

Preoperative Malnutrition Doubles Risk of Infection and Amputation After Ankle ORIF: A Multicenter Propensity-Matched Study Highlighting an Underrecognized and Modifiable Risk Factor

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INTRODUCTION:

Malnutrition is a frequently underrecognized but potentially modifiable risk factor, especially in trauma patients presenting to community hospitals. Despite its known impact on surgical recovery, routine nutritional screening is often omitted in orthopedic trauma workflows. Malnourished patients are at heightened risk of impaired wound healing, infection, thromboembolic events, and delayed recovery. In the context of ankle fractures—one of the most common lower extremity injuries this study aims to quantify the impact of preoperative malnutrition on postoperative complications following open reduction and internal fixation (ORIF).

METHODS:

We performed a retrospective cohort study using a multi-institutional electronic health record-derived database. Adult patients undergoing ankle ORIF between 2004 and 2022 were included if preoperative labs were available and a minimum of 2 years of follow-up was recorded. Malnutrition was defined by either serum transferrin <204 mg/dL or leukocyte count <1,500/μL within 3 months prior to surgery. A 1:1 propensity score-matched analysis was conducted to balance demographic and clinical variables. Outcomes included 90-day complications (infection, thromboembolic events, myocardial infarction, transfusion, amputation) and 2-year complications (hardware removal, device infection, post-traumatic osteoarthritis, nonunion, and amputation).

RESULTS: A total of 46,843 patients who underwent ankle ORIF were identified, of whom 3,453 were classified as malnourished based on preoperative laboratory values. After 1:1 propensity score matching, malnourished patients demonstrated significantly higher rates of postoperative complications compared to controls. At 90 days, malnourished patients had increased rates of hardware removal (5.0% vs 3.0%; RR 1.68, 95% CI 1.32–2.13, $P<0.001$), device infection (1.5% vs 0.9%; RR 1.67, 95% CI 1.06–2.61, $P=0.025$), myocardial infarction (0.7% vs 0.3%; RR 2.45, 95% CI 1.17–5.12, $P=0.014$), pulmonary embolism (1.1% vs 0.6%; RR 1.88, 95% CI 1.08–3.28, $P=0.024$), deep vein thrombosis (1.7% vs 0.9%; RR 1.80, 95% CI 1.16–2.79, $P=0.007$), and transfusion (3.1% vs 1.0%; RR 3.21, 95% CI 2.18–4.73, $P<0.001$). The risk of amputation was also significantly elevated at 90 days (0.6% vs 0.3%; RR 2.11, 95% CI 0.99–4.47, $P=0.047$). At 2-year follow-up, malnourished patients continued to show increased risks of hardware removal (17.5% vs 15.7%; RR 1.11, 95% CI 1.00–1.24, $P=0.045$), device infection (3.6% vs 1.7%; RR 2.05, 95% CI 1.51–2.78, $P<0.001$), and amputation (1.5% vs 0.4%; RR 4.09, 95% CI 2.23–7.49, $P<0.001$). There were no statistically significant differences between groups in the rates of nonunion, stroke, or post-traumatic osteoarthritis at either time point ($P>0.05$).

DISCUSSION AND CONCLUSION:

This multi-center propensity-matched study demonstrates that preoperative malnutrition is a significant and independent predictor of both short- and long-term complications following ankle ORIF. Malnourished patients experienced up to a fourfold increased risk of serious outcomes, including device infection, transfusion, myocardial infarction, and amputation, with complications persisting through 2-year follow-up. These findings underscore the critical yet under appreciated role of nutritional status in orthopedic trauma outcomes. Given the high volume of ankle fractures treated nationwide and the substantial burden of complications associated with malnutrition, these results support the integration of nutritional optimization protocols into preoperative planning for orthopedic trauma patients, especially in non-academic or resource-limited settings.

