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IS PSYCHIATRIC ILLNESS ASSOCIATED WITH WORSE OUTCOMES FOLLOWING PILON FRACTURE?

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ABSTRACT

Background: Patients with psychiatric comorbidities represent a significant subset of those sustaining pilon fractures. The purpose of this study is to examine the association of psychiatric comorbidities (PC) in patients with pilon fractures and clinical outcomes.

Methods: A multi-institution, retrospective review was conducted. Inclusion/exclusion criteria were skeletally mature patients with a tibia pilon fracture (OTA Type 43B/C) who underwent definitive fracture fixation utilizing open reduction internal fixation (ORIF) with a minimum of 24 weeks of follow-up. Patients were stratified into two groups for comparison: PC group and no PC group.

Results: There were 103 patients with pilon fractures that met the inclusion/exclusion criteria of this study. Of these patients, 22 (21.4%) had at least one psychiatric comorbidity (PC) and 81 (78.6%) did not have psychiatric comorbidities (no PC). There was a higher percentage of female patients (PC: 59.1% vs no PC: 25.9%, p=0.0.005), smokers (PC: 40.9% vs no PC: 16.0%, p=0.02), and drug users (PC: 22.7% vs no PC: 8.6%, p=0.08) amongst PC patients. Fracture comminution (PC: 54.5% vs no PC: 32.1%, p=0.05) occurred more frequently in PC patients. The PC group had a higher incidence of weightbearing noncompliance (22.7% vs 7.5%, p=0.04) and reoperation (PC: 54.5% vs no PC: 29.6%, p=0.03).

Conclusion: Patients with psychiatric comorbidities represent a significant percentage of pilon fracture patients and appear to be at higher risk for postoperative complication. Risk factors that may predispose patients in the PC group include smoking/substance use, weightbearing noncompliance, and fracture comminution.

Level of Evidence: III

Keywords: mental illness, psychiatric, orif, pilon, complication

INTRODUCTION

Representing <10% of all tibial fractures, pilon fractures occur most frequently in males and have bimodal peaks of incidence from ages 20 to 30 and 50 to 60.[1] They tend to occur secondary to both high (impaction) and low (rotational) energy mechanisms of injury. Concurrent fibular and soft tissue trauma can also be seen in these patients and are signs of the energy imparted to the limb. Surgical treatment of these fractures may be difficult, and outcomes remain poor.[2-3]

Existing studies have identified the prevalence of psychiatric illness in orthopaedic trauma patients and an association with poor postoperative outcomes after orthopaedic surgery.[4-14] A study using thousands of Humana and Medicare patients found significantly higher rates of readmission, revision, and complication after treatment of pilon fractures in patients with pre-existing mental health conditions.[4] This study lacked details regarding injury mechanism, AO/ OTA fracture type, soft tissue status, type of operative fracture management, development of complications beyond the 90 days postoperative period, and non-fusion revisions.

Acknowledging this patient population's predisposition for poor outcomes, we aim to offer greater insight into the effects of psychiatric comorbidities (PC) on patients with pilon fractures through a retrospective, multi-institutional cohort study. We hypothesize that patients with psychiatric comorbidities have worse outcomes because of higher rates of tobacco/substance use, more severe initial injury, and greater weightbearing noncompliance.

METHODS

A retrospective chart review of pilon fractures treated with open reduction internal fixation (ORIF) was conducted at three large urban academic institutions with

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level I trauma centers between 2012 and 2020. Skeletally immature patients and patients with fewer than 24 weeks of follow-up were excluded from evaluation of outcome measures.

Psychiatric comorbidities were identified through reviewing the electronic medical record for documented DSM-5 diagnoses including major depressive disorder, generalized anxiety disorder, panic disorder, schizophrenia, schizoaffective disorder, and bipolar disorder on or before the admission on which the patient presented with a pilon fracture.

Patient demographics included patient age, sex, body mass index (BMI), smoking status (within one year of surgery), diabetes mellitus, and Charlson Comorbidity Index (CCI).

