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Trends in non-operative management of low-energy pelvic fracture: An analysis of the Nationwide Inpatient Sample

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ABSTRACT

Introduction: Non-operative management is common for low-impact pelvic fractures. In this study, we characterize the epidemiology of those treated nonoperatively following low-energy pelvic fracture, while identifying recent management trends.

Methodology: Data from the Nationwide Inpatient Sample (NIS) database from 2011 to 2018 were analyzed. We identified adult patients diagnosed with pelvic fracture based on International Classification of Diseases (ICD) codes, excluding fractures of the acetabulum, femur, polytrauma, and open fractures to isolate cases caused by low-impact mechanisms. Codes indicating operative management were excluded. Demographic information and outcomes (length of stay, in-hospital mortality, hospital discharge status) were collected. Sub-analyses were performed to identify trends.

Findings: 123,936 eligible patients were identified. The average age was 68.7 years. 70% were female, showing a decline from 75% to 66% over the study period. Pubic bone involvement was observed in 59% of fractures. The mean Charlson Comorbidity Index (CCI) was 3.83, corresponding to a 10-year survival rate of 58.5%, which remained relatively stable throughout the study period. 62.4% of patients received treatment at urban teaching hospitals. Average length of hospital stay was 6.3 days. Discharge to a skilled nursing facility (SNF) was the most common outcome, ranging from 62.1% to 65.0% during the study period, while 20.0% of patients were discharged home (18.4%–21.1%). Mean in-hospital mortality was 3.28%, showing no significant change, with higher rates among male patients (5.1%) and patients of Asian descent (3.8%).

Conclusion: The majority of patients receiving nonoperative treatment for low-energy pelvic fractures were females in their mid-60s with moderate comorbidity. The study reveals a relatively high in-hospital mortality rate of 3.28%, particularly among male patients and those of Asian descent, indicating the need for increased surveillance for further injury in these groups. Most patients were discharged to a SNF, highlighting the necessity for extended rehabilitation in this population. This persistent trend is noteworthy considering the growing emphasis on the cost of inpatient admissions and advancements in outpatient management of orthopedic injuries.

1. Introduction

Pelvic fractures are estimated to comprise about 1.5–8% of all fractures.[1–4] Despite the frequency of this injury, subsequent medical and surgical management often present a unique challenge to orthopedic surgeons. There is considerable diversity in patient age, medical comorbidities, mechanism of injury, and fracture pattern, among other factors, that must be considered when determining the most appropriate course of action.[1,5,6] Further, pelvic fractures may cause significant morbidity and mortality,[1,5,7,8] emphasizing the importance of appropriate immediate and long-term management.

Perhaps the most significant branchpoint in treatment planning is the determination to pursue operative or nonoperative treatment. While advances in operative care have made this treatment option increasingly attractive, given ease of stabilization and potentially improved long-term outcomes,[9–11] nonoperative treatment remains the most commonly chosen option across pelvic fracture patients.[12–14] This is especially true following low-energy pelvic fracture, the most common

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of which are lateral compression type 1 (LC-1) fractures.[15,16] Current literature identifies the injury mechanism, fracture type and stability, pain level, hemodynamic stability, medical comorbidities, baseline mobility, and mobility in the days immediately following injury to be among the major considerations when deciding to treat nonoperatively.[17,18]

While most high-energy pelvic fractures require operative treatment to control bleeding and provide a stable pelvic ring, management of low-energy pelvic fractures, particularly LC-1 fracture, remains highly debated. Treatment decision-making for low-energy pelvic fracture requires a holistic view of the patient presentation. To optimize the management of this patient population, it is imperative to fully understand patient characteristics and the environment in which these patients receive care. While minimally invasive procedures such as percutaneous sacroiliac screws have been developed, their utility remains unknown in the mortality or mobilization of patients.

In this study, we aim to report on notable trends related to those who undergo nonoperative treatment of low-impact pelvic fractures and to determine if the use of nonoperative management may have decreased in response to the development of new surgical techniques. We also sought to evaluate how these patients fared in the immediate post-operative setting across the United States between 2011 and 2018. We additionally hope to better define the epidemiology of this patient population and identify trends regarding their management.

