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COMORBIDITIES AND SHORT-TERM OUTCOMES AFTER PROXIMAL FEMORAL FRACTURE

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ABSTRACT

Background: Proximal femoral (hip) fractures are a major global health issue, primarily affecting older adults after low-energy falls in osteoporotic bone. Incidence is increased, with high morbidity, mortality, and healthcare costs. Fractures are classified as intracapsular or extracapsular, with biomechanical differences guiding treatment. **Objectives:** This study primarily aimed to assess the association between the Age-Adjusted Charlson Comorbidity Index (ACCI) and fracture-related complications, with secondary objectives evaluating mortality, and postoperative short functional outcomes in proximal femur fractures. **Methods:** This prospective longitudinal study conducted at Basrah Teaching Hospital for the duration from 1st of July 2024 till 1st of July 2025, included 104 surgically managed adults with proximal femoral fractures. Data collection involved sociodemographic, fracture type, comorbidity assessment Charlson Comorbidity Index (CCI) and Age-Adjusted Charlson Comorbidity Index (ACCI), clinical and radiological evaluation, and surgical intervention. Postoperative outcomes were assessed at 2 weeks and 3 months, including complications and functional recovery using the Oxford Hip Score. **Results:** The study included 104 patients (mean age 65.3 ± 8.5 years, 57 (54.8% female). Most were non-employed 81 (77.9%) and urban residents 64 (61.5%). Over half 59 (56.7%) had severe comorbidities (CCI Grade 3), and 79 (76%) were high-risk by ACCI. Extracapsular fractures 59 (56.7%) were more common, with ORIF performed in 58 (55.8%). Functional recovery improved significantly (OHS: 18.7 at 2 weeks → 31.2 at 3 months). Higher CCI and ACCI scores were significantly associated with poorer OHS at 2 weeks (p=0.004, p=0.003) and 3 months (p=0.002, p=0.001), lower improvement, and higher mortality (up to 8.5%), particularly in Grade 3/high-risk groups. **Conclusions:** Proximal femoral fractures mainly affect older adults with high comorbidity burden. Surgery improves function, but higher CCI/ACCI scores predict poorer recovery, higher mortality, and complications. ACCI showed superior prognostic value, underscoring the importance of comorbidity assessment for outcome prediction and risk stratification.

KEYWORDS: Chronic, Existent, Hip, Fracture, Results, Short.

1. INTRODUCTION

Proximal femoral (hip) fractures are a major global public health challenge. They predominantly affect older adults and are usually caused by low-energy falls in osteoporotic bone.[1] Worldwide hip fracture incidence was estimated at 1.5 million cases per year (in patients ≥55 years), projected to rise to 2.6 million by 2025 and 4.5 million by 2050. Population ageing has driven a recent increase in hip fracture rates among the elderly, even as rates in younger adults decline. Falls are the leading cause in all age groups.[2] Hip fractures lead to prolonged hospitalizations, high healthcare costs, functional dependency, and high mortality. In the United States, for example, hip fractures cause hospitalization of

~300,000 patients annually, with one-year mortality of 15–20% and many survivors never return to independent living.[3] Early (30-day) mortality is typically 5–10%, and one-year mortality ranges from 8 to 36% depending on age and comorbidity.[4] These injuries thus impose a heavy social and economic burden, underscoring the need to understand factors, especially patient comorbidities, that influence short-term outcomes.

The aim of this study was to determine the Age-adjusted Charlson Comorbidity Index (ACCI) in association with the increased fracture-related complications in proximal femur fractures and to assess the mortality, and function of recovery after surgery.

2. PATIENTS AND METHODS

The study protocol was approved by the Basrah Health Directorate and the ethical committee at Basrah University/ College of Medicine. Before participation, verbal and signed informed consent was obtained from all enrolled in the study.

This is a prospective longitudinal study conducted at Basrah Teaching Hospital, from the 1st of July 2024 till 1st of July 2025. One hundred and four patients presented with proximal femoral fractures were included in the study. The study included patients age ≥ 18 years, who diagnosed with a proximal femoral fracture (including intertrochanteric fractures, femoral neck fractures, and subtrochanteric fractures) undergoing surgical management during the study period and willing to participate and provide informed consent. On the other hand, the study excluded patients younger than 18 years of age (Skeletal Immaturity), patients with fractures occurring around previously implanted prosthetic devices or those with pathological Fractures such as metastatic bone disease or osteoporosis (diagnosed by DEXA) leading to spontaneous fractures without significant trauma, in addition to those who were unable to Participate in follow-up assessment.

