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Complications and associated risk factors after surgical management of proximal femoral fractures

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Aims

This work aimed at answering the following research questions: 1) What is the rate of mechanical complications, nonunion and infection for head/neck femoral fractures, intertrochanteric fractures, and subtrochanteric fractures in the elderly USA population? and 2) Which factors influence adverse outcomes?

Methods

Proximal femoral fractures occurred between 1 January 2009 and 31 December 2019 were identified from the Medicare Physician Service Records Data Base. The Kaplan-Meier method with Fine and Gray sub-distribution adaptation was used to determine rates for nonunion, infection, and mechanical complications. Semiparametric Cox regression model was applied incorporating 23 measures as covariates to identify risk factors.

Results

Union failure occured in 0.89% (95% confidence interval (CI) 0.83 to 0.95) after head/neck fracturs, in 0.92% (95% CI 0.84 to 1.01) after intertrochanteric fracture and in 1.99% (95% CI 1.69 to 2.33) after subtrochanteric fractures within 24 months. A fracture-related infection was more likely to occur after subtrochanteric fractures than after head/neck fractures (1.64% vs 1.59%, hazard ratio (HR) 1.01 (95% CI 0.87 to 1.17); $p < 0.001$) as well as after intertrochanteric fractures (1.64% vs 1.13%, HR 1.31 (95% CI 1.12 to 1.52); $p < 0.001$). Anticoagulant use, cerebrovascular disease, a concomitant fracture, diabetes mellitus, hypertension, obesity, open fracture, and rheumatoid disease was identified as risk factors. Mechanical complications after 24 months were most common after head/neck fractures with 3.52% (95% CI 3.41 to 3.64; currently at risk: 48,282).

Conclusion

The determination of complication rates for each fracture type can be useful for informed patient-clinician communication. Risk factors for complications could be identified for distinct proximal femur fractures in elderly patients, which are accessible for therapeutical treatment in the management.

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Keywords: Proximal femur fracture, Risk factors, Complications, Union failure, Fracture-related infection

Introduction

Proximal femur fractures (PFFs) are among the most common type of fractures. These can be caused by a variety of factors such as falls, osteoporosis, and trauma. PFFs primarily affect elderly individuals, and comorbitant injuries are common.[1] The incidence is expected to rise as the ageing population increases.[2] Projections have estimated that the annual prevalence would heighten from 1.26 million in 1990 to 4.5 million by 2050.[3]

PFFs can have significant consequences including increased morbidity, decreased quality of life, and one-year mortality rates up to 23%.[4-6] Additionally, PFFs are associated with high healthcare costs including long hospitalization periods, surgery, and rehabilitation and thus, it was ranked as the

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13th most expensive diagnosis.[7] A meta-analysis revealed one-year healthcare costs of USD $43,000 per patient.[8] Treatment for PFF typically involves surgical intervention such as hip arthroplasty or internal fixation. For femoral neck fractures, a high number of arthroplasties is reported,[9] while intertrochanteric and subtrochanteric fractures are mainly treated with nailing. [10,11]

Despite advances in surgical techniques as well as interdisciplinary treatment approaches, complications such as failure of bony union, or the occurrence of a fracture-related infection, are still unavoidable. As optimal management including the considerations of risk factors for adverse events is critical for reducing the burden of this condition on both patients, and the healthcare systems, this work aimed at answering the following questions: 1) What is the rate of complications in terms of mechanical complications, nonunion and infection after surgical fixation of head/neck femoral fractures, intertrochanteric fractures, and subtrochanteric fractures in the elderly USA population? and 2) Which factors influence adverse outcomes?

Methods

Proximal femoral fractures occurring between 1 January 2009 and 31 December 2019 were identified from the Medicare Physician Service Records Data Base. These records encompassed services rendered in medical offices, clinics, hospitals, emergency departments, skilled nursing facilities, and other healthcare institutions. They were compiled by the Centres for Medicare and Medicaid Services (CMS) and, after deidentification, were made available for research, known as the Limited Data Set (LDS). CMS replaced the beneficiary's identity with a synthetic and unique ID in the LDS data sets, which allowed patients to be followed longitudinally for survivorship and outcomes analyses. The population of interest included elderly Medicare patients (aged 65 years and above). Since the CMS data are deidentified, it was exempt from review by the Institutional Review Board.