2. Materials and methods

2.1. Database characteristics

In our analysis, we conducted a review of data from the Nationwide Inpatient Sample (NIS) from 2011 to 2018. The NIS is a publicly accessible database sponsored by the Agency for Healthcare Research and Quality, known as the largest comprehensive inpatient care database in the United States. Its extensive scope encompasses data extracted from 7 to 8 million hospital stays, enabling analysis of national trends in outcomes, quality, charges, access, and healthcare utilization. These hospital stays represent approximately 20% of community hospitals across the United States, encompassing academic medical centers, general specialty hospitals, nonfederal institutions, and short-term medical centers. Our analysis excluded chemical dependency treatment facilities, short-term rehabilitation facilities, and psychiatric hospitals, as they are unlikely to manage patients with pelvic fractures. Hospitals within a specific category possess a comparable statistical probability of being selected for sampling, irrespective of their inclusion in previous samples.

2.2. Compliance with ethical guidelines

The NIS database is a collection of de-identified billing and diagnostic codes utilized by participating hospitals for the purpose of quality control, population monitoring, and procedure tracking. Institutional review board approval is not required for its utilization. The assignment of diagnostic and procedure codes in the database was based on the discretion of physicians or hospital billing departments, rather than on defined clinical or radiographic diagnostic criteria. The NIS dataset does not involve direct participation of human subjects as defined by federal regulations and guidance.[19] Therefore, all procedures conducted adhered to the ethical standards set forth by institutional and national research committees, as well as the principles outlined in the 1964 Helsinki Declaration and its subsequent amendments, or equivalent ethical standards.

2.3. Patient selection

All adult patients who had International Classification of Diseases (ICD)- 9 or −10 diagnostic codes for initial encounters of pelvic fractures (Appendix) were included in our initial search.[20] Given the constraints of the NIS database for determining mechanism of injury, we made several exclusions to better isolate low-energy impact injuries. We utilized ICD-9 and -10 codes for fracture of the acetabulum, fracture of the femoral head and neck, femoral intracapsular fracture, femoral epiphyseal fracture, femoral shaft fracture, peri-trochanteric fracture, subtrochanteric fracture, distal femur fracture, and polytrauma to exclude patients presenting with these concomitant injuries from our study, as they are likely due to higher-energy mechanisms of injury. Patients who underwent operative management were subsequently excluded based on ICD-9 and -10 procedure codes for operative management of pelvic fracture (Appendix).[12,20]

2.4. Statistical analysis

Analyses were performed using RStudio version 1.4.1717 (RStudio Team (2021). RStudio: Integrated Development for R. RStudio, PBC, Boston, MA).[21] Each patient's Charlson Comorbidity Index (CCI) was manually calculated via a comprehensive search strategy of ICD-9 and ICD-10 codes for each comorbid condition with appropriate weighting.[22] CCI allows prediction of 10-year mortality for patients with selected comorbid conditions.[23] Descriptive statistics were used to examine the characteristics of the inpatient sample with a diagnosis of nonoperative pelvic fractures from 2011 to 2018. First, summary statistics of mean, standard deviation, and percentage were used to compare the distribution of the baseline demographic characteristics (e.g., age, sex, race, comorbidities) in the sample as a whole. Separate sub-analyses were performed of both categorical (gender, race, geography, medication use, hospital type) and continuous demographic distributions (age, CCI) across included years, allowing data to be trended over time, with chi-square tests calculated to assess for statistical change over time. There were two outcomes measured: in-hospital mortality and hospital disposition. Similar chi-square tests were performed to measure differences in outcome between years. Additionally, sub-analysis was performed on both outcomes, stratifying the data by the demographic variables of sex, geographic region, race, and hospital type with chi-square testing used for comparisons. P-values <0.05 were considered statistically significant.

3. Results

3.1. Patient demographics

A total of 123,936 patients underwent nonoperative management of pelvic fracture from the years 2011–2018. Table 1 outlines the overall demographic of these patients. On average, patients were 68.7 years of age, ranging from 67.0 to 71.4 (Table 3). There was more than a two-to-one ratio of women to men (70%–30%), with a decreasing trend from 75% in 2011 to 66% in 2018 (Table 3). In total, there were 154,743 fractures among this population. 59% of the fractures occurred at the pubis, 18% at the sacrum, 7.5% at the ilium, and 2.1% at the ischium,

Table 1
Demographics for patients averaged across 2011 to 2018.

