

Factors Associated with Postoperative Mortality in Intertrochanteric Femur Fractures Treated with PFNA

İlhan Kaan ÇELEBİ, MD* Faruk KARACA, MD**

ABSTRACT

In this study, we aimed to investigate the 1-year postoperative mortality rate and the factors affecting it after treatment with proximal femoral nail antirotation (PFNA) in patients with intertrochanteric femur fractures. The remaining 115 patients who applied to our clinic between 01.01.2013-01.01.2023 and underwent surgery using intramedullary implants due to intertrochanteric fractures and were excluded from the exclusion criteria were evaluated. All patients underwent PFNA. These patients were classified and compared according to their demographic data, ASA scores, time to surgery, need for and duration of intensive care unit stay, additional comorbid diseases, reduction method, type of anesthesia, timing of operation and trauma mechanism during their 1-year follow-up. The number of patients who died within 1 year was 20 (17.39%). The most common cause of death among known causes was multiple organ failure - sepsis. It was observed that the age values of the patient group with intertrochanteric fractures exposed to low-energy trauma were statistically significantly higher ($p=0.001$). It was observed that patients who had high-energy trauma or were younger had more additional fractures ($p=0.001$ for both values). Higher age, intensive care stay of 96 hours or more within two weeks post-operatively, ASA score >2 , additional chronic disease number $2\leq$, and the time between fracture and operation showed significant differences on 1-year mortality ($p<0.05$ for each). In patients who underwent PFNA after intertrochanteric femur fractures, high age, postoperative intensive care stay of 96 hours or more within two weeks, ASA score >2 , additional chronic disease count $2\leq$, and the time between fracture and operation were determined as predictive parameters for 1-year mortality. These predictive parameters will provide better information to the patient and their relatives and more careful postoperative care of the patients. In addition, this type of fracture, which has a high postoperative mortality especially in the geriatric patient group, was most frequently seen as a fall from its own level and low-energy trauma. Therefore, osteoporosis monitoring and both indoor and outdoor precautions should be taken in the geriatric patient group.

Keywords: mortality, intertrochanteric fracture, pertrochanteric fracture, intramedullary nailing, trochanteric fracture, geriatric patient

INTRODUCTION

Hip fractures are a common injury, especially in the elderly population, and their frequency is increasing, and they are mostly seen as Intertrochanteric femur fracture (IFF)¹. Intertrochanteric fractures are associated with high-energy trauma in young patients and low-energy trauma in elderly patients². Conservative treatment has been tried in a limited number of patients, but due to the high number of postoperative complications, surgical treatment is preferred³. In the surgical treatment of intertrochanteric region fractures, DHS (Dynamic Hip Screw) and Proximal Femoral Nailing are used. DHS is still frequently used in stable fractures. In unstable fractures, PFN-A (Proximal Femoral Nail Antirotation) is a common and popular treatment method⁴.

Increased mortality rates within 1 year after intertrochanteric femur fractures in the elderly population, regardless of conservative or surgical treatment, are noteworthy and have been associated with decreased quality of life, loss of mobility, and increased dependency

rates⁵. Mortality has been observed to increase by approximately 30% in the 1-year period after surgery⁶.

Hip fractures are an important cause of mortality and morbidity, especially in elderly patients⁷. It has been determined that mortality rates are high in proximal femur fractures, especially within the first 30 days⁸. Some factors have been presented as predictors of mortality, especially in the early period, in patients with proximal femur region fractures. These are: advanced age, male gender, higher American Society of Anesthesiologists (ASA) classification, higher Charlson Comorbidity Index (CCI), higher The Nottingham Hip Fracture Score (NHFS), history of chronic obstructive pulmonary disease (COPD), dementia, hypoalbuminemia, time to surgery, postoperative delirium and pneumonia^{9,10,11}. Canbeyli et al.¹² evaluated the factors associated with 1-year mortality in patients who underwent surgery after hip fractures and stated that higher ASA grade, male gender, general anesthesia and hemiarthroplasty were associated with higher mortality rates. These predictors are important because they can be used to inform

* Niksar State Hospital