The International Classification of Diseases (ICD), Ninth and Tenth Revisions,[12,13] were used to identify femoral fractures from these physician records. Diagnoses in claims submitted before 1 October 2015 were recorded in ICD-9-CM and thereafter in ICD-10-CM. Several steps were implemented to ensure that the identified fracture was true, and was a new fracture. First, only records with fracture diagnosis listed as the primary diagnosis were retained. Second, there must be no fracture record of the same type in the previous year. Concurrent fracture of different parts of the femur (e.g. a head/neck fracture) was not uncommon, and was included. Some patients did experience the same type of fracture more than once during the ten-year study period, but from one fracture to the next, a minimal interval of one year was required to ensure that the next fracture was not associated with continued care for the previous fracture. Third, for fractures coded using ICD-10, the seventh digit must be "A", "B", or "C", indicating a new encounter with that condition. Fractures with diagnoses indicating postoperative care for healing of fracture, or codes that indicated malunion or nonunion, would not be counted because these conditions were consistent only with pre-existing fractures.

Three types of outcome analysis were investigated. They were: a) the likelihood of malunion or nonunion following the fracture, b) the risk of post-fracture infection, and c) mechanical complication following fracture repairs.

Statistical analysis. We used survival analysis techniques to analyze these outcomes. The Kaplan-Meier (KM) method, with the Fine and Gray sub-distribution adaptation, was used to calculate the cumulative incidence rate of the malunion/nonunion, infection, and mechanical complications.[14] We also used the semiparametric Cox regression with competing risk correction to investigate these outcomes and to compare the risk between different types of femoral fracture, after adjusting for a number of potential confounding factors. The Cox models incorporated demographic, clinical, and several community-level socioeconomic measures as covariates. The demographic factors included: age, sex, race, resident region, and Medicare buy-in (as a surrogate for patient's economic status). Clinical factors included were osteoporosis, obesity, diabetes mellitus, rheumatoid disease, chronic kidney disease, tobacco dependence, regular use of anticoagulant, regular insulin use, regular non-steroidal anti-inflammatory drugs (NSAID) use, hypertension, ischaemic heart disease, cerebrovascular disease, chronic obstructive pulmonary disease (COPD), and congestive heart failure. These conditions were identified from physician records in a one-year period prior to the fracture. Supplementary Table i provides the codes used to identify these conditions. These conditions could appear as either primary or secondary diagnosis, but at least two mentions of such condition in the prior year was required. All data processing and statistical analyses were performed using the SAS statistical software (Version 9.4; SAS Institute, USA) and significance was determined at $\alpha = 0.05$.

Results

Study population. A total of 163,091 proximal femoral fractures were identified. Out of these, 97,957 (60.0%) were head/neck fractures, 56,896 (34.9%) intertrochanteric fractures, and 8,238 (5.1%) subtrochanteric fractures. The majority of patients was in the age group 80 years or older (112,841, 69.2%). Patients were predominantly female (117,724, 72.2%) (Table I).

Union failure. The union failure rate rose from 0.44% (95% confidence interval (CI) 0.40 to 0.49; currently at risk: 65,263) after 12 months to 0.89% (95% CI 0.83 to

Table I. Demographic data and comorbidities of the study population.