Total patients (n)	**123,936**
Age in years (sd; range)	68.7 (22.8; 65.8–75.3)
Gender	
Females	86,463 (70%)
Male	37,426 (30%)
Other	47 (0.0%)
Race	
White	94,154 (76%)
Black	7835 (6.3%)
Hispanic	9278 (7.5%)
Asian or Pacific Islander	2382 (1.9%)
Other or Unlisted	10,287 (8.3%)

Table 2
Underlying patient comorbidities. Mean Charlson Comorbidity Index (CCI) among included patients was 3.83 (sd = 2.54).

Comorbidity	Number of Patients (%)
Diabetes	20,120 (16.2)
Dementia	18,113 (14.6)
Chronic Kidney Disease	16,209 (13.1)
Congestive Heart Failure	15,474 (12.5)
Deep Vein Thrombosis	12,295 (9.9)
Peripheral Vascular Disease	6922 (5.6)
Myocardial Infarct	6399 (5.2)

Table 3
Demographic trends from 2011 to 2018.

	Age (sd)	% Female	Charlson Comorbidity Index (CCI) (% 10-year survival)
2011	71.4 (22.5)	75.3	3.93 (55.4)
2012	69.2 (22.8)	73.2	3.85 (57.7)
2013	69.0 (22.8)	71.7	3.86 (57.7)
2014	69.5 (22.6)	72.1	3.94 (55.2)
2015	69.0 (22.6)	70.5	3.88 (56.9)
2016	67.0 (23.2)	66.2	3.65 (63.2)
2017	67.4 (22.8)	66.3	3.75 (60.5)
2018	67.8 (22.4)	65.8	3.83 (58.5)

with 13% with pelvic bone unspecified. The average Charlson Comorbidity Index was 3.83, corresponding to a 58.5% 10-year survival rate. Diabetes and dementia were the most prevalent of the comorbidities assessed in this population, affecting 16.2% and 14.6% of the sample respectively (Table 2). Table 3 demonstrates each of these demographic characteristics over time assessing stability in these characteristics across a 7-year span.

3.2. Hospital course and discharge disposition

Patient data was gathered from across the United States, with a predominance from the South (39%). Geographic trends across region of the United States are represented in Fig. 1, demonstrating a relatively stable regional distribution, with slight increases in patients treated in the South and the West. Most patients received care at an urban teaching hospital (62.4%). They remained in the hospital for an average length of stay of 6.3 days (ranging from 5.8 in 2011 to 6.6 in 2018). Upon discharge, the majority of patients were sent to a skilled nursing or intermediate care facility (62.8%, 62.1–65.0% over the measured time frame with no identifiable trend), with home discharge as the second most frequent, occurring 20.0% (18.0%–21.1%) of the time (Fig. 2).

3.3. Mortality

In-hospital mortality was recorded in 3.28% of patients. This outcome was stratified by sex, geographic region, race, and hospital type, with significant differences found between sexes, racial groups, and hospital type (Fig. 3). Men were found to have significantly higher rates of in-hospital mortality, suffering a 5.1% mortality rate compared to 2.5% for females ($p < 0.00001$). Asian race had the highest mortality rate, at 3.8%. Urban teaching hospitals had the highest rate of mortality at 4.3%. There was no significant difference in mortality rate over time from 2011 to 2018 ($p = 0.0752$).

4. Discussion

In this study, we evaluated the trends in the epidemiology and management of nonoperative pelvic fractures. Low-impact pelvic fracture routinely presents orthopedic surgeons with challenging decisions regarding operative versus nonoperative treatment, particularly given high incidence rates of secondary internal injury and mortality.[24] Nonoperative treatment may be chosen with several factors in mind, including fracture stability, fracture pattern, and patient age and comorbidities, among other considerations. Previous literature has revealed that nonoperative treatment is the more commonly elected option for pelvic fractures.[11] While various studies have reported reduced morbidity and mortality after operative management,[11,12] others have confirmed that nonoperative treatment can provide satisfactory outcomes,[11,25,26] and thus may be considered a reasonable option for the appropriate patient population. Our analysis revealed

