RESEARCH PAPER

Risk Factors and Short-Term Outcomes of Lower Limb Fractures in Diabetic Patients Presenting to Emergency

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Abstract

Background: Diabetes mellitus may adversely affect bone health, tissue perfusion, wound healing, and fracture recovery, increasing the risk of complications following lower limb fractures.

Objective: To evaluate risk factors and short-term outcomes of lower limb fractures in diabetic patients presenting to the emergency department and identify independent predictors of adverse outcomes.

Methods: This retrospective observational cohort study was conducted at Department of Orthopedic department Nowshera medical college Nowshera from June 2024 June 2025 and included 180 adult diabetic patients with radiologically confirmed lower limb fractures. Demographic and clinical variables including age, gender, body mass index, smoking status, duration and type of diabetes, antidiabetic treatment, HbA1c, random blood glucose at presentation, hypertension, ischemic heart disease, chronic kidney disease, peripheral neuropathy, peripheral vascular disease, diabetic retinopathy, and previous diabetic foot problems were recorded.

Results: Of 180 patients, 52 developed adverse outcomes. Patients with adverse outcomes had higher HbA1c (9.64±1.65% vs. 7.91±1.48%), higher admission glucose (274.69±85.42 vs. 195.62±69.81 mg/dL), and longer diabetes duration (15.42±6.91 vs. 10.36±6.12 years), all $p<0.001$. Open fractures (32.7% vs. 10.9%), significant soft-tissue injury (42.3% vs. 14.1%), peripheral neuropathy (61.5% vs. 31.3%), peripheral vascular disease (36.5% vs. 14.8%), and chronic kidney disease (40.4% vs. 15.6%) were significantly more frequent among patients with adverse outcomes. Wound infection occurred in 13.9%, delayed healing in 12.8%, reoperation in 7.8%, 30-day readmission in 8.9%, and in-hospital mortality in 3.3%.

Conclusion: Poor glycemic control, diabetic vascular and neurological complications, renal disease, and severe fracture characteristics were strongly associated with adverse short-term outcomes.

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Introduction

Fractures of the lower limb are very common orthopedic emergencies and can lead to significant pain, disability, hospitalisation, surgery and short term disability [1]. Diabetes mellitus is a highly vulnerable condition as it alters the bone quality, neuromuscular function, peripheral circulation and tissue healing process [2]. While the bone mineral density of some patients with type 2 diabetes may be normal or even elevated, fracture risk is still elevated due to a potential compromise in bone strength and microarchitecture [3]. Population studies have also revealed that people with type 2 diabetes are at higher risk of hip fracture than those without diabetes [4]. There are multiple factors related to diabetes that could be involved in lower limb fracture. Proprioception, balance and protective sensation may be affected by peripheral neuropathy, which can lead to a higher risk of falls and undiagnosed lower extremity injuries [5]. Fracture susceptibility can also be exacerbated by visual impairment, muscle weakness, elderly age, hypoglycemic episodes, and lower levels of physical function [6]. Other diabetes-related complications, such as chronic kidney disease, and low glycemic control, as well as long duration of diabetes and insulin therapy, may also affect the frequency and extent of fractures [7].

After an injury, diabetes can affect healing by the way it causes inflammation to be impaired, affects microvascular function, changes the way bone remodels, and slows down soft-tissue repair [8]. Clinical studies have revealed that diabetics have increased incidence of infection, malunion, nonunion, and reoperation after the surgical treatment of fractures of the lower extremities [9]. In ankle fractures, specifically, diabetes has been correlated with a higher risk of nonunion, wound complications, infection and Charcot arthropathy [10]. In addition, sensory neuropathy, end-stage renal disease (ESRD), insulin therapy, and the severity of the fracture have been linked to nonunion and other complications in diabetic patients with ankle fractures [11]. Therefore, the short-term prognosis after a fracture of the lower limb could vary according to fracture characteristics and diabetes severity. Injuries that are open, displaced, or comminuted, poor vascular status, neuropathy, renal impairment, anemia, and poorly-controlled blood glucose can make the wound more susceptible to infection, delayed healing, longer hospital stays, and further surgery [12]. A longer hospital stay and increased complications after an operation have also been reported in diabetic patients with hip fracture when compared to non-diabetic patients [13]. Poor glycemic control might be further to affect prognosis as higher values of HbA1c and glucose variability after hip fracture surgery have been correlated with higher mortality in diabetic patients [14]. Thus, early recognition of high-risk diabetic patients in the emergency room may have a role in guiding orthopedic treatment, optimizing glycemic control, preventing infection, vascular assessment, and appropriate follow-up [15].