Table 1: Patient demographics pre and post 1:1 propensity matching:

Variable	Pre Matched			Post Matched		
	Malnutrition	Control	P-value	Malnutrition	Control	P-value
Age at index	67.6 (7.7)	65.9 (8.3)	<0.001	67.4 (7.7)	67.6 (7.7)	0.626
Male	1,502 (34.6%)	17,234 (39.7%)	<0.001	1,194 (34.6%)	1,215 (35.2%)	0.596
Female	2,174 (62.8%)	24,842 (66.8%)	<0.001	2,159 (62.8%)	2,147 (62.3%)	0.769
Not Hispanic	2,720 (78.3%)	30,881 (71.5%)	<0.001	2,899 (78.3%)	2,716 (78.8%)	0.618
Hispanic	260 (8.3%)	5,231 (12.1%)	<0.001	289 (8.4%)	262 (8.5%)	0.897
White	2,636 (75.9%)	30,327 (69.9%)	<0.001	2,815 (75.8%)	2,640 (76.8%)	0.48
Black	463 (13.3%)	6,103 (14.1%)	0.222	461 (13.4%)	450 (13.1%)	0.866
American Indian	13 (0.4%)	209 (0.5%)	0.213	13 (0.4%)	12 (0.3%)	0.841
Unknown Race	261 (7.5%)	4,543 (10.5%)	<0.001	258 (7.5%)	240 (7.3%)	0.462
Asian	29 (0.8%)	726 (1.7%)	<0.001	29 (0.8%)	31 (0.9%)	0.795
Native Hawaiian	10 (0.3%)	133 (0.3%)	0.846	10 (0.3%)	10 (0.3%)	1
Other Race	67 (1.9%)	1,317 (3.0%)	<0.001	67 (1.9%)	71 (2.1%)	0.731
Comorbidity	1,812 (52.2%)	10,773 (24.8%)	<0.001	1,787 (51.8%)	1,817 (52.7%)	0.47
Diseases of liver	280 (8.1%)	1,039 (2.4%)	<0.001	288 (8.2%)	290 (7.3%)	0.411
Diabetes mellitus	1,016 (29.3%)	4,175 (9.9%)	<0.001	999 (29.0%)	994 (28.9%)	0.994
Chronic kidney disease	868 (24.8%)	1,212 (2.8%)	<0.001	861 (24.8%)	866 (24.8%)	0.982
Heart failure	474 (13.6%)	861 (2.0%)	<0.001	448 (13.0%)	431 (12.4%)	0.529
Nicotine dependence	642 (18.5%)	5,405 (12.5%)	<0.001	635 (18.4%)	659 (19.1%)	0.459

Table 2: 90 Day Complications in propensity matched patients with ankle fractures.

Complication	% Outcome Malnutrition	% Outcome Control	Risk Ratio (95% CI)	P-value
Hardware Removal	5.00%	3.00%	1.68 (1.32, 2.13)	<0.001
Post-Traumatic OA	0.30%	0.30%	1.00 (0.42, 2.40)	0.996
Amputation	0.60%	0.30%	2.11 (0.99, 4.47)	0.047
SSI	0.70%	0.60%	1.09 (0.61, 1.94)	0.767
Device Infection	1.50%	0.90%	1.67 (1.06, 2.61)	0.025
Malunion	0.30%	0.30%	1.00 (0.42, 2.40)	0.999
MI	0.70%	0.30%	2.45 (1.17, 5.12)	0.014
PE	1.10%	0.60%	1.88 (1.08, 3.28)	0.024
DVT	1.70%	0.90%	1.80 (1.16, 2.79)	0.007
Transfusion	3.10%	1.00%	3.21 (2.18, 4.73)	<0.001
Stroke	0.50%	0.30%	1.72 (0.79, 3.76)	0.165

Table 3: 2 Year Mechanical in Propensity Matched Patients with Ankle Fractures.

Complication	% Outcome Malnutrition	% Outcome Control	Risk Ratio (95% CI)	P-value
Nonunion Hardware Removal	1.00%	1.10%	0.92 (0.58, 1.46)	0.715
Post-Traumatic OA	17.50%	15.70%	1.11 (1.00, 1.24)	0.045
Amputation	2.90%	2.60%	1.11 (0.84, 1.47)	0.471
Device Infection	1.50%	0.40%	4.09 (2.23, 7.49)	<0.001
Malunion	0.30%	0.30%	1.00 (0.42, 2.40)	1