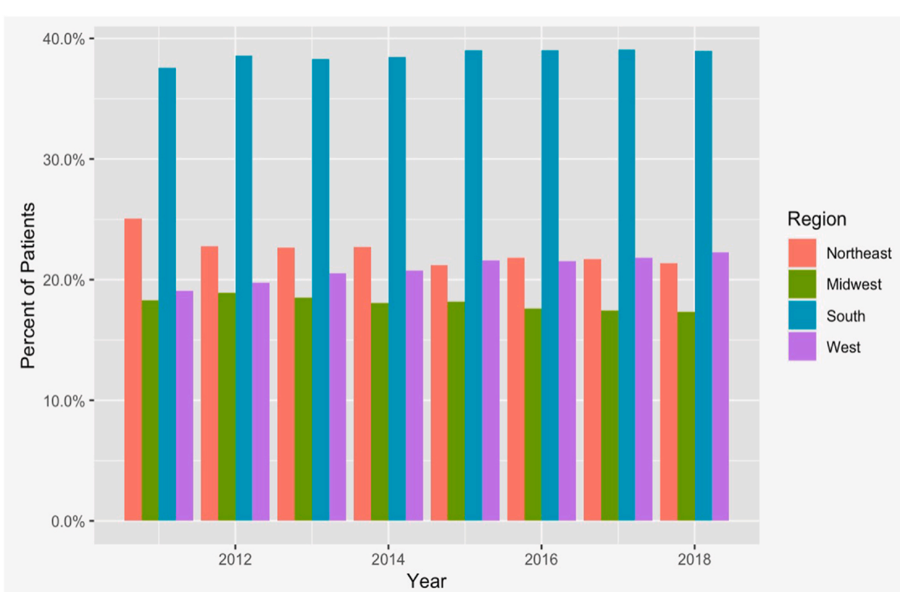

Fig. 1. Geographic trends regarding patient population with low-energy pelvic fracture.

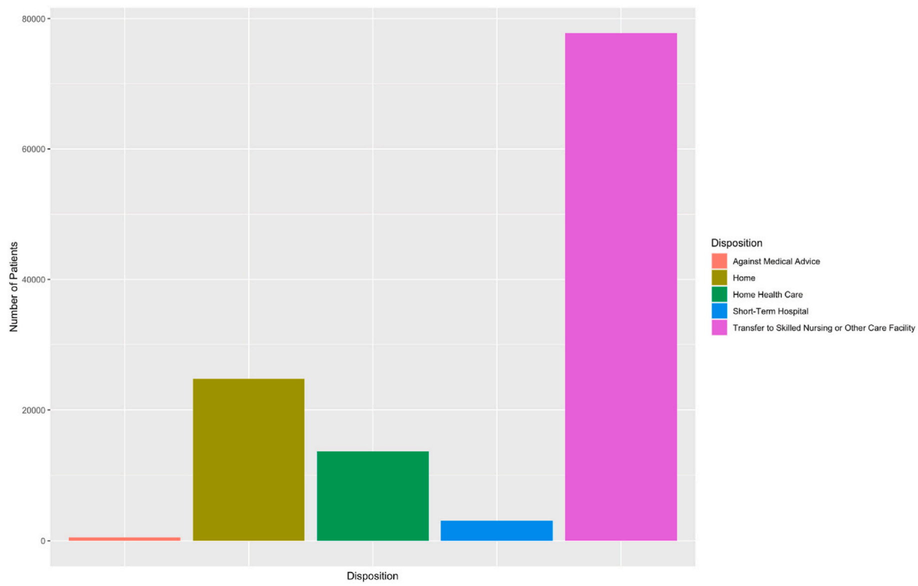

Fig. 2. Hospital disposition.