Data were collected using a standardized questionnaire and structured clinical assessments; including, patients' sociodemographic such as patients' age, gender, occupation residency, marital status and educational level, patients' clinical and radiological characteristics such as side of injury, type of fracture if intra or extracapsular, patients' Charlson Comorbidity Index[5-6]: calculated for each participant to evaluate the burden of comorbidities. Additionally, patients' comorbidities such as diabetes, hypertension, chronic kidney disease, malignancy, and others are recorded and scored based on the CCI scale. The CCI score is categorized as follows:

- Grade 0: 0-No comorbidities (control group)
- Grade 1:1-Low comorbidity burden.
- Grade 2: 2- moderate comorbidity burden
- Grade 3: ≥3: High comorbidity burden.

For the purpose of this study, patients were stratified based on their ACCI scores into two risk categories: low-risk group (<5 points) and high-risk group (≥5 points). Then each patient had a detailed clinical examination generally and for the injured limb, assessment of pain, deformity and function, and neurovascular assessment checking for any nerve or vascular insult.

Then patients were sent for Radiographic imaging (X-ray) in abduction and external rotation, the standard anteroposterior and lateral views of the hip and femur. However, CT or MRI were performed for complex fractures or cases where X-rays were inconclusive.

The fracture was divided into intracapsular and extracapsular fractures. Intracapsular Fractures (femoral neck fractures) occur within the hip joint capsule and are prone to disrupting the blood supply to the femoral head, increasing the risk of avascular necrosis and non-union. Surgical options were either closed reduction with cannulated screw fixation or open reduction internal fixation (ORIF) or hemiarthroplasty (unipolar and bipolar) or total hip arthroplasty (THA). While extracapsular fractures (intertrochanteric and subtrochanteric fractures) occur outside the hip joint capsule, generally maintaining a better blood supply to the femoral head, leading to more effective healing. Surgical options included either closed reduction and proximal femoral nail arthroplasty (PFNA), or open reduction internal fixation or arthroplasty.

Patients were assessed for vital signs, general conditions and complications until discharge. Follow-up assessment was done 2 weeks and 3 months after surgery. The two-week assessment includes a physical examination, wound assessment, evaluation of early complications (DVT, infection and Bedsore) and functional assessment by Oxford hip score. As well as three-month assessments include a functional assessment by Oxford hip score.[7]

Data analysis was conducted using the Statistical Package for Social Sciences (SPSS) software, version 26. Comparative analyses were conducted using t-tests for continuous variables and chi-square tests for categorical data. Functional improvement was evaluated by comparing OHS scores at 2 weeks and 3 months. A p-value ≤ 0.05 was considered statistically significant.

3. RESULTS

The study population had a mean age of 65.3 ± 8.5 years (range: 47–81). Females represented 57 (54.8%) of the sample. Regarding educational status, 32 (30.8%) were illiterate, and 41 (39.4%) had only primary education. The majority were non-employed 81 (77.9%) and urban residents 64 (61.5%), as shown in Table 3.1.

Table 3.1: Sociodemographic characteristics among patients (No =104).

Variables		No. (%)
Age	**Mean± sd Range**	65.3± 8.5 (47-81)
Sex	**Male**	47 (45.2)
	Female	57 (54.8)
Education	**Illiterate**	32 (30.8)
	Primary	41 (39.4)
	Secondary	20 (19.2)
	College	11 (10.6)
Occupation	**Employed**	23 (22.1)
	Non employed	81 (77.9)
Residency	**Rural**	40 (38.5)
	Urban	64 (61.5)
Total	**104**	100.0

Table 2 shows the Standard Charlson Comorbidity Index (CCI) Among Patients. Over half of the patients 59 (56.7%) had a CCI Grade 3, indicating multiple or severe comorbid conditions. Only 5 (4.8%) had no comorbidities. As shown in Table 3.2 and Figure 3.1.