	Fracture							
Variable	**All proximal femur Fx**		**Head/neck**		**Pertrochanteric**		**Subtrochanteric**	
Demographic	**Fx, n**	**Fx, %**	**Fx, n**	**Fx, %**	**Fx, n**	**Fx, %**	**Fx, n**	**Fx, %**
Total	163,091	100.0	97,957	100.0	56,896	100.0	8,238	100.0
Age at Fx, yrs								
65 to 69	10,150	6.2	6,303	6.4	3,270	5.7	577	7.0
70 to 74	16,926	10.4	10,385	10.6	5,567	9.8	974	11.8
75 to 79	23,174	14.2	14,357	14.7	7,603	13.4	1,214	14.7
80+	112,841	69.2	66,912	68.3	40,456	71.1	5,473	66.4
Medicare buy-in								
No buy-in	131,557	80.7	79,257	80.9	45,627	80.2	6,673	81.0
State buy-in	31,467	19.3	18,661	19.1	11,245	19.8	1,561	18.9
Unknown	67	0.0	39	0.0	24	0.0	4	0.0
Race								
Black	5,717	3.5	3,589	3.7	1,805	3.2	323	3.9
Other	6,455	4.0	3,806	3.9	2,301	4.0	348	4.2
White	150,919	92.5	90,562	92.5	52,790	92.8	7,567	91.9
Sex								
Female	117,724	72.2	70,618	72.1	41,023	72.1	6,083	73.8
Male	45,367	27.8	27,339	27.9	15,873	27.9	2,155	26.2
USA regions								
Midwest	37,638	23.1	22,501	23.0	13,184	23.2	1,953	23.7
Northeast	30,454	18.7	18,100	18.5	10,783	19.0	1,571	19.1
South	67,592	41.4	40,778	41.6	23,449	41.2	3,365	40.8
West	27,407	16.8	16,578	16.9	9,480	16.7	1,349	16.4
Urban-rural								
Metro large	73,698	45.2	44,266	45.2	25,871	45.5	3,561	43.2
Metro medium	36,051	22.1	21,652	22.1	12,537	22.0	1,862	22.6
Metro small	18,352	11.3	11,118	11.3	6,291	11.1	943	11.4
Non-metro large urban	13,080	8.0	7,807	8.0	4,588	8.1	685	8.3
Non-metro small urban	17,688	10.8	10,598	10.8	6,139	10.8	951	11.5
Total rural	4,165	2.6	2,480	2.5	1,452	2.6	233	2.8
Clinical								
Anticoagulant use								
No	151,796	93.1	91,161	93.1	53,062	93.3	7,573	91.9
Yes	11,295	6.9	6,796	6.9	3,834	6.7	665	8.1
COPD								
No	135,290	83.0	81,389	83.1	46,996	82.6	6,905	83.8
Yes	27,801	17.0	16,568	16.9	9,900	17.4	1,333	16.2
Cerebrovascular disease								
No	140,977	86.4	84,614	86.4	49,127	86.3	7,236	87.8
Yes	22,114	13.6	13,343	13.6	7,769	13.7	1,002	12.2
Chronic kidney disease								
No	141,984	87.1	85,311	87.1	49,480	87.0	7,193	87.3
Yes	21,107	12.9	12,646	12.9	7,416	13.0	1,045	12.7
Congestive heart failure								
No	137,542	84.3	82,919	84.6	47,745	83.9	6,878	83.5
Yes	25,549	15.7	15,038	15.4	9,151	16.1	1,360	16.5
Concomitant Fx								
No	146,471	89.8	87,746	89.6	51,223	90.0	7,502	91.1
Yes	16,620	10.2	10,211	10.4	5,673	10.0	736	8.9
Diabetic Dx								
No	124,818	76.5	75,401	77.0	43,292	76.1	6,125	74.4
Yes	38,273	23.5	22,556	23.0	13,604	23.9	2,113	25.6
Fall-related Fx								
No	134,387	82.4	80,945	82.6	46,501	81.7	6,941	84.3