Objective

To evaluate risk factors and short-term outcomes of lower limb fractures in diabetic patients presenting to the emergency department and identify independent predictors of adverse outcomes.

Methodology

This retrospective observational cohort study was conducted at Department of Orthopedic department Nowshera medical college Nowshera from June 2024 June 2025 and included 180 patients with diabetes mellitus presenting to the emergency department with radiologically confirmed lower limb fractures. Patients aged ≥18 years with fractures of the hip, femur, knee region, tibia, fibula, ankle or foot and type 1 or type 2 diabetes were included. Low and high energy fractures with either open or closed fracture were eligible. Pathological fractures caused by malignancy, periprosthetic fractures, patients who had suffered a previous fracture at the same site who had not fully healed, patients with severe polytrauma where the fracture specific outcomes could not be assessed and patients with incomplete medical records or no short-term follow up were excluded. The primary outcome was an adverse short-term outcome – wound or surgical-site infection, delayed wound healing, reoperation, hospitalization >30 days, hospital readmission, major medical complication, or in-hospital mortality.

Data Collection

The patients were selected from the emergency department, orthopedic and hospital records by non-probability consecutive sampling technique after approval of the Institutional Ethical Review Committee. Demographic and clinical data such as age, gender, BMI, diabetes type, diabetes duration, antidiabetic therapy, HbA1c, blood sugars at presentation, hypertension, IHD, CKD, peripheral neuropathy, peripheral vascular disease, DR, and history of previous diabetic foot problems were gathered. Fracture-related characteristics included the mechanism of injury, anatomical site of fracture, open vs closed fracture, fracture displacement, fracture comminution, presence of associated soft-tissue injury, neurovascular status, and the necessity of emergency fracture reduction. Management variables identified were conservative treatment, internal fixation, external fixation, time from presentation to surgery, antibiotic therapy, thromboprophylaxis and perioperative glycemic control. Short-term outcomes included wound infection, delayed wound healing, postoperative medical complications, reoperation, length of hospital stay, readmission within 30 days, limb threatening complications and hospital mortality.

Statistical Analysis

The analysis of the data was carried out by SPSS version 26.0. Data for continuous variables were reported as mean±standard deviation or median with interquartile range (IQR) depending on the distribution of the data, and data for categorical variables were reported in terms of frequencies and percentages. Independent t-test, Mann–Whitney U test, Chi-square test, or Fisher's exact test were used to compare patients with and without adverse short-term outcomes with continuous variables and categorical variables, respectively. Adverse outcome variables significant on univariate analysis were entered in a multivariable binary logistic regression to determine independent predictors. Odds ratios with 95% confidence intervals were presented. A p-value ≤0.05 was considered statistically significant.

Results

Patients with adverse outcomes were older (67.79±11.96 vs. 59.42±12.31 years), had longer diabetes duration (15.42±6.91 vs. 10.36±6.12 years), higher HbA1c (9.64±1.65% vs. 7.91±1.48%), and higher admission glucose (274.69±85.42 vs. 195.62±69.81 mg/dL), all p<0.001. Peripheral neuropathy, peripheral vascular disease, chronic kidney disease, retinopathy, insulin use, and previous diabetic foot problems were also significantly more common among patients with adverse outcomes.

