Inpatient versus Outpatient Surgical Ankle Fracture Fixation: Choice of Setting and Associated Outcomes

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INTRODUCTION:

Ankle fracture fixation can be performed in an inpatient or an outpatient setting. The optimal choice of setting for the surgical fixation of ankle fractures remains in question. An analysis of which patients would maximally benefit from outpatient care will serve to strengthen the practice of value-based healthcare. The purpose of the present study was to compare the safety and outcomes of inpatient vs. outpatient surgical ankle fracture management.

METHODS: Using Current Procedural Terminology codes, we queried the Health Intelligence Company, LLC (HIC) administrative claims database from 2015 to 2020 to identify all cases of open reduction and internal fixation procedures of closed unimalleolar, bimalleolar, and trimalleolar ankle fractures. We categorized patients as receiving surgery at inpatient facilities or receiving surgery at outpatient facilities. One year post-surgical complication rates were determined for each cohort. The 1 year complication probability per comorbidity burden was compared between cohorts. We performed a multivariate linear regression model to determine the specific effect of patient variables on 1 year complication outcome. We determined the standard mean difference (SMD) between groups to estimate overall effect size.

RESULTS: Our final cohort included 8,615 inpatient-treated ankle fractures and 38,055 outpatient-treated ankle fractures. The majority of inpatient-treated fractures were trimalleolar fractures, while the majority of outpatient-treated fractures were unimalleolar fractures. Outpatient and inpatient cohorts were also statistically unique based on age, gender, and comorbidity profile. At 1 year, inpatient setting (OR 2.53, 95% CI 2.19 – 2.91; p <0.001), greater fracture complexity, and greater comorbidity burden were each independently associated with an increased odds of overall complication. All investigated complications demonstrated statistically elevated rates among inpatient-treated patients. Complications with the greatest observed difference between inpatient vs. outpatient groups included hospital readmission (20.6% vs. 5.0%, p<0.001), pain (13.4% vs. 5.8%, p<0.001), emergency department visits (22.7% vs. 16.4%, p<0.001), and deep vein thrombosis and pulmonary embolism (4.9% vs. 2.1%, p<0.001). Patients with unimalleolar fractures treated in the inpatient setting generally experienced the greatest frequency of postoperative complications. Finally, a high degree of variability of inpatient vs. outpatient management was observed between regions in the United States.

DISCUSSION AND CONCLUSION:

Although there is a high degree of variability, the choice to perform outpatient surgical ankle fracture fixation may be based on determinants including age, fracture complexity, and comorbidity profile. As evidenced by the increased odds of complications associated with inpatient treatment, outpatient ankle fracture management is a safe and effective option when chosen.

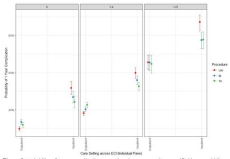

Figure 1. Probability of 1 year complication among inpatients vs outpatients stratified by comorbidity burden. As comorbidity burden increases, the probability of 1 year complication increases. Per comorbidity burden group, inpatient surgery is associated with a greater probability of 1 year complication, with respect to outpatient surgery. In the inpatient setting, unimalleolar fractures are associated with a greater probability of 1 year complication.

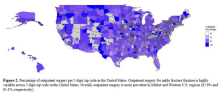

Figure 2. Percentage of outpatient surgery per 3-digit zip code in the United States. Outpatient surgery for ankle fracture fixation is highly variable across 3-digit zip code in the United States. Overall, outpatient surgery is most prevalent in Idaho and Western U.S. regions (81.9% and 81.5%, respectively).

Table 1. Inpatient vs Outpatient Demographics and Clinical Characteristics

	Outpatient (n = 38055)	Inpatient (n = 8615)	p	SMD[1]
Age (mean (SD))	42.30 (15.49)	46.82 (16.53)	<0.001	0.281
Gender = *Male* (%)	16148 (42.5)	3089 (35.9)	<0.001	0.136
Region (%)			<0.001	0.236
Northeast	6503 (17.1)	2042 (23.7)		
Midwest	10732 (28.2)	1785 (20.7)		
South	19637 (51.7)	4073 (47.3)		
West	4388 (11.5)	728 (8.5)		
Other	35 (0.1)	3 (0.1)		
Fracture (%)			<0.001	0.418
Unimalleolar	17712 (46.5)	2325 (27.0)		
Bimalleolar	11382 (29.4)	3029 (35.2)		
Trimalleolar	8761 (23.0)	3261 (37.9)		
Elixhauser Comorbidity Index (%)			<0.001	0.319
0	18113 (48.1)	2790 (32.4)		
1-2	19118 (50.3)	5184 (60.2)		
≥3	804 (1.6)	441 (5.1)		
1 Year Complication = *Yes* (%)	13658 (35.8)	4673 (54.1)	<0.001	0.377

Note: [1]Standard Mean Difference. Univariate tests across opioid manner diagnosis include independent samples t-tests for continuous variables and chi-square tests for categorical variables.