Continued

Table I. Continued

Variable	Fracture							
	All proximal femur Fx		Head/neck		Pertrochanteric		Subtrochanteric	
Demographic	**Fx, n**	**Fx, %**	**Fx, n**	**Fx, %**	**Fx, n**	**Fx, %**	**Fx, n**	**Fx, %**
Yes	28,704	17.6	17,012	17.4	10,395	18.3	1,297	15.7
Hypertensive disease								
No	53,065	32.5	31,964	32.6	18,522	32.6	2,579	31.3
Yes	110,026	67.5	65,993	67.4	38,374	67.4	5,659	68.7
Insulin use								
No	161,317	98.9	96,952	99.0	56,239	98.8	8,126	98.6
Yes	1,774	1.1	1,005	1.0	657	1.2	112	1.4
Ischaemic heart disease								
No	124,648	76.4	74,975	76.5	43,326	76.1	6,347	77.0
Yes	38,443	23.6	22,982	23.5	13,570	23.9	1,891	23.0
Morbid obesity								
No	162,180	99.4	97,432	99.5	56,597	99.5	8,151	98.9
Yes	911	0.6	525	0.5	299	0.5	87	1.1
NSAID use								
No	162,990	99.9	97,893	99.9	56,864	99.9	8,233	99.9
Yes	101	0.1	64	0.1	32	0.1	5	0.1
Open Fx								
No	161,440	99.0	96,902	98.9	56,425	99.2	8,113	98.5
Yes	1,651	1.0	1,055	1.1	471	0.8	125	1.5
Opioid use								
No	162,525	99.7	97,615	99.7	56,694	99.6	8,216	99.7
Yes	566	0.3	342	0.3	202	0.4	22	0.3
Osteoporosis Dx								
No	144,726	88.7	87,377	89.2	50,277	88.4	7,072	85.8
Yes	18,365	11.3	10,580	10.8	6,619	11.6	1,166	14.2
Prior osteoporotic Fx								
No	159,367	97.7	95,813	97.8	55,547	97.6	8,007	97.2
Yes	3,724	2.3	2,144	2.2	1,349	2.4	231	2.8
Rheumatoid arthritis								
No	159,082	97.5	95,501	97.5	55,570	97.7	8,011	97.2
Yes	4,009	2.5	2,456	2.5	1,326	2.3	227	2.8
Tobacco dependence								
No	159,809	98.0	96,047	98.1	55,661	97.8	8,101	98.3
Yes	3,282	2.0	1,910	1.9	1,235	2.2	137	1.7
Vehicle-related Fx								
No	162,842	99.8	97,827	99.9	56,799	99.8	8,216	99.7
Yes	249	0.2	130	0.1	97	0.2	22	0.3

COPD, chronic obstructive pulmonary disease; Dx, diagnosis; Fx, fracture; NSAID, non-steroidal anti-inflammatory drugs.

0.95; currently at risk: 49,618) after 24 months for head/neck fractures, from 0.45% (95% CI 0.39 to 0.51; currently at risk: 36,967) after 12 months to 0.92% (95% CI 0.84 to 1.01, currently at risk: 27,691) after 24 months for intertrochanteric fractures and from 1.23% (95% CI 1.00 to 1.40, currently at risk: 5,625) after 12 months to 1.99% (95% CI 1.69 to 2.33, currently at risk: 4,380) after 24 months for subtrochanteric fractures (Figure 1). Union failure was significantly less common in patients aged 75 to 79 years (hazard ratio (HR) 0.73 (95% CI 0.63 to 0.84); $p < 0.001$) and in patients older than 80 years (HR 0.42 (95% CI 0.37 to 0.47); $p < 0.001$) compared to patients aged 65 to 69 years. Further, in comparison to femoral neck fractures, failure of union was more likely to occur after subtrochanteric fractures (HR 1.54 (95% CI 1.39 to 1.71); $p < 0.001$). Significant risk factors included cerebrovascular disease, concomitant fracture, congestive heart failure, fall-related fracture, hypertension, osteoporosis, and rheumatoid disease (Table II).

Fracture-related infection. For all three fracture types, the occurrence of a fracture-related infection increased with time (Figure 2). The infection rate rose from 0.51% (95% CI 0.46 to 0.55; currently at risk: 90,101) after one month, to 1.59% (95% CI 1.51 to 1.67; currently at risk: 49,449) after 24 months for head/neck fractures, from 0.32% (95% CI 0.28 to 0.37; currently at risk: 52,057)

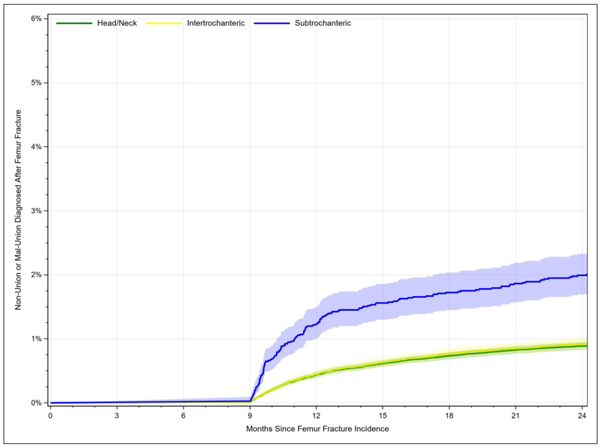

Fig. 1

Risk of proximal femur fracture consolidation failure (malunion or nonunion) as a function of time.