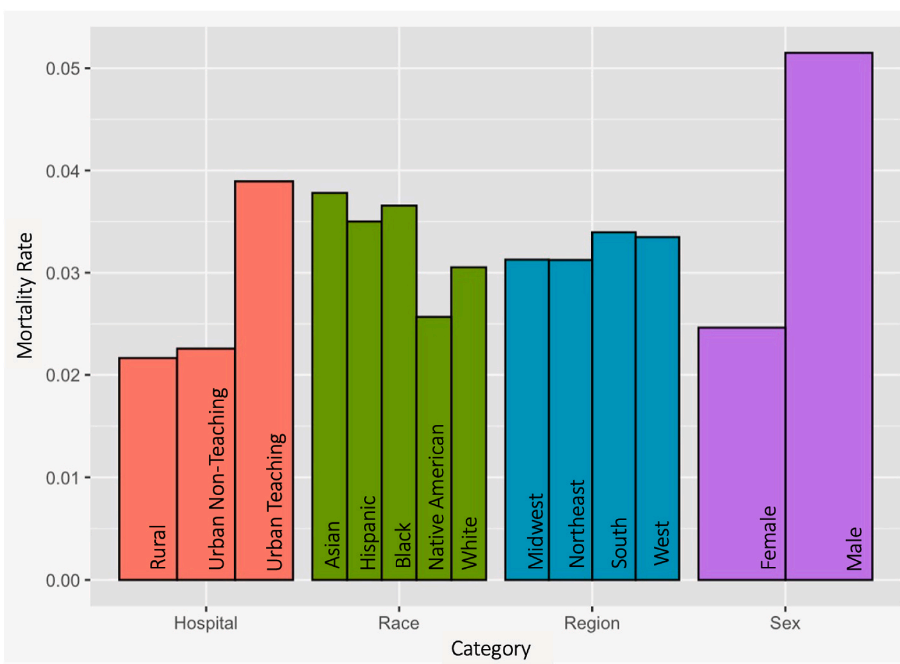

Fig. 3. Mortality rate. From left to right: mortality by hospital type (red); mortality by race (green); mortality by region (blue); and mortality by sex (purple).

several trends discussed below.

We report that on average, patients who had their pelvic fracture treated nonoperatively were in their mid-to late-60s (mean 68.7 years); this trend remained steady through the reported study period. This age range is lower than reported age ranges typically associated with low-energy pelvic fracture.[1,11] This suggests that nonoperative treatment is commonly deemed appropriate even when treating a relatively younger population that requires return to baseline mobility and functionality. It is significant that, despite the recent advancement of percutaneous stabilization techniques reported to be effective for several pelvic fracture patterns,[27–29] nonoperative management continues to be used in these populations over the time period featured in this study. We found that the patient population treated nonoperatively was female-predominant, at 70%. Given that low-energy pelvic fractures are often treated nonoperatively, this finding is consistent with current literature reporting that 80–90% of patients who present with low-energy pelvic fracture are female.[11,30,31] However, we did report a downtrend in proportion of female patients sustaining this injury, from 75.3% in 2011 to 65.8% in 2018 (Table 3). This is perhaps related to the increasingly sedentary lifestyle among both men and women that increases risk of poor bone health and thus, risk of fragility fracture, equally in both.[32–34] Racial demographics were roughly representative of the United States population.[35] Over this time period, patients were found to have a Charlson Comorbidity Index ranging from 3.65 to 3.94 (mean 3.83), associated with an estimated 58.5% 10-year mortality rate (Table 3). Notably, this is indicative of only a moderate level of comorbidity, suggesting that, despite improvements in operative treatment, nonoperative management has remained a viable option for patients who, from a medical clearance standpoint, would likely tolerate surgery well. The most common region of the fractured pelvis in this population was the pubis at 59% of all fractures, followed by sacral fracture (18%), iliac fracture (7.5%), and ischial fracture (2.1%) occurring least often. In this study, we elected to exclude evaluation of acetabular involvement, as fracture of this region may have a distinct associated morbidity and mortality, as well as higher-energy mechanism of injury.[36–38] In accordance with our analyses, current literature similarly identifies pubic involvement (i.e., lateral compression fracture) as the most common presentation for low impact pelvic fracture, at about 67%.[39,40] Pelvic fractures commonly present with concomitant fractures at additional pelvic site, consistent with our findings.[40,41] Interestingly, we found that hospitals in the South of the United States elected to treat pelvic fracture nonoperatively more often than hospitals in the Northeast, the Midwest, or the West Coast. This trend was stable across the time frame of this study (Fig. 1). In all regions, urban teaching hospitals treated the most nonoperative pelvic fractures compared to rural or urban non-teaching hospitals. This may be due to either a preference for more conservative treatments in these settings, a higher patient census presenting with pelvic fracture overall given the significant role of teaching hospitals in their communities, or patient-focused factors, such as elevated average BMI in this population,[42] that make percutaneous or other operative treatment challenging.[43–45]

Overall mortality rate among this patient population was stable at a relatively high value of 3.28%. Men were found to have a notably higher rate of in-hospital mortality (Fig. 3: 5.1%, versus 2.5% for females). This is in accord with reports that female patients with fracture of the pelvis more commonly present after lower-impact injury,[46] when compared to the mechanism of injury sustained by male patients, and thus are more likely to have isolated fracture of the bony pelvis without additional injury to local structures. Urban teaching hospitals were also found to have higher mortality rates than urban non-teaching hospitals and rural hospitals, which may be due to the increased complexity of patients presenting to these types of hospitals[47,48] or to delayed access to care due to various factors, including transportation, long wait times, or inadequate healthcare coverage (Fig. 3).

