, Cyrus F Eghtedari, Logan Good, Samuel Florentino, Robert John Burkhart, George Ochenjele, Robert Joseph Wetzel, Joshua Kyle Napora

INTRODUCTION:

While tobacco use is known to impair wound healing and increase complications after tibial shaft fractures, the impact of non-tobacco nicotine dependence (NTND) remains unclear. With the rising use of alternative nicotine delivery systems such as e-cigarettes and nicotine pouches, this study aims to evaluate the effect of NTND on outcomes following operative fixation of tibial shaft fractures.

METHODS:

The TriNetX database was queried to identify patients aged 18 and older who underwent operative fixation of closed tibial shaft between January 2004 and January 2024. Open fractures and polytrauma patients were excluded. Patients were categorized into two cohorts: those with preoperative NTND and those with no history of nicotine use. Cohorts were propensity-matched by age, gender, race, ethnicity, BMI, and comorbidities. Ninety-day major medical complications and two-year procedure-related complications were assessed.

RESULTS:

A total of 25,528 patients undergoing operative fixation of tibial shaft fractures were identified and met inclusion criteria, of which 2,701 had a documented history of NTND. After 1:1 propensity score matching, both cohorts included 2,570 patients. Within the 90-day postoperative period, the NTND group experienced significantly higher rates of deep surgical site infection (RR 1.60, 95% CI 1.05–2.43; p = 0.026) and ED visits (RR 1.68, 95% CI 1.44–1.96; p<0.001). No differences in the rates of deep vein thrombosis, pulmonary embolism, myocardial infarction, superficial surgical site infection, compartment syndrome, or death were noted. At 2-year follow-up, rates of deep surgical site infection (RR 1.55, 95% CI 1.17–2.07; p = 0.002), osteomyelitis (RR 2.16, 95% CI 1.47–3.18; p<0.001), hardware removal (RR 1.28, 95% CI 1.10–1.48; p = 0.002), hardware failure (RR 1.54, 95% CI 1.12–2.18; p = 0.007), and death (RR 1.90, 95% CI 1.43–2.53; p<0.001) were higher amongst the NTND group. No difference was observed in the rates of malunion, nonunion, or revision fixation.

DISCUSSION AND CONCLUSION:

Non-tobacco nicotine dependence is associated with significantly increased rates of deep surgical site infection, hardware-related complications, and mortality following operative fixation of tibial shaft fractures. These findings suggest that NTND may confer similar risks to traditional tobacco use and should be considered when counseling patients and assessing perioperative risk.

Table 1. Baseline Demographics and Comorbidities

	Before Propensity Matching			After Propensity Matching		
	NTND (n =2,701)	Control (n = 22,827)	*p*-value	NTND (n = 2,570)	Control (n = 2,570)	*p*-value
Demographics						
Age	41.7 ± 15.8	42.0 ± 20.2	0.465	41.6 ± 15.8	41.2 ± 16.8	0.350
BMI	27.4 ± 6.4	28.3 ± 7.0	<0.001	27.4 ± 6.4	27.7 ± 6.5	0.220
Female	701 (27.3)	8,021 (37.7)	<0.001	701 (27.3)	667 (26.0)	0.283
White	1,757 (68.3)	14,250 (66.9)	0.153	1,757 (68.4)	1,762 (68.6)	0.881
Black	502 (19.5)	2,837 (13.3)	<0.001	500 (19.5)	494 (19.2)	0.832
Hispanic or Latino	255 (9.9)	2,961 (13.9)	<0.001	255 (9.9)	269 (10.5)	0.519
Comorbidities						
Diabetes Mellitus	227 (8.8)	1,918 (9.0)	0.763	227 (8.8)	193 (7.5)	0.083
Heart Failure	104 (4.0)	769 (3.6)	0.27	102 (4.0)	87 (3.4)	0.266
Chronic Kidney Disease	110 (4.3)	930 (4.4)	0.832	110 (4.3)	86 (3.3)	0.081
Liver Disease	31 (1.2)	122 (0.6)	<0.001	30 (1.2)	27 (1.1)	0.690
Alcohol Use Disorder	329 (12.8)	681 (3.2)	<0.001	327 (12.7)	326 (12.7)	0.967
Anxiety	322 (12.5)	1,916 (9.0)	<0.001	321 (12.5)	302 (11.8)	0.417
Depression	122 (4.7)	911 (4.3)	0.273	122 (4.7)	103 (4.0)	0.195

All data are presented as mean ± SD or n (%) unless otherwise specified. *Statistically significant with p≤0.05. Abbreviations: BMI, Body Mass Index; Fx, Fracture; OA, osteoarthritis; standardized mean difference; THA, total hip arthroplasty

Table 2. 90d Complications in 1:1 Propensity Matched NTND versus Control Cohorts

Complication	NTND (n = 2,570)	Control (n = 2,570)	RR	95% CI	*p*-value
DVT	1.71%	2.22%	0.77	0.52-1.14	0.191
PE	1.32%	1.67%	0.79	0.51-1.24	0.301
MI	0.51%	0.62%	0.81	0.39-1.69	0.576
Stroke	1.75%	1.52%	1.15	0.75-1.77	0.509
Pneumonia	2.57%	1.71%	1.50	1.03-2.19	0.034
AKI	2.45%	2.45%	1.00	0.71-1.41	1.00
ABLA	6.89%	7.32%	0.94	0.77-1.15	0.550
Sepsis	1.32%	1.21%	1.10	0.68-1.78	0.708
Superficial SSI	0.51%	0.58%	0.87	0.41-1.82	0.705
Deep SSI	2.18%	1.36%	1.60	1.05-2.43	**0.026**
ED Visit	14.86%	8.87%	1.68	1.44-1.96	**<0.001**
Rehospitalization	14.13%	1311.00%	1.08	0.94-1.24	0.290
Compartment Syndrome	1.52%	1.32%	1.15	0.72-1.18	0.556
Death	1.44%	0.90%	1.61	0.96-2.70	0.069

All data are presented as % of cohort unless otherwise specified. Abbreviations: ABLA, acute blood loss anemia; AKI, acute kidney injury; CI, confidence interval; ED, emergency department; MI, myocardial infarction; PE, pulmonary embolism; RR, relative risk; SSI, surgical site infection

Table 3. 2y Complications in 1:1 Propensity Matched NTND versus Control Cohorts

Complication	NTND (n = 2,570)	Control (n = 2,570)	RR	95% CI	*p*-value
Deep SSI	4.48%	2.88%	1.55	1.17-2.07	**0.002**
Osteomyelitis	3.11%	1.44%	2.16	1.47-3.18	**<0.001**
Malunion	0.58%	0.74%	0.79	0.40-1.55	0.789
Nonunion	3.81%	4.36%	0.88	0.67-1.14	0.324
Hardware removal	13.15%	10.31%	1.28	1.10-1.48	**0.002**
Hardware failure	3.66%	2.37%	1.54	1.12-2.18	**0.007**
Revision fixation	4.05%	3.35%	1.22	0.91-1.60	0.183
Death	5.10%	2.69%	1.90	1.43-2.53	**<0.001**

All data are presented as % of cohort unless otherwise specified. Abbreviations: CI, confidence interval; RR, relative risk; SSI, surgical site infection