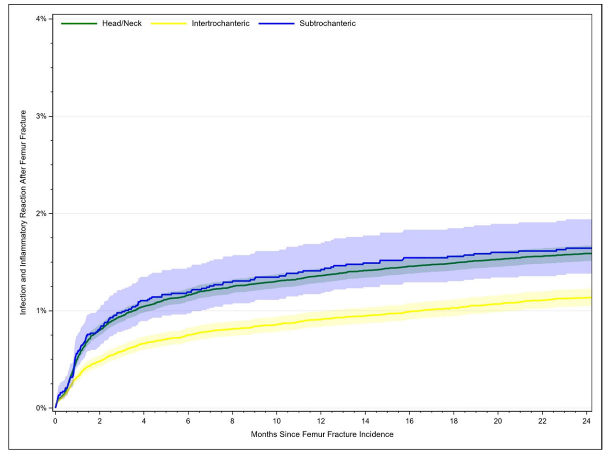

Fig. 2

Risk of fracture-related infections after proximal femur fracture as a function of time.

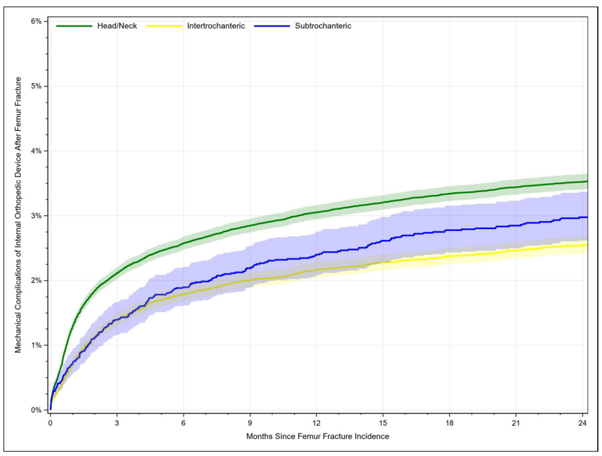

Fig. 3

Risk of mechanical complications after proximal femur fracture as a function of time.

after one month to 1.13% (95% CI 1.05 to 1.23; currently at risk: 27,708) after 24 months for intertrochanteric fractures and from 0.56% (95% CI 0.42 to 0.74; currently at risk: 7,575) after one month to 1.64% (95% CI 1.38 to 1.94; currently at risk: 4,431)) after 24 months for subtrochanteric fractures. A fracture-related infection was more likely to occur after subtrochanteric fractures than after head/neck fractures (HR 1.01 (95% CI 0.87 to 1.17); p < 0.001) as well as after intertrochanteric fractures (HR 1.31 (95% CI 1.12 to 1.52); p < 0.001).

The occurrence of a fracture-related infection was significantly less common in patients aged 70 to 74 years (HR 0.83 (95% CI 0.70 to 0.99); p = 0.036), in patients aged 75 to 79 years (HR 0.62 (95% CI 0.52 to 0.74); p < .001) and in patients older than 80 years (HR 0.33 (95% CI 0.28 to 0.39); p < 0.001) compared to patients aged 65 to 69 years. Further significant risk factors included anticoagulant use, cerebrovascular disease, a concomitant fracture, diabetes mellitus, hypertension, obesity, open fracture, and rheumatoid disease (Table I).

Mechanical complications. Mechanical complications were also found to increase with time in proximal femoral fractures (Figure 3). The complication rate rose from 1.28% (95% CI 1.21 to 1.3; currently at risk: 89,410) after one month to 3.52% (95% CI 3.41 to 3.64; currently at risk: 48,282) after 24 months for head/neck fractures, from 0.69% (95% CI 0.63 to 0.76; currently at risk: 51,863) after one month to 2.54% (95% CI 2.41 to 2.68; currently at risk: 27,207) after 24 months for intertrochanteric fractures and from 0.72% (95% CI 0.55 to 0.92; currently at risk: 7,562) after one month to 2.98% (95% CI 2.62 to 3.37; currently at risk: 4,351) after 24 months for subtrochanteric fractures. A mechanical complication was more likely to occur after head/neck fractures compared to intertrochanteric fractures (HR 1.35 (95% CI 1.29 to 1.40); p < 0.001) and subtrochanteric fractures (HR 1.20 (95% CI: 1.07 to 1.35); p < 0.001).