Regarding hospital discharge, we measured length of hospital stay and hospital disposition. Over this time period, patients spent an average of 6.3 days in the hospital following nonoperative treatment of pelvic fractures, with a stable trend (range 5.8–6.6 days). Patients were typically discharged to a SNF or an intermediate care facility (mean 62.8%, range 62.8%–65.0% over our study period). Discharge to home was the second most common discharge plan at 20.0% (18.0%–21.1%). The combination of extended length of stay and discharge to SNF is likely due to the need for prolonged periods of close in-hospital and post-discharge rehabilitation, and follow-up, in patients treated nonoperatively, as these patients increasingly rely on their lower body strength for pelvic stability and long-term functionality. This additionally emphasizes the chronic nature of the recovery process of low-impact, nonoperative pelvic fracture with continued involvement of medical providers and physical therapists long after the initial event. This is an important component of nonoperative treatment that should be shared with the patient during discussion of treatment options. The lack of trend towards discharge to home is notable given the improvements in outpatient management, particularly regarding the efficacy of anti-osteoporosis medication in this setting,[49,50] and increasing awareness of the cost-effectiveness implications of pelvic injury management.[51,52] Patients who do not qualify for home discharge are typically those with increased injury severity, high comorbidity, and poor ambulation status[53]; thus, among the low-impact population evaluated in this study, who typically lack many of these characteristics, it may be expected that discharge home should be more common. Further evaluation of this trend is perhaps an important area for additional research in order to improve quality of life among this patient population.

There are limitations to this study that warrant discussion. As a retrospective analysis of a major database, this study was subject to limitations related to collection of NIS data, particularly regarding errors or biases in coding, contributing to over- or under-analysis. Second, CCI is not directly provided by the NIS database; while ICD-9 and ICD-10 codes for comorbidities included in the CCI calculation were manually collected as guided by previous literature,[22] it remains possible that codes were missing, leading to an underestimate of comorbidity in this patient population. Third, we elected to evaluate trends over a 7-year period, and thus there may be trends extending over a longer period of time that are not appropriately reflected in our study. Lastly, because the NIS database features only inpatient events, we were unable to evaluate for post-discharge morbidity and mortality, which may not adequately describe true outcomes in this patient population. Nonetheless, this robust database and subsequent analysis provides reliable insight into important trends following nonoperative management of low-energy pelvic fracture.

Overall, our study aimed to characterize the patient population with low-energy pelvic fracture treated nonoperatively and to evaluate trends in management decisions. We report that patients of relatively young age and moderate comorbidity have consistently been treated nonoperatively from 2011 to 2018. We found several patient factors, particularly male sex and Asian race, to be associated with increased mortality, potentially suggesting the need for increased surveillance among patients with these characteristics. We also found a persistently elevated rate of discharge to SNF after a length of stay of about seven days, which is an important potential target for improvement for disposition planning as outpatient management continues to improve. We hope that the findings presented in this study aid orthopedic surgeons to better characterize good candidates for nonoperative treatment following low-energy pelvic fracture.

Author contributions

AF: Conceptualization, methodology, investigation, writing – original draft, writing – review and editing.

SS: Methodology, validation, formal analysis, investigation, writing – original draft, visualization.

JA: Conceptualization, methodology, resources.

NS: Validation, writing – review and editing.

MW: Validation, writing – review and editing.

AVK: Conceptualization, methodology, writing – review and editing, supervision, project administration.

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Declaration of competing interest

AF, SS, JA, NS: Declarations of interest: none.

MW: Osteocentric, receives royalties for implant design, unrelated to this manuscript.

AVK: Orthopedic Trauma Association, leadership role; Customsurg AG, stock/stock options holder.