Table 3.2: The Standard Charlson Comorbidity Index (CCI) among patients

CCI	No.	%
Grade 0	5	4.8
Grade 1	16	15.4
Grade 2	24	23.1
Grade 3	59	56.7

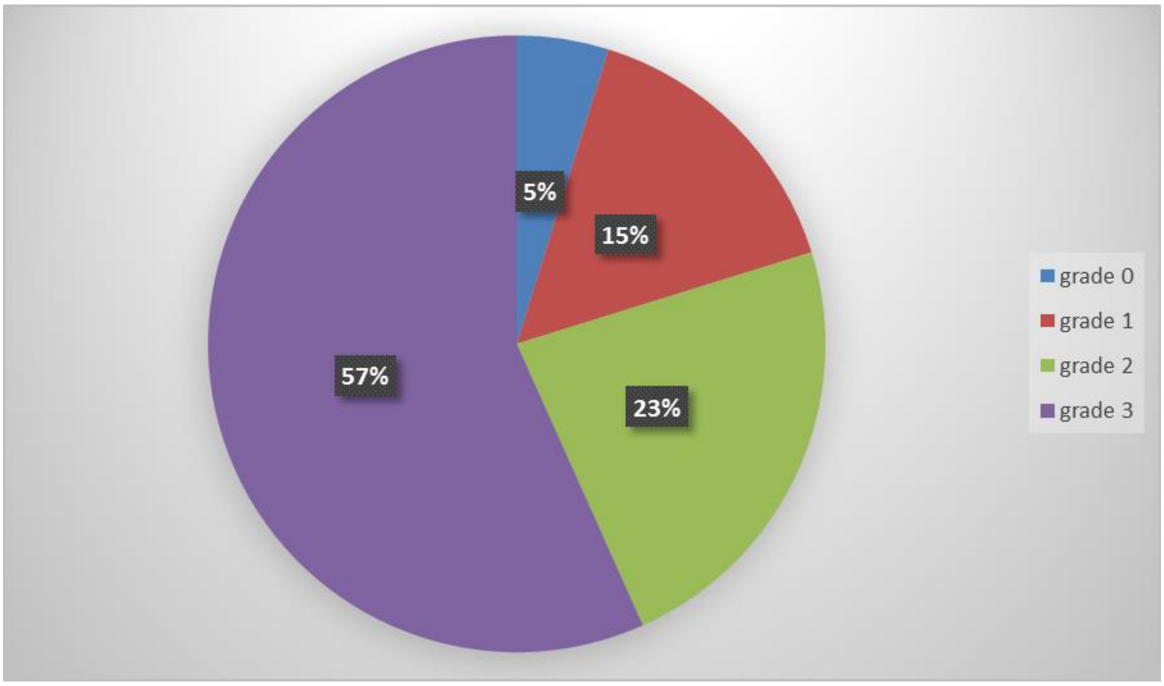

Figure 3.1: The distribution of standard CCI.

Table 3.3 shows the Age-Adjusted Charlson Comorbidity Index (ACCI) Among Patients. Incorporating age into the CCI further stratified patients' risk. 79 (76.0%) were classified as high-risk (ACCI ≥ 5), while only 25 (24.0%) were low-risk (<5).

Table 3.3: The age-adjusted Charlson Comorbidity Index (ACCI) among patients.