Injury-specific information gathered included mechanism, AO/ OTA classification, comminution (AO/OTA B3/ C3), soft tissue status as classified by the system of Gustilo et al.[15] and concurrent fibula fracture.

Surgical details including the frequency of staged external fixation (ex fix), time between injury and ex fix, time between ex fix and ORIF, time between injury and ORIF, operative time (in minutes) were obtained.

Early weightbearing was documented in cases when providers noted patients did not follow recommended weightbearing restrictions in the electronic medical record. Follow-up times were determined by evaluating the number of days between date of ORIF and the date of a patient's last follow-up.

Primary outcomes were unplanned reoperation, infection requiring antibiotics, irrigation and debridement (I&D) in the operating room, nonunion, revision, and implant removal.

A comparison between demographics, injury characteristics, and outcomes in patients with patients with psychiatric comorbidities and no psychiatric comorbidities was completed.

SPSS V28 was used for all statistical analysis. Fischer's exact test and chi-squared test were used for categorical variables. Kolmogorov-Smirnov test for normality was conducted. For normally distributed variables, an independent-samples t-test was conducted. For non-normally distributed samples, a Mann-Whitney U test was used. The threshold for statistical significance was 0.05. When applicable, standard deviations were reported parenthetically following means in the same units.

RESULTS

There were 103 skeletally mature patients with pilon fractures (OTA types 43B/C) that met the inclusion/ exclusion criteria of this study. Of these patients, 22 (21.4%) had at least one psychiatric comorbidity (PC) and 81 (78.6%) did not have psychiatric comorbidities (no PC). The prevalence of specific psychiatric diagnoses in the PC group was as follows: depression (41.9%), anxiety (25.8%), bipolar disorder (16.1%), schizophrenia (12.9%), and schizoaffective disorder (3.2%). There was a significantly higher percentage of female patients comprising the PC group relative to the no PC group (females: 59.1% vs 29.7%, p=0.003). There was also a higher rate of smoking (PC: 40.9% vs no PC: 16.0%, p=0.02) and illicit drug use (PC: 22.7% vs no PC 8.6%, p=0.08) in the PC group, though only the difference in smoking attained statistical significance. A comparison of all demographics can be found in Table 1.

The leading cause of pilon fracture in both groups was fall (PC: 63.6% vs no PC: 56.3%) and car accident (PC: 18.2% vs no PC: 17.5%). There was a higher incidence of comminuted fractures in the PC group (PC: 54.5% vs no PC: 32.1%, p=0.05). External fixator was not significantly different between groups (PC: 86.4% vs no PC: 72.8, p=0.19). There was no difference in the incidence of open tibia fractures or concurrent fibula fractures sustained by the two groups. Injury characteristics can be found in Table 2.

Operative time skewed longer on average in the PC group (241.3 minutes [SD: 84.2]) than the no PC group (217.2 minutes [SD: 102.6]); this difference was not

Table 1. A Comparison of Demographics Between Patients With Psychiatric Comorbidities (PC) and Patients With No Psychiatric Comorbidities (No PC)

	PC	No PC	P-Value
N	22	81	
Age (years)	46.4 (9.5)	42.9 (13.5)	0.27
BMI	31.2 (8.4)	29.7 (7.2)	0.41
Sex (% F)	59.1	25.9	0.005
Smoking (%)	40.9	16	0.02
Illicit Drug Use (%)	22.7	8.6	0.08
DM (%)	14.3	7.6	0.39
CCI (%)			0.46
0	59.1	66.7	
1	31.8	17.3	
2	0	7.4	
3	9.1	3.7	
4	0	2.5	
5	0	0	
6	0	1.2	
7	0	1.2	

Standard deviation reported in parenthesis after mean values.
Abbreviations: Diabetes Mellitus (DM), Charlson Comorbidity Index (CCI)

Table 2. Injury Characteristics Compared Between Patients With Psychiatric Comorbidities (PC) and Patients With No Psychiatric Comorbidities (No PC)