APPENDIX. International Classification of Diseases (ICD)-9 and −10 codes used to include patients in the study based on fracture diagnosis and management strategy

Diagnosis Codes		
Fracture type	ICD-9 codes	ICD-10 codes
Acetabulum, closed	808.0	S32.409A
Acetabulum, open	808.1	S32.409B
Pubis, closed	808.2	S32.501A, S32.502A, S32.509A, S32.511A, S32.512A, S32.519A, S32.591A, S32.592A, S32.599A
Pubis, open	808.3	S32.501B, S32.502B, S32.509B, S32.511B, S32.512B, S32.519B, S32.591B, S32.592B, S32.599B
Ischium, closed	808.42	S32.601A, S32.602A, S32.609A, S32.611A, S32.612A, S32.613A, S32.614A, S32.615A, S32.616A, S32.619A, S32.691A, S32.692A, S32.699A
Ischium, open	808.52	S32.601B, S32.602B, S32.609B, S32.611B, S32.612B, S32.613B, S32.614B, S32.615B, S32.616B, S32.619B, S32.691B, S32.692B, S32.699B
Ilium, closed	808.41	S32.301A, S32.302A, S32.309A, S32.311A, S32.312A, S32.313A, S32.314A, S32.315A, S32.316A, S32.391A, S32.392A, S32.399A
Ilium, open	808.51	S32.301B, S32.302B, S32.309B, S32.311B, S32.312B, S32.313B, S32.314B, S32.315B, S32.316B, S32.391B, S32.392B, S32.399B
Sacrum/coccyx, closed	805.6	S32.10XA, S32.2XXA
Sacrum/coccyx, open	805.7	S32.10XB, S32.2XXB
Femoral head and neck, closed	820.0	S72.001A, S72.002A, S72.009A, S72.051A, S72.052A, S72.059A, S72.091A, S72.092A, S72.099A
Femoral head and neck, open	820.1	S72.001B, S72.002B, S72.009B, S72.051B, S72.052B, S72.059B, S72.091B, S72.092B, S72.099B
Intracapsular fracture of femur, closed	820.00	S72.011A, S72.012A, S72.019A
Intracapsular fracture of femur, open	820.10	S72.011B, S72.012B, S72.019B
Femoral epiphysis, closed	821.01	S72.021A, S72.022A, S72.023A, S72.024A, S72.025A, S72.026A
Femoral epiphysis, open	821.11	S72.021B, S72.022B, S72.023B, S72.024B, S72.025B, S72.026B
Midcervical fracture of femur, closed	820.02	S72.031A, S72.032A, S72.033A, S72.034A, S72.035A, S72.036A
Midcervical fracture of femur, open	820.12	S72.031B, S72.032B, S72.033B, S72.034B, S72.035B, S72.036B
Femoral base of neck, closed	820.03	S72.041A, S72.042A, S72.043A, S72.044A, S72.045A, S72.046A
Femoral base of neck, open	820.13	S72.041B, S72.042B, S72.043B, S72.044B, S72.045B, S72.046B
Peritrochanteric, closed	820.20	S72.101A, S72.102A, S72.109A, S72.111A, S72.112A, S72.113A, S72.114A, S72.115A, S72.116A, S72.121A, S72.122A, S72.123A, S72.124A, S72.125A, S72.126A, S72.131A, S72.132A, S72.133A, S72.134A, S72.135A, S72.136A, S72.141A, S72.142A, S72.143A, S72.144A, S72.145A, S72.146A
Peritrochanteric, open	820.30	S72.101B, S72.102B, S72.109B, S72.111B, S72.112B, S72.113B, S72.114B, S72.115B, S72.116B, S72.121B, S72.122B, S72.123B, S72.124B, S72.125B, S72.126B, S72.131B, S72.132B, S72.133B, S72.134B, S72.135B, S72.136B, S72.141B, S72.142B, S72.143B, S72.144B, S72.145B, S72.146B
Subtrochanteric, closed	820.22	S72.21XA, S72.22XA, S72.23XA, S72.24XA, S72.25XA, S72.26XA
Subtrochanteric, open	820.32	S72.21XB, S72.22XB, S72.23XB, S72.24XB, S72.25XB, S72.26XB