Table I. Baseline Characteristics and Diabetes-Related Risk Factors According to Short-Term Outcome

Characteristic	Total (n=180)	No adverse outcome (n=128)	Adverse outcome (n=52)	p-value
Age, years, Mean±SD	61.84±12.76	59.42±12.31	67.79±11.96	<0.001
Male, n (%)	102 (56.7)	70 (54.7)	32 (61.5)	0.402
BMI, kg/m², Mean±SD	27.18±4.62	27.34±4.51	26.79±4.91	0.471
Duration of diabetes, years, Mean±SD	11.82±6.74	10.36±6.12	15.42±6.91	<0.001
Type 2 diabetes, n (%)	164 (91.1)	118 (92.2)	46 (88.5)	0.431
Insulin therapy, n (%)	81 (45.0)	48 (37.5)	33 (63.5)	0.002
HbA1c, %, Mean±SD	8.41±1.72	7.91±1.48	9.64±1.65	<0.001
Admission glucose, mg/dL, Mean±SD	218.46±82.73	195.62±69.81	274.69±85.42	<0.001
Hypertension, n (%)	116 (64.4)	77 (60.2)	39 (75.0)	0.059
Peripheral neuropathy, n (%)	72 (40.0)	40 (31.3)	32 (61.5)	<0.001
Peripheral vascular disease, n (%)	38 (21.1)	19 (14.8)	19 (36.5)	0.001
Chronic kidney disease, n (%)	41 (22.8)	20 (15.6)	21 (40.4)	<0.001
Diabetic retinopathy, n (%)	48 (26.7)	28 (21.9)	20 (38.5)	0.023
Previous diabetic foot problem, n (%)	29 (16.1)	13 (10.2)	16 (30.8)	0.001

Adverse outcomes were more frequent in patients with open fractures (32.7% vs. 10.9%, p<0.001), displaced fractures (73.1% vs. 55.5%, p=0.029), comminuted fractures (46.2% vs. 23.4%, p=0.003), significant soft-tissue injury (42.3% vs. 14.1%, p<0.001), and neurovascular compromise (15.4% vs. 3.9%, p=0.009). Hip fractures were the most common fracture type overall (30.6%).

Table II. Fracture Pattern and Injury Characteristics

Fracture characteristic	Total (n=180)	No adverse outcome (n=128)	Adverse outcome (n=52)	p-value
Hip fracture, n (%)	55 (30.6)	35 (27.3)	20 (38.5)	0.140
Femoral shaft/distal femur, n (%)	29 (16.1)	20 (15.6)	9 (17.3)	0.782
Tibia/fibula fracture, n (%)	38 (21.1)	24 (18.8)	14 (26.9)	0.222
Ankle fracture, n (%)	36 (20.0)	29 (22.7)	7 (13.5)	0.161
Foot fracture, n (%)	22 (12.2)	20 (15.6)	2 (3.8)	0.028
Low-energy fall, n (%)	111 (61.7)	77 (60.2)	34 (65.4)	0.513
High-energy trauma, n (%)	69 (38.3)	51 (39.8)	18 (34.6)	0.513
Open fracture, n (%)	31 (17.2)	14 (10.9)	17 (32.7)	<0.001
Displaced fracture, n (%)	109 (60.6)	71 (55.5)	38 (73.1)	0.029
Comminuted fracture, n (%)	54 (30.0)	30 (23.4)	24 (46.2)	0.003
Significant soft-tissue injury, n (%)	40 (22.2)	18 (14.1)	22 (42.3)	<0.001
Neurovascular compromise, n (%)	13 (7.2)	5 (3.9)	8 (15.4)	0.009

Time to surgery was longer among patients with adverse outcomes (39.54±21.39 vs. 27.82±15.94 hours, p=0.002), while perioperative glucose >200 mg/dL was more frequent (75.0% vs. 34.4%, p<0.001). Wound infection occurred in 13.9%, delayed healing in 12.8%, reoperation in 7.8%, 30-day readmission in 8.9%, and mortality in 3.3%. Mean hospital stay was significantly longer among those with adverse outcomes (12.52±6.53 vs. 5.91±3.42 days, p<0.001).