	PC	No PC	P-value
Mechanism of Injury (%)			0.66
Fall	63.6	56.3	
Car accident	18.2	17.5	
Motorcycle accident	9.1	6.3	
Struck by car	9.1	5	
Gunshot wound	0	2.5	
Assault	0	0	
Object dropped on leg	0	1.3	
Sports	0	11.3	
Mean height of fall from height (in feet) [n=9 ,24]	18.3 (15.1)	10.7 (7.7)	0.15
Fell in Suicide Attempt (%)	9.1		
AO Classification (%)			0.18
B1	9.1	13.6	
B2	9.1	25.9	
B3	9.1	12.3	
C1	4.5	8.6	
C2	22.7	19.8	
C3	45.5	19.8	
Open Fx (%)	22.7	28.4	0.41
Gustilo Classification (%)			0.37
I	0	4.9	
II	18.2	8.6	
IIIA	4.5	9.9	
IIIB	0	4.9	
IIIC	0	0	
Comminuted (%)	54.5	32.1	0.05
Fibula Fx (%)	72.7	64.2	0.46
Ex Fix (%)	86.4	72.8	0.19

statistically significant (0.32%). There was no statistical difference in bone graft use between groups (PC: 45.5 vs no PC 35.8%, p=0.41).

In this dataset, 22.7% of PC patients were noncompliant with weightbearing restrictions relative to 7.5% of no PC patients (p=0.04). There was a mean follow-up of 83.6 weeks (SD: 59.2) in the PC group and 49.7 weeks (SD: 48.2) in the no PC group (p=0.2).

The PC group had more frequent complications, with differences in reoperation (PC: 54.5% vs no PC: 29.6%, p=0.03), infection (PC: 27.3% vs no PC: 9.9%, p=0.04), nonunion (PC: 27.3% vs no PC: 8.6%, p=0.03), and implant removal (PC: 45.5% vs. no PC: 24.7%, p=0.05) achieving statistical significance. There was no significant difference in oral antibiotic use (PC: 13.6% vs. no PC: 6.2%, p=0.25) and revision rates (PC: 27.3% vs no PC: 16.3%), although these adverse events did occur more frequently in the PC group.

DISCUSSION

Patients with psychiatric comorbidities represented a significant proportion (20%) of all pilon fracture patients. The patients in the PC group had higher grade injury characteristics and poorer outcomes relative to patients without psychiatric comorbidities, though these differences did not always reach statistical significance.

There was a considerably higher percentage of female patients in the PC group. Amongst the top three most prevalent psychiatric conditions within our dataset, depressive[16] and anxiety disorders[17] are described by epidemiologic research as effecting a greater proportion of women, while bipolar disorder affects men and women at similar rates.[18] Another potential explanation for the difference in sex between groups is that many falls from height in men were a result of construction or handy work. These work and hobby related injuries contributed to the incidence of pilon fractures in many male patients without psychiatric comorbidities. The combination of these factors may have driven the rate of female sex in the PC group higher relative to the no PC group.

Smoking is a known risk factor for complication following fracture fixation.[19] The higher rate of active smokers in the psychiatric comorbidity group suggests that this patient population may benefit from additional attention regarding smoking cessation in the perioperative period.[12] Noncompliance with smoking was not documented in this study due to inconsistent reporting, but the sheer number of active smokers in the PC group at the time of injury suggests that this factor could have contributed to the higher rate of nonunions in these patients.

Illicit drug use can also be a risk factor for complication after fracture fixation.[21] The pathophysiologic effects of drug use depend on the drug used and the method of use. There was a trend towards a higher rate of illicit substance use patients with psychiatric. More details would be necessary to better evaluate this factor's effects on complication rates. Intravenous drug use, which was inconsistently reported but at least two PC patients had a reported history of, may have contributed to this group's higher infection rate.[22]

The higher rate of fracture comminution in the PC group may be attributable to higher energy mechanisms of injury experienced by PC patients.[23-24] Falling was the most frequent cause of injury in both groups, albeit more frequently a cause of pilon fracture in the PC group. Patients with psychiatric comorbidities also skewed towards having more motorcycle/motor vehicle accidents and being hit by motor vehicles more frequently. On the whole, the PC group appeared to have higher energy mechanisms of injury, which may help explain their higher rate of fracture comminution.