Femoral shaft, closed	821.01	S72.301A, S72.302A, S72.309A, S72.321A, S72.322A, S72.323A, S72.324A, S72.325A, S72.326A, S72.331A, S72.332A, S72.333A, S72.334A, S72.335A, S72.336A, S72.341A, S72.342A, S72.343A, S72.344A, S72.345A, S72.346A, S72.351A, S72.352A, S72.353A, S72.354A, S72.355A, S72.356A, S72.361A, S72.362A, S72.363A, S72.364A, S72.365A, S72.366A, S72.391A, S72.392A, S72.393A, S72.399A
Femoral shaft, open	821.11	S72.301B, S72.302B, S72.309B, S72.321B, S72.322B, S72.323B, S72.324B, S72.325B, S72.326B, S72.331B, S72.332B, S72.333B, S72.334B, S72.335B, S72.336B, S72.341B, S72.342B, S72.343B, S72.344B, S72.345B, S72.346B, S72.351B, S72.352B, S72.353B, S72.354B, S72.355B, S72.356B, S72.361B, S72.362B, S72.363B, S72.364B, S72.365B, S72.366B, S72.391B, S72.392B, S72.393B, S72.399B
Distal femur, closed	821.2	S72.401A, S72.402A, S72.409A, S72.411A, S72.412A, S72.413A, S72.414A, S72.415A, S72.416A, S72.421A, S72.422A, S72.423A, S72.424A, S72.425A, S72.426A, S72.431A, S72.432A, S72.433A, S72.434A, S72.435A, S72.426A, S72.441A, S72.442A, S72.443A, S72.444A, S72.445A, S72.446A, S72.451A, S72.452A, S72.453A, S72.454A, S72.455A, S72.456A, S72.461A, S72.462A, S72.463A, S72.464A, S72.465A, S72.466A, S72.471A, S72.472A, S72.479A, S72.491A, S71.492A, S71.499A
Distal femur, open	821.3	S72.401B, S72.402B, S72.409B, S72.411B, S72.412B, S72.413B, S72.414B, S72.415B, S72.416B, S72.421B, S72.422B, S72.423B, S72.424B, S72.425B, S72.426B, S72.431B, S72.432B, S72.433B, S72.434B, S72.435B, S72.426B, S72.441B, S72.442B, S72.443B, S72.444B, S72.445B, S72.446B, S72.451B, S72.452B, S72.453B, S72.454B, S72.455B, S72.456B, S72.461B, S72.462B, S72.463B, S72.464B, S72.465B, S72.466B, S72.471B, S72.472B, S72.479B, S72.491B, S71.492B, S71.499B
Other femur, closed	N/A	S72.X1A, S72.X2A, S72.X9A
Other femur, open	N/A	S72.X1B, S72.X2B, S72.X9B
Unspecified femur, closed	821.00	S72.90XA, S72.91XA, S72.92XA
Unspecified femur, open	821.10	S72.90XB, S72.91XB, S72.92XB
Other specified part, closed	808.43, 808.44, 808.49	S32.810A, S32.811A, S32.82XA, S32.89XA
Other specified part, open	808.53, 808.54, 808.59	S32.810B, S32.811B, S32.82XB, S32.89XB
Unspecified, closed	808.8	S32.9XXA
Unspecified, open	808.9	S32.9XXB
Unspecified multiple injuries	959.8	T07
Codes for operative management		
Application of external fixator devices	78.10, 78.19	0QH205Z, 0QH235Z, 0QH245Z, 0QH305Z, 0QH335Z, 0QH345Z
Closed reduction of fracture with internal fixation	79.10, 79.19	0QS234Z, 0QS244Z, 0QS334Z, 0QS344Z, 0QS434Z, 0QS444Z, 0QS534Z, 0QS544Z
Open reduction of fracture without internal fixation	79.20, 79.29	0QQ20ZZ, 0QQ30ZZ, 0QQ40ZZ, 0QQ50ZZ, 0QS20ZZ, 0QS30ZZ, 0QS40ZZ, 0QS50ZZ
Open reduction of fracture with internal fixation	79.30, 79.39	0QS204Z, 0QS304Z, 0QS404Z, 0QS504Z
Internal fixation without reduction	78.50, 78.59	0QS204Z, 0QS234Z, 0QS244Z, 0QS304Z, 0QS334Z, 0QS344Z, 0QH204Z, 0QH234Z, 0QH244Z, 0QH304Z, 0QH334Z, 0QH344Z,

(*continued on next page*)

(*continued*)

Diagnosis Codes		
Fracture type	ICD-9 codes	ICD-10 codes
Debridement of open fracture site	79.60, 79.69	0QB20ZZ, 0QB30ZZ, 0QB40ZZ, 0QB50ZZ
Unspecified operation on bone injury	79.90, 79.99	0QQ20ZZ, 0QQ23ZZ, 0QQ24ZZ, 0QQ30ZZ, 0QQ33ZZ, 0QQ34ZZ, 0QQ40ZZ, 0QQ43ZZ, 0QQ44ZZ, 0QQ50ZZ, 0QQ53ZZ, 0QQ54ZZ

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