Table III. Management Characteristics and Short-Term Clinical Outcomes

Variable	Total (n=180)	No adverse outcome (n=128)	Adverse outcome (n=52)	p-value
Operative management, n (%)	132 (73.3)	91 (71.1)	41 (78.8)	0.287
Conservative management, n (%)	48 (26.7)	37 (28.9)	11 (21.2)	0.287
Time to surgery, hours, Mean±SD*	31.46±18.72	27.82±15.94	39.54±21.39	0.002
Perioperative glucose >200 mg/dL, n (%)	83 (46.1)	44 (34.4)	39 (75.0)	<0.001
Surgical-site/wound infection, n (%)	25 (13.9)	0 (0.0)	25 (48.1)	—
Delayed wound healing, n (%)	23 (12.8)	0 (0.0)	23 (44.2)	—
Major medical complication, n (%)	18 (10.0)	0 (0.0)	18 (34.6)	—
Reoperation, n (%)	14 (7.8)	0 (0.0)	14 (26.9)	—

30-day readmission, n (%)	16 (8.9)	0 (0.0)	16 (30.8)	—
Limb-threatening complication, n (%)	8 (4.4)	0 (0.0)	8 (15.4)	—
In-hospital mortality, n (%)	6 (3.3)	0 (0.0)	6 (11.5)	—
Hospital stay, days, Mean±SD	7.82±5.36	5.91±3.42	12.52±6.53	<0.001

*Among patients undergoing operative management.

Independent predictors of adverse outcomes included open fracture (OR 3.91), HbA1c ≥9% (OR 3.76), significant soft-tissue injury (OR 3.36), peripheral vascular disease (OR 3.12), admission glucose ≥250 mg/dL (OR 2.89), chronic kidney disease (OR 2.74), peripheral neuropathy (OR 2.68), diabetes duration ≥10 years (OR 2.47), delayed surgery >48 hours (OR 2.43), and age ≥65 years (OR 2.21), all statistically significant.

Table IV. Independent Predictors of Adverse Short-Term Outcomes

Predictor	Adjusted OR (95% CI)	p-value
Age ≥65 years	2.21 (1.06–4.62)	0.035
Diabetes duration ≥10 years	2.47 (1.15–5.29)	0.020
HbA1c ≥9%	3.76 (1.72–8.23)	0.001
Admission glucose ≥250 mg/dL	2.89 (1.32–6.35)	0.008
Peripheral neuropathy	2.68 (1.24–5.81)	0.012
Peripheral vascular disease	3.12 (1.35–7.21)	0.008
Chronic kidney disease	2.74 (1.22–6.16)	0.015
Open fracture	3.91 (1.65–9.27)	0.002
Significant soft-tissue injury	3.36 (1.45–7.78)	0.005
Surgery delayed >48 hours	2.43 (1.07–5.53)	0.034