The higher rate of weightbearing noncompliance in the PC group was associated with at least two cases of broken implants and consequent revision in the PC group. Assessment of a patient's insight into their injury, plan for mobility in light of lessened or lost weightbearing of the affected limb, and the repercussions of early weightbearing may be useful in identifying patients needing additional counselling or support.[25] Haptic feedback or electronic messaging reminders upon unpermitted weightbearing could also be helpful in reinforcing weightbearing restrictions.[26-27] Additionally, in patients with treatment resistant psychiatric disease that may impede their capacity to consent to surgery or follow postoperative restrictions, methods of fracture fixation less reliant on weightbearing restrictions for success such as circular external fixation and arthrodesis could be explored to lower complication rates.[25,28-29] An objective method of measuring weightbearing noncompliance, such as a pressure-sensitive film or sensor, would also likely provide more accurate rates of weightbearing noncompliance between patients with and without psychiatric comorbidities than those offered by this study.[30]

Patients in the PC group had higher rates of complications than patients in the no PC group. Existing literature has shown higher rates of readmission, reoperation, and complication in patients with psychiatric comorbidities that suffer pilon fractures at short-term follow-up.[4] Our study also showed this trend, with reoperations occurring twice as frequently in patients with psychiatric illness at an average follow-up of one year after surgery. Taken together, the findings of our study and the study that precedes it suggest patients with psychiatric comorbidities have worse postoperative outcomes after pilon fracture ORIF.

This study is meant to emphasize that psychiatric disease is an important, potentially neglected determinant of orthopaedic outcomes after pilon fractures. As highlighted by Weinberg et al., patients with psychiatric comorbidities are less likely to receive their psychiatric medication and relevant follow-up instructions when managed by orthopaedic trauma services.[6] Orthopaedic surgeons should be aware of the prevalence of psychiatric comorbidities in trauma patients and make plans of care that consider a patient's psychiatric disease. Consulting an inpatient psychiatric team or a patient's own psychiatric provider in the preoperative period may also prove efficacious in improving acute psychiatric management and long-term psychiatric follow-up.[31-33] It is our hope that these collaborative efforts will, in turn, improve orthopaedic outcomes in this patient subset.

Given our study's retrospective design, patient outcome reporting and follow-up was not standardized. To mitigate this, patients with incomplete data or lost to follow-up sooner than 24 weeks were excluded. The rate of psychiatric illness in our dataset should also be considered a minimum rather than a true rate of psychiatric comorbidities amongst all pilon fracture patients, given the potential for inconsistent reporting of patient psychiatric histories after orthopaedic trauma.[31] We limited our analysis to only a handful of commonly encountered and consistently reported psychiatric diseases in clinical practice and grouped them together into a "psychiatric comorbidity" cohort. We also lacked the information necessary to distinguish between well managed and poorly managed psychiatric disease. Future studies may benefit from stratifying outcomes by psychiatric diagnosis and the addition of objective severity scores for a given psychiatric comorbidity.[34]

In conclusion, a considerable proportion of patients with pilon fractures had psychiatric comorbidities, and we saw differences in the presentation and outcomes of these patients. Identification of modifiable and nonmodifiable psychiatric conditions in patients presenting with severe pilon fractures is critical. It is important for physicians taking on surgical care of this injury pattern and it is important for the patient, family, or caregivers to understand the higher risk and complication profile associated with these comorbidities. Formal clinical pathways that prompt cross-departmental collaboration between orthopedic surgeons and mental health professionals is not only good medicine but warrants further study to potentially improve inpatient management and postoperative outcomes of these patients.

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