The occurrence of a mechanical complication was significantly less common in patients aged 75 to 79 years (HR 0.73 (95% CI 0.65 to 0.83); p < 0.001) and in patients older than 80 years (HR 0.45 (95% CI 0.40 to 0.50); p < 0.001) compared to patients aged 65 to 69 years. Further significant risk factors included COPD, cerebrovascular disease, congestive heart failure, fall-related fracture, hypertension, rheumatoid disease, and poverty (Table I).

Discussion

The present analysis provides an estimation of complication rates after PFF, with its associated risk factors, based on Medicare registry data of elderly patients. Impaired fracture consolidation was reported in 0.89% of head/neck fractures and 0.92% of intertrochanteric fractures after 24 months. Subtrochanteric fractures

Table II. Multivariate analysis of risk factors for union failure, fracture-related infection, and mechanical complications after proximal femur fractures.

Factor	Union failure			Fracture-related infection			Mechanical complications		
	HR (95% CI)	**χ2**	**p-value**	**HR (95% CI)**	**χ2**	**p-value**	**HR (95% CI)**	**χ2**	**p-value**
Age 70 to 74 yrs	0.90 (0.78 to 1.04)	2.06	0.151	0.83 (0.70 to 0.99)	4.39	0.036	0.90 (0.79 to 1.03)	2.36	
Age 75 to 79 yrs	0.73 (0.63 to 0.84)	19.65	< 0.001	0.62 (0.52 to 0.74)	27.62	< 0.001	0.73 (0.65 to 0.83)	22.96	< 0.001
Age 80+ yrs	0.42 (0.37 to 0.47)	180.28	< 0.001	0.33 (0.28 to 0.39)	184.26	< 0.001	0.45 (0.40 to 0.50)	189.24	< 0.001
Female sex	0.98 (0.90 to 1.08)	0.11	0.736	1.11 (0.99 to 1.25)	3.08	0.079	1.04 (0.96 to 1.13)	1.06	0.302
Anticoagulant use	1.04 (0.89 to 1.21)	0.24	0.621	1.36 (1.15 to 1.61)	12.60	< 0.001	1.02 (0.89 to 1.17)	0.11	0.735
COPD	0.95 (0.86 to 1.05)	1.00	0.317	0.99 (0.87 to 1.12)	0.04	0.842	0.90 (0.82 to 0.98)	5.25	0.022
Cerebrovascular disease	0.88 (0.79 to 0.99)	4.57	0.033	0.81 (0.69 to 0.94)	7.82	0.005	0.87 (0.79 to 0.97)	6.96	0.008
Chronic kidney disease	1.03 (0.91 to 1.16)	0.21	0.643	1.08 (0.93 to 1.25)	0.93	0.335	0.94 (0.84 to 1.05)	1.11	0.291
Concomitant fracture	1.20 (1.07 to 1.34)	9.92	0.002	1.16 (1.00 to 1.35)	3.90	0.048	0.96 (0.86 to 1.07)	0.49	0.483
Congestive heart failure	0.88 (0.79 to 0.99)	4.45	0.035	0.92 (0.80 to 1.06)	1.35	0.245	0.83 (0.75 to 0.93)	11.17	< 0.001
Diabetes mellitus	1.01 (0.92 to 1.11)	0.02	0.881	1.19 (1.06 to 1.34)	8.27	0.004	0.94 (0.86 to 1.02)	2.06	0.151
Fall-related fracture	0.90 (0.83 to 0.97)	6.89	0.009	0.95 (0.85 to 1.06)	0.93	0.335	0.90 (0.84 to 0.97)	8.27	0.004
Hypertensive disease	1.22 (1.11 to 1.33)	19.17	< 0.001	1.27 (1.13 to 1.43)	15.88	< 0.001	1.23 (1.14 to 1.33)	28.21	< 0.001
Insulin use	1.17 (0.86 to 1.61)	0.99	0.319	1.20 (0.82 to 1.75)	0.91	0.340	0.79 (0.55 to 1.14)	1.57	0.211
Ischemic heart disease	1.04 (0.94 to 1.14)	0.56	0.455	1.01 (0.89 to 1.14)	0.01	0.915	1.05 (0.96 to 1.15)	1.15	0.283
Morbid obesity	1.39 (0.96 to 2.01)	3.00	0.083	2.84 (2.10 to 3.84)	46.38	< 0.001	1.28 (0.92 to 1.80)	2.10	0.147
Open fracture	0.79 (0.58 to 1.07)	2.39	0.122	1.41 (1.05 to 1.89)	5.22	0.022	1.13 (0.90 to 1.42)	1.09	0.296
Osteoporosis	1.26 (1.13 to 1.42)	16.11	< 0.001	0.99 (0.85 to 1.16)	0.01	0.928	1.10 (0.99 to 1.23)	3.41	0.065
Rheumatoid disease	1.34 (1.10 to 1.63)	8.63	0.003	1.84 (1.45 to 2.33)	25.22	< 0.001	1.53 (1.29 to 1.81)	23.68	< 0.001
Tobacco dependence	1.07 (0.85 to 1.35)	0.32	0.573	1.02 (0.76 to 1.38)	0.02	0.892	1.03 (0.82 to 1.29)	0.06	0.807