Table 2. Multivariate Binary Logistic Regression Investigating the 1 Year Complication

Outcome	DV: Complication [Y/N]		
Independent Variables	OR	95% CI	p
(Intercept)	0.42	0.40 – 0.45	
Gender[1]: *Male*	0.90	0.87 – 0.94	**<0.001**
Age	1.00	0.99 – 1.00	**<0.001**
Type[2]: *Inpatient*	2.53	2.19 – 2.91	**<0.001**
Procedure[3]: *Bi*	1.18	1.10 – 1.27	**<0.001**
Procedure[3]: *Tri*	1.10	1.01 – 1.20	**0.023**
ECI[4]: *1-4*	1.46	1.36 – 1.53	**<0.001**
ECI[4]: *≥5*	4.48	3.75 – 5.36	**<0.001**
Type[2]: *Inpatient* x **Procedure**[3]: *Bi*	0.70	0.57 – 0.85	**<0.001**
Type[2]: *Inpatient* x **Procedure**[3]: *Tri*	0.67	0.55 – 0.82	**<0.001**
Type[2]: *Inpatient* x **ECI**[4]: *1-4*	0.96	0.79 – 1.15	0.629
Type[2]: *Inpatient* x **ECI**[4]: *≥5*	1.42	0.93 – 2.23	0.118
Procedure[3]: *Bi* x **ECI**[4]: *1-4*	0.93	0.84 – 1.03	0.148
Procedure[3]: *Tri* x **ECI**[4]: *1-4*	1.09	0.97 – 1.22	0.133
Procedure[3]: *Bi* x **ECI**[4]: *≥5*	0.84	0.63 – 1.10	0.212
Procedure[3]: *Tri* x **ECI**[4]: *≥5*	0.87	0.66 – 1.16	0.348
Type[2]: *Inpatient* x **Procedure**[3]: *Bi* x **ECI**[4]: *1-4*	1.11	0.88 – 1.44	0.411
Type[2]: *Inpatient* x **Procedure**[3]: *Tri* x **ECI**[4]: *1-4*	0.92	0.71 – 1.20	0.546
Type[2]: *Inpatient* x **Procedure**[3]: *Bi* x **ECI**[4]: *≥5*	0.72	0.41 – 1.26	0.256
Type[2]: *Inpatient* x **Procedure**[3]: *Tri* x **ECI**[4]: *≥5*	0.79	0.44 – 1.39	0.411
Observations	46,670		
R^2 / *Yes*	0.066		

Note: OR: Odds Ratio. CI: Confidence Interval. [1]Referant: Female. [2]Referent: Outpatient. [3]Referent: Unimalleolar. [4]Referent: 0. *Yes* = *N* in a representation of total model R representing the coefficient of determination. Continuous independent variables are mean centered.

Table 3. 1 Year Complication per Surgery Setting and Fracture Morphology

	Inpatient	Outpatient	p	SMD[1]
n	8,615	38,055		
Hospital Admission = *Yes* (%)	1773 (20.6)	1888 (5.0)	<0.001	0.481
Pain = *Yes* (%)	1154 (13.4)	2223 (5.8)	<0.001	0.258
ED Visit[2] = *Yes* (%)	1959 (22.7)	6234 (16.4)	<0.001	0.161
DVT or PE[3] = *Yes* (%)	418 (4.9)	802 (2.1)	<0.001	0.150
Renal Failure = *Yes* (%)	160 (1.9)	173 (0.5)	<0.001	0.132
Pneumonia = *Yes* (%)	232 (2.7)	396 (1.0)	<0.001	0.122
UTI[4] = *Yes* (%)	495 (5.7)	1277 (3.4)	<0.001	0.115
Sepsis = *Yes* (%)	165 (1.9)	238 (0.7)	<0.001	0.110
Pressure Ulcer = *Yes* (%)	93 (1.1)	82 (0.2)	<0.001	0.108
Implant Removal = *Yes* (%)	1233 (17.8)	5374 (14.1)	<0.001	0.100
Inhalation Therapy Complication = *Yes* (%)	161 (1.9)	302 (0.8)	<0.001	0.097
Disruption of Wound = *Yes* (%)	199 (2.3)	477 (1.2)	<0.001	0.080
MI[5] = *Yes* (%)	53 (0.6)	77 (0.2)	<0.001	0.065
Infection = *Yes* (%)	74 (0.9)	173 (0.5)	<0.001	0.050
I&D[6] = *Yes* (%)	263 (3.1)	900 (2.4)	<0.001	0.042

Note: [1]Standard Mean Difference. [2]Emergency Department Visits. [3]Deep Vein Thrombosis or Pulmonary Embolism. [4]Urinary Tract Infection. [5]Myocardial Infarction. [6]Irrigation and Debridement. Univariate tests across opioid manner diagnosis include independent samples t-tests for continuous variables and chi-square tests for categorical variables.