ACCI	No.	%
Low risk <5	25	24.0
High risk 5	79	76.0
Total	104	100.0

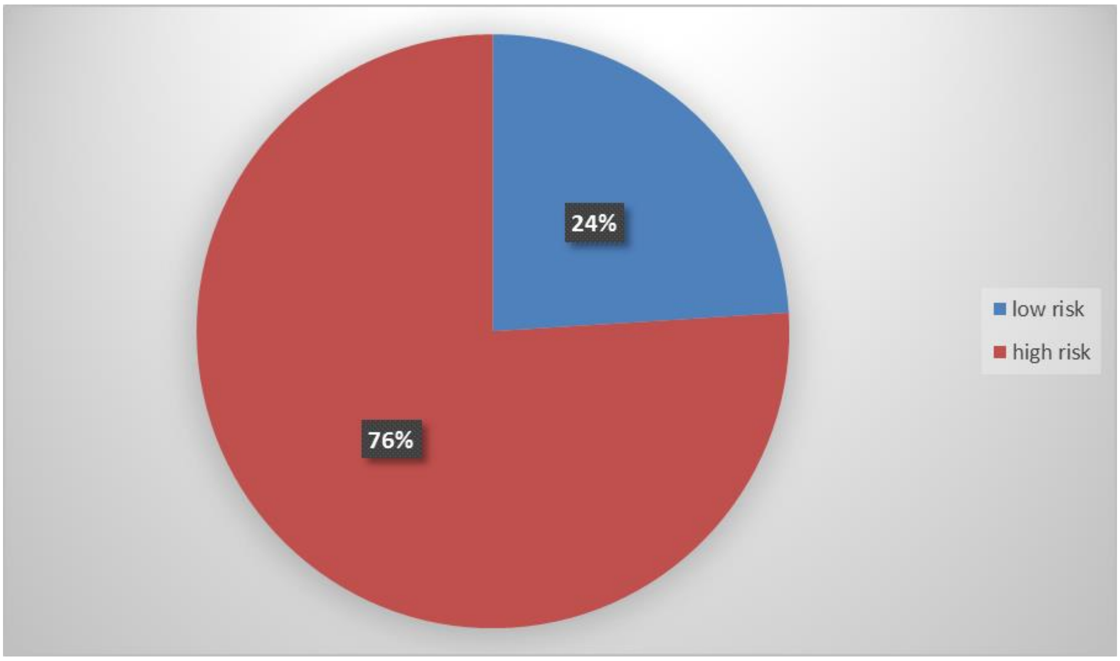

Figure 3.2: The distribution of ACCI.

The Injury-related Variables among Patients are shown in Table 3.4. The distribution of injuries was fairly balanced by side, with a slight predominance of right-sided fractures 56 (53.8%). Extracapsular fractures 59 (56.7%) were more common than intracapsular types. Regarding treatment, 58 (55.8%) of patients underwent open reduction and internal fixation (ORIF), while the remainder received arthroplasty.

Table 3.4: The injury-related variables among patients.

Variables		No.	%
Side of injury	**Right**	56	53.8
	Left	48	46.2
Type of fracture	**Intracapsular**	45	43.3
	Extracapsular	59	56.7
Operative treatment	**ORIF**	58	55.8
	Arthroplasty	46	44.2
Total		104	100.0

Table 3.5 shows Surgery-Related Outcomes. Postoperative recovery showed positive trends. The mean Oxford Hip Score (OHS) improved from 18.7 ± 4.3 at 2 weeks to 31.2 ± 6.1 at 3 months. 88 (84.6%) of patients showed clinical improvement, with a mortality rate of 5.8% and complication rate of 9.6%. Complications included DVT 3(2.9%), infection 4 (3.8%), and bed sores 3 (2.9%).

Table 3.5: The surgery-related outcomes.

Variables		No (%)
Oxford hip score	**2 weeks post op (mean ± standard deviation)**	18.7± 4.3
	3 months post op (mean ± standard deviation)	31.2± 6.1
Postoperative outcomes	**Improved**	88 (84.6)
	Death	6 (5.8)
	Complication	10 (9.6)
Complication	**DVT**	3 (2.9)
	Infection	4 (3.8)
	Bed sore	3 (2.9)

Table 3.6 shows the Association between CCI and Patient Outcomes (All Patients). There was a significant inverse relationship between CCI and functional recovery. Patients with higher CCI scores had lower OHS at both 2 weeks (p=0.004) and 3 months (p=0.002). Additionally, mortality and complications were more frequent in those with Grade 3 CCI (8.5% mortality), and improvement rates were lower (81.4% in Grade 3 vs. 100% in Grade 0).

Table 3.6: The association between the CCI and patient outcomes among all patients.

CCI		Grade 0 (N=5)	Grade 1 (N=16)	Grade 2 (N=24)	Grade 3 (N=59)	p-value
Type of fracture	Intracapsular	3 (60.0)	8 (50.0)	10 (41.7)	24 (40.7)	0.410
	Extracapsular	2 (40.0)	8 (50.0)	14 (58.3)	35 (59.3)	
Oxford hip score	2 weeks post op (mean ± sd)	24.5±1.5	22.0± 2.8	19.3± 3.8	16.8± 4.2	0.004
	3 months post op (mean ± sd)	33.8 ± 3.5	31.5 ±4.2	28.2 ±5.0	25.0 ±5.8	0.002
Postoperative outcomes	Improved	5 (100.0)	14 (87.5)	21 (87.5)	48 (81.4)	0.003
	Death	0 (0.0)	0 (0.0)	1 (4.2)	5 (8.5)	
	Complication	0 (0.0)	2(12.5)	2 (8.3)	6(10.1)	
Early Complication	DVT	0 (0.0)	0 (0.0)	1(4.2)	2 (3.4)	0.754
	Infection	0 (0.0)	1(4.2)	1(4.2)	2 (3.4)	
	Bed sore	0 (0.0)	0 (0.0)	1(4.2)	2 (3.4)	