CI, confidence interval; HR, hazard ratio.

were associated with a higher risk of union failure (1.99% (95% CI 1.69 to 2.33)). The rates were lower compared to findings in the literature. For instance, a multicentre, randomized trial showed a 21% revision rate after low-energy femoral neck fractures in patients aged over 50 years treated with sliding hip screw or cannulated screws. Further, only 67% of all fractures consolidated fully by 24 months.[15] Whereas here, cerebrovascular disease, concomitant fractures, congestive heart failure, fall-related fracture, hypertension, osteoporosis, and rheumatoid disease were determined as risk factors. Other studies have also found female sex, high BMI, and displaced fractures to be a prerequisite for necessary revision surgeries.[16,17]

The occurrence of a fracture-related infection was reported in 1.59% of head/neck fractures and 1.13% of intertrochanteric fractures after 24 months. Subtrochanteric fractures were associated with a higher risk of infection (1.64% (95% CI 1.38 to 1.94)). A recent meta-analysis of pooled data from 20 studies reporting on 88,615 patients estimating a incidence of 2.1% (95% CI 1.54 to 2.62), whereby infection incidences were higher after hemiarthroplasty (2.87% (95% CI 1.99 to 3.75)) compared to sliding hip screws (1.35% (95% CI 0.78 to 1.93)).[18] Comparable infection rates of 1.05% after proximal femoral fractures were also reported.[19] Determined risk factors included anticoagulant use, cerebrovascular disease, a concomitant fracture, diabetes mellitus, hypertension, obesity, open fracture, and rheumatoid disease. Other authors also found BMI (p = 0.031), corticosteroid therapy (p = 0.003), and anaemia (p = 0.041), length of hospital stay (15 vs 8 days, p < 0.001), and operating time (117 vs 77 minutes, p < 0.001) as associative factors in the development of an infection.[20,21]

This study revealed a maximum mechanical complication rate of 3.52% after head/neck fractures. The numbers were considerably lower compared to patients younger than 60 years, for which up to 10% out of 1,600 fractures have been reported.[22] Other investigations found 7% mechanical failure rates. [23,24]

A limitation of the study is that the data, based on the Medicare 5% sample equivalent to the records from approximately 1.6 million enrollees, are not truly a clinical data set, but administrative claims data. In particular, the coding of surgical therapies is often inaccurate from a surgical perspective and can only describe the exact surgical procedure to a limited extent. Therefore, detailed analysis of treatment concepts was not a focus of the present study. However, it was possible to ensure that all included patients underwent a surgical procedure for fracture fixation. In contrast, it can be assumed that the extensive information on patient characteristics and complications has a high level of quality due to its relevance for reimbursement of costs. In terms of the range of available parameters, the Medicare dataset is characterized by a richness of relevant parameters that is incomparable to other registry data.

In conclusion, despite a prevalence lower than 5%, complications after surgical management of PFFs can be challenging. The determination of complication rates for each fracture type can be useful for informed patient-clinician communication. Risk factors for complications could be identified for distinct PFFs in elderly patients, which are accessible for therapeutical treatment in the management of these complications.

Take home message

- The determination of complication rates for each fracture type can be useful for informed patient-clinician communication.
- Risk factors for complications could be identified for distinct proximal femur fractures in elderly patients, which are accessible for therapeutical treatment in the management of these complications.

Supplementary material

A table of the ICD-9 and ICD-10 codes of the clinical indicator used.

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