Discussion

In the present study, there were adverse short-term outcomes in 52 of 180 diabetic patients with LLFs. The incidence of surgical-site or wound infection was 13.9%, delayed wound healing, 12.8%, reoperation, 7.8%, in-hospital mortality, 3.3%, and 30-day readmission, 8.9%. Patients having adverse outcomes also had significantly longer duration of hospital stay (12.52±6.53 vs. 5.91±3.42 days). As in previous studies that analyzed patients who underwent surgical treatment of ankle fractures, diabetes was found to be a significant independent risk factor for increased postoperative complications, mortality, and longer hospital stay (by about 1 day) compared to non-diabetic patients [17]. One of the most significant findings was poor glycemic control. Patients with adverse outcomes had significantly higher HbA1c (9.64±1.65% vs. 7.91±1.48%) and admission glucose (274.69±85.42 vs. 195.62±69.81 mg/dL). The admission glucose ≥250 mg/dL was associated with a nearly three-fold (OR 2.89) increase in the odds of adverse outcome, and the HbA1c ≥9% was associated with a nearly four-fold (OR 3.76) increase in odds of adverse outcome. Correlation of HbA1c >7% with bone-healing complications has also been seen in previous studies of diabetic patients undergoing foot and ankle procedures [18]. Another prior study showed that diabetic patients with HbA1c < 8% had a 90.0% fracture union rate while those with HbA1c ≥ 8% had a 62.5% rate, demonstrating the relationship between poor glycemic control and non-union [19]. Frequent adverse outcomes were associated with peripheral neuropathy (61.5% vs 31.3% in those who did not have adverse outcomes; OR 2.68). A prior study with 165 diabetic patients also found that the most important diabetes-related factor for nonunion, delayed union or malunion of the foot and ankle surgery was peripheral neuropathy [18]. Peripheral neuropathy can create a risk by reducing protective sensation, changing the way the body is loaded, delaying injury recognition, and the way recovery occurs.

Poor outcome also was strongly associated with peripheral vascular disease, occurring in 36.5% of patients with poor outcome vs 14.8% of those without poor outcome, and was an independent risk factor more than 3-fold (OR 3.12). Decreased tissue perfusion may lead to a decreased oxygen supply, impaired wound healing and decreased resistance to infection. Similarly, studies of DLD have shown that complicated vascular and other types of diabetic illness are linked with significantly higher post-operative wound and healing complications [20]. Another important predictor was chronic kidney disease (40.4% of the patients with adverse outcomes vs 15.6% of those without) which also raised the risk of adverse outcomes (OR 2.74). Previous studies have evaluated the risk of nonunion after ankle fracture in 439 patients and have found approximately 7.7-fold and >3-fold higher risk of nonunion associated with dialysis and diabetes, respectively [21]. Renal dysfunction may thus be an indicator of a population with more advanced systemic diabetic disease, changes in mineral metabolism, vascular dysfunction, and decreased healing ability. Fracture severity was strongly related to prognosis. Open fractures (32.7% vs. 10.9%) and comminution (46.2% vs. 23.4%) and significant soft-tissue injury (42.3% vs. 14.1%) and neurovascular compromise (15.4% vs. 3.9%) were also more common in patients with adverse outcomes. Open fracture (OR 3.91) and major soft-tissue injury (OR 3.36) were the most important injury-related factors of significance. In a previous study with 335 distal femoral fractures, diabetes was found to be an independent risk factor for reoperation as a method of achieving union and preventing deep infection, as well as open fracture [22]. In a previous study of diabetic ankle fractures, nonunion, infection, wound complications, and Charcot arthropathy were found to be more common, and that a more severe fracture was associated with nonunion [21].

Timing of operative management also seemed to be a factor. In surgically treated patients, delay beyond 48 hours was the only independent risk factor for adverse outcome (OR 2.43) and mean time to surgery was 39.54±21.39 hours in adverse outcome group and 27.82±15.94 hours in no adverse outcome group ($p=0.002$). A similar study of the fixation of ankle fractures found that surgical-site infection rates were significantly higher if fixation is not performed within the first few days after injury [23]. This study has certain limitations. It has a retrospective, single-center design which could result in selection and documentation bias and restrict generalizability. Some estimates may be less precise due to the relatively small sample size. Long-term healing of the fracture, functional recovery and complications after healing were not evaluated and not all of the patients had bone mineral density and detailed vascular status.

Conclusion

Adverse short-term outcomes in diabetic patients with lower limb fractures were associated with poor glycemic control, peripheral neuropathy, peripheral vascular disease, chronic kidney disease, open fractures, significant soft-tissue injury, longer diabetes duration, advanced age, and delayed surgery. Open fracture and HbA1c ≥9% were the strongest predictors. Early metabolic optimization, careful assessment of diabetic complications, and timely fracture management may help reduce complications and improve short-term outcomes.

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