Table 3.7 shows the CCI and Outcomes in Patients with Extracapsular Fractures. Among patients with extracapsular fractures, a similar trend was observed. Higher CCI scores were significantly associated with lower OHS at both time points (p=0.006 and p=0.004). Improvement rates declined with increasing comorbidity, and mortality and complication rates were slightly higher in the high CCI group.

Table 3.7: The association between the CCI and patient outcomes among patients with extracapsular fractures.

CCI		Grade 0 (No.=2)	Grade 1 (No.=8)	Grade 2 (No.=14)	Grade 3 (No.=35)	p-value
Oxford hip score	**2 weeks post op (mean ± standard deviation)**	23.5± 1.8	21.2± 2.6	18.9 ± 3.6	16.3 ± 4.3	0.006
	3 months post op (mean ± standard deviation)	32.8 ± 3.3	30.2± 4.5	27.5± 4.8	24.1 ± 5.5	0.004
Postoperative outcomes	**Improved**	2 (100.0)	7 (87.5)	12 (85.7)	29 (82.9)	0.038
	Death	0 (0.0)	0 (0.0)	1 (7.1)	3 (8.6)	
	Complication	0 (0.0)	1(12.5)	1 (7.1)	3 (8.6)	

3.8. The association between the CCI and patient outcomes among patients with intracapsular fractures

Table 3.8 shows CCI and Outcomes in Patients with Intracapsular Fractures. In the intracapsular group, patients with higher CCI scores also demonstrated significantly lower functional scores at both 2 weeks (p=0.008) and 3 months (p=0.006). Improvement rates dropped from 100% (Grade 0) to 79.2% (Grade 3). Mortality and complications were confined to patients with higher CCI scores.

Table 3.8: The association between the CCI and patient outcomes among patients with intracapsular fractures.

CCI		Grade 0 (No.=3)	Grade 1 (No.=8)	Grade 2 (No.=10)	Grade 3 (No.=24)	p-value
Oxford hip score	**2 weeks post op (mean ± standard deviation)**	25.0± 1.4	22.8 ± 2.9	19.8± 3.7	17.3± 4.0	0.008
	3 months post op (mean ± standard deviation)	34.5± 3.0	32.5± 3.5	28.8± 4.7	26.0± 5.8	0.006
Postoperative outcomes	**Improved**	3 (100.0)	7 (87.5)	9 (90.0)	19 (79.2)	0.004
	Death	0 (0.0)	0 (0.0)	0 (0.0)	2 (8.3)	
	Complication	0(0.0)	1 (12.5)	1 (10.0)	3 (12.5)	

Table 3.9 shows the ACCI and Patient Outcomes (All Patients). When age was factored into comorbidity scoring, patients in the high-risk ACCI group had significantly worse outcomes, with lower OHS at both 2 weeks (p=0.003) and 3 months (p=0.001). Mortality occurred exclusively in the high-risk group (7.6%), and improvement was less common compared to the low-risk group (82.3% vs. 92.0%, p=0.001).

Table 3.9: The association between the ACCI and patient outcomes among all patients.

ACCI		Low risk (No.=25)	High risk (No.=79)	p-value
Type of fracture	Intracapsular	14 (56.0)	31 (39.2)	0.430
	Extracapsular	11 (44.0)	48 (60.8)	
Oxford hip score	2 weeks post op (mean ± standard deviation)	21.8 ±3.7	17.0 ± 4.1	0.003
	3 months post op (mean ± standard deviation)	31.5 ± 4.4	25.8 ± 5.5	0.001
Postoperative outcomes	Improved	23 (92.0)	65 (82.3)	0.001
	Death	0 (0.0)	6 (7.6)	
	Complication	2 (8.0)	8 (10.1)	
Early Complication	DVT	0 (0.0)	3 (3.8)	0.710
	Infection	1 (4.0)	3 (3.8)	
	Bed sore	1 (4.0)	2 (2.5)	

Table 3.10 shows ACCI and Outcomes in Patients with Extracapsular Fractures. In extracapsular fractures, high-risk ACCI patients had significantly poorer functional outcomes (OHS: p=0.006 at 2 weeks, p=0.004 at 3 months). Mortality occurred only in the high-risk group, and the rate of improvement was slightly lower (79.2% vs. 90.9%, p=0.038).

Table 3.10: The association between the ACCI and patient outcomes among patients with extracapsular fractures.

ACCI		Low risk (No.=11)	High risk (No.=48)	p-value
Oxford hip score	2 weeks post op (mean ± standard deviation)	23.0 ± 3.6	16.3 ± 4.3	0.006
	3 months post op (mean ± standard deviation)	30.8± 4.1	24.1± 5.5	0.004
Postoperative outcomes	Improved	10 (90.9)	38 (79.2)	0.038
	Death	0 (0.0)	4 (8.3)	
	Complication	1(9.1)	6 (12.5)	

Table 3.11 shows the ACCI and Outcomes in Patients with Intracapsular Fractures. In intracapsular fractures, patients with high ACCI scores had significantly poorer outcomes at both time points (p=0.008 and p=0.006). Although the difference in improvement rates was modest (87.1% vs. 92.9%), deaths occurred only in the high-risk group.

Table 3.11: The association between the ACCI and patient outcomes among patients with intracapsular fractures.

ACCI		Low risk (No.=14)	High risk (No.=31)	p-value
Oxford hip score	2 weeks post op (mean ± standard deviation)	22.1± 3.2	17.3 ± 4.0	0.008
	3 months post op (mean ± standard deviation)	32.1± 4.5	26.0± 5.8	0.006
Postoperative outcomes	Improved	13 (92.9)	27 (87.1)	0.004
	Death	0(0.0)	2 (6.5)	
	Complication	1 (7.1)	2 (6.5)	

4. DISCUSSION

Proximal femoral fractures represent one of the most serious injuries in the elderly population, carrying significant morbidity, mortality, and socioeconomic burden worldwide.[8] With an aging population and increasing prevalence of chronic diseases, the coexistence of multiple comorbidities further complicates both surgical management and postoperative recovery in these patients.[9] Evaluating the impact of comorbidity burden using validated tools such as the Charlson Comorbidity Index (CCI) and the age-adjusted Charlson Comorbidity Index (ACCI) is therefore of critical importance for guiding perioperative decision-making, predicting functional recovery, and improving patient outcomes.[10] The present study contributes valuable insights by prospectively assessing short-term surgical outcomes in hip fracture patients in Basrah, Iraq, while highlighting the prognostic role of CCI and ACCI in functional recovery and survival.

The mean age of the study population was 65.3 years, which is consistent with the global epidemiology of hip fractures, typically affecting older adults as reported by Amarilla-Donoso et al. (2020) and Feng et al. (2024).[11,12] Females constituted a slight majority (54.8%), reflecting the higher prevalence of osteoporosis and fragility fractures among women due to postmenopausal bone loss which is in line with a study by Imran et al. (2022).[12] A considerable proportion of patients had low educational attainment and were unemployed, which may reflect the demographic profile of elderly patients in this region but could also indirectly influence outcomes through health literacy, treatment adherence, and access to rehabilitation services.[13] The majority were urban residents, aligning with evidence that urbanization is associated with both increased life expectancy and higher fracture incidence due to changes in lifestyle and fall risks.[14]

The results demonstrated that most patients had a high comorbidity burden, with 56.7% scoring Grade 3 on the standard CCI. Only 4.8% of patients had no comorbidities. When age was factored in through the ACCI, the majority (76.0%) were classified as high-risk. These findings underscore the dual influence of aging and multimorbidity on hip fracture prognosis. Comparable distributions have been reported in other cohorts of hip fracture patients, where the prevalence of high CCI scores exceeded 50% as reported by Piñeiro-Fernández et al. (2025) and Lunde et al. (2019).[15,16] The use of ACCI provided greater prognostic discrimination, as previously validated in orthopaedic and geriatric populations as claimed by Zhang et al. (2023).[17]

Extracapsular fractures were more common than intracapsular fractures (56.7% vs. 43.3%), which mirrors global trends, particularly in older populations which is in agreement with the findings from Alpantaki et al. (2015).[18] Regarding surgical treatment, a slightly higher proportion underwent open reduction and internal fixation (55.8%) compared to arthroplasty (44.2%). This balance reflects current surgical practice, where fixation is favored in extracapsular fractures while arthroplasty is more common for displaced intracapsular fractures in older adults.[19]

Encouragingly, the Oxford Hip Score (OHS) improved substantially from a mean of 18.7 at two weeks to 31.2 at three months, with 84.6% of patients demonstrating clinical improvement. The overall mortality rate of 5.8% aligns with early postoperative mortality rates (4–10%) reported in international literature by Clement et al. (2025) and Wylde et al. (2015).[20, 21] The complication rate (9.6%), including DVT, infection, and bedsores, also falls within expected ranges (10–15%) reported in comparable studies.[22] These findings reinforce that, despite high comorbidity burdens, surgical treatment of hip fractures yields meaningful functional recovery in the majority of patients.

A key finding of this study was the strong inverse association between higher CCI/ACCI scores and poorer functional recovery, higher mortality, and greater complication rates. Patients with Grade 3 CCI had significantly lower OHS at both two weeks and three months, and mortality was confined to those with higher scores. Similarly, all deaths occurred within the high-risk ACCI group. These associations remained consistent when stratifying patients by fracture type (intracapsular vs. extracapsular). These findings corroborate evidence from prior research. Kirkland et al. (2011) demonstrated that higher CCI scores were independently predictive of 30-day and one-year mortality following hip fracture.[23] Gatot et al. (2021) found that comorbidities strongly influenced functional recovery trajectories, with higher CCI scores associated with slower or incomplete recovery.[24] Likewise, a meta-analysis by Zhang et al. (2025) confirmed that both CCI and ACCI are reliable predictors of postoperative complications and mortality in orthopaedic trauma.[25]

The predictive strength of the ACCI in our cohort further supports its clinical utility. By incorporating age, the ACCI captures an additional layer of risk particularly relevant in hip fracture patients, where advanced age itself is an independent predictor of poor outcomes.[26] The worse outcomes in the high-risk ACCI group in this study—lower OHS, higher mortality, and greater complications—are consistent with international findings emphasizing its superiority over standard CCI.[27]

The worse functional outcomes in high-CCI/ACCI groups may be explained by several mechanisms. Patients with multimorbidity are more vulnerable to perioperative complications, have reduced physiological reserve, and may experience prolonged immobilization, which hinders rehabilitation. Additionally, comorbid conditions such as cardiovascular disease, diabetes, and chronic lung disease can directly impair surgical recovery and increase susceptibility to complications such as infections and thromboembolism.[28-29] This highlights the need for integrated perioperative management that not only addresses the fracture but also optimizes comorbidity control, involving multidisciplinary teams including geriatricians, internists, and physiotherapists.

Although this study provides important insights, certain limitations should be acknowledged. The follow-up period was relatively short (three months), which may not capture long-term functional outcomes or late complications. The sample size, while sufficient for short-term associations, may limit the power of subgroup analyses. Furthermore, potential confounding factors such as nutritional status, socioeconomic variables, and access to postoperative rehabilitation were not fully assessed but may have influenced outcomes.

5. CONCLUSIONS AND RECOMMENDATIONS

Proximal femoral fractures predominantly affect older adults with a mean age of 65.3 years, with a slight female predominance. Extracapsular fractures were more common than intracapsular types, and open reduction with internal fixation was the most frequent surgical intervention. Surgical treatment led to significant functional improvement as measured by the Oxford Hip

Score (OHS), with 84.6% of patients showing clinical improvement at three months. Mortality (5.8%) and complication rates (9.6%), highlighting that operative treatment remains beneficial despite comorbidity burden. Routine use of comorbidity indices (CCI and ACCI) should be incorporated into the preoperative evaluation of patients with hip fractures to identify high-risk individuals. Additionally, multidisciplinary management, involving orthopedics, geriatrics, internal medicine, physiotherapy, and nursing teams, should be implemented for patients with high comorbidity scores to optimize perioperative care with enhanced postoperative rehabilitation programs tailored to high-risk patients are necessary to improve mobility and independence.

Conflict of interest

The authors of this study report no conflicts of interest.

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