Nicotine Exposure and Surgical Risk: Comparing Tobacco and Non-Tobacco Nicotine Dependence in Ankle Arthrodesis

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INTRODUCTION: There have been many studies showing the negative impacts of cigarette smoke on orthopedic post-surgical outcomes; however, the impacts of nicotine in other forms, such as vaping, nicotine gum, and nicotine patches is less documented. The purpose of this study is to review the impact of non-tobacco nicotine dependence (NTND) use on postoperative outcomes in the ankle arthrodesis population. We hypothesize that NTND will be associated with increased postoperative risk of adverse outcomes.

METHODS: The TriNetX Global Collaborative Network was used to create a retrospective cohort study of patients who underwent an ankle arthrodesis and had a preoperative diagnosis of tobacco/nicotine dependence, NTND, or no dependence. Propensity-matching was performed based on the factors of age, gender, ethnicity, race, body mass index and hemoglobin A1c as well as diagnoses of essential hypertension, hyperlipidemia, type 2 diabetes mellitus, peripheral vascular disease, chronic obstructive pulmonary disease, fibrosis and cirrhosis of the liver, alcohol dependence, and end stage renal disease. Outcomes were analyzed within 90 days (hospital readmission, infection, sepsis, delayed wound healing, myocardial infarction, pulmonary embolism, deep vein thrombosis, anemia) and 2 years (infection, sepsis, nonunion of fracture, pseudoarthrosis) of the ankle arthrodesis surgery. Analyses were done comparing tobacco/nicotine dependence with NTND, NTND with no dependence, and tobacco/nicotine dependence with no dependence use via three chi-square analyses with statistical significance set at $p< 0.05$.

RESULTS: In the NTND vs no dependence 90-day analysis (n=5,263), the NTND cohort showed significantly higher rates of hospital readmission, infection, MI, and delayed wound healing rates as compared to the no dependence cohort. In the NTND vs no dependence 2 year analysis (n= 5,272), the NTND cohort had higher rates of pseudoarthrosis, infection, sepsis, and nonunion. In the tobacco vs no dependence 90 day analysis (n=8,880), the tobacco cohort had significantly higher rates of hospital readmission, infection, MI, and delayed wound healing. In the tobacco 2-year analysis (8,896), tobacco/nicotine cohort showed higher rates of pseudoarthrosis, infection, sepsis, and nonunion. In both the NTND vs tobacco/nicotine 90 day (n=5,313) and 2-year (n=5,272) analysis, there were no statistically significant differences. See Table 1 below.

DISCUSSION: Both tobacco use and NTND are associated with significantly worse short-term and long-term postoperative outcomes when compared to patients with no nicotine exposure. At 90 days, the tobacco/nicotine and NTND cohorts showed higher rates of hospital readmission, infection, myocardial infarction, and delayed wound healing when compared to the no dependence cohort. At the 2-year interval, both nicotine-exposed cohorts also showed elevated risks for pseudoarthrosis, infection, sepsis, and nonunion, suggesting that nicotine exposure, regardless of delivery method, is detrimental to postoperative recovery and overall health outcomes. Given the increasing popularity of alternative nicotine deliveries, these non-significantly different findings between tobacco/nicotine and NTND highlight the importance of including NTND in preoperative assessments and counseling. Further research is needed regarding associations between negative health outcomes and NTND when compared to tobacco related nicotine delivery. Limitations include reliance on CPT and ICD-10 codes from the TriNetX global database.

SIGNIFICANCE/CLINICAL RELEVANCE: These findings emphasize that the postoperative risks associated with non-tobacco nicotine dependence are comparable to those of traditional tobacco dependence, demonstrating the need for comprehensive preoperative screening for all forms of nicotine dependence to improve patient outcomes.

IMAGES AND TABLES:
Table 1. Comparison of NTND, Tobacco/Nicotine, and No Dependence Outcomes at 90 days and 2 years

Cohorts	Timeframe	Outcomes	Odds Ratio	Risk Ratio	P-value	Timeframe	Outcomes	Odds Ratio	Risk Ratio	P-value
NTND vs No Dependence	90 days	Hospital Readmissioin	1.24	1.183	<0.0001	2 years	Pseudoarthrosis	1.17	1.127	0.0006
		Infection	1.363	1.347	0.0028		Infection	1.43	1.401	<0.0001
		MI	1.741	1.733	0.0147		Sepsis	1.236	1.225	0.0332
		Delayed Wound Healing	1.287	1.271	0.0042		Nonunion	1.454	1.429	<0.0001
		Sepsis	1.231	1.227	0.2128					
		Pulmonary Embolism	1.052	1.051	0.8224					
		Anemia	1.088	1.083	0.3594					
		DVT	0.862	0.864	0.3672					
Tobacco/Nicotine vs No Dependence	90 days	Hospital Readmissioin	1.278	1.214	<0.0001	2 years	Pseudoarthrosis	1.193	1.15	<0.0001
		Infection	1.564	1.539	<0.0001		Infection	1.542	1.502	<0.0001
		MI	1.664	1.659	0.0095		Sepsis	1.455	1.434	<0.0001
		Delayed Wound Healing	1.402	1.378	<0.0001		Nonunion	1.422	1.403	<0.0001
		Sepsis	1.201	1.198	0.1768					
		Pulmonary Embolism	1.11	1.109	0.5453					
		Anemia	1.048	1.046	0.5139					
		DVT	0.947	0.948	0.6625					
NTND vs Tobacco/Nicotine	90 days	Hospital Readmissioin	0.995	0.996	0.9103	2 years	Pseudoarthrosis	1.003	1.002	0.9469
		Infection	1.023	1.022	0.8118		Infection	1.003	1.003	0.9697
		MI	1	1	1		Sepsis	1.017	1.016	0.8544
		Delayed Wound Healing	1.007	1.006	0.9345		Nonunion	0.993	0.993	0.9321
		Sepsis	1.013	1.012	0.9371					
		Pulmonary Embolism	0.977	0.977	0.9143					
		Anemia	1.004	1.004	0.9647					
		DVT	0.973	0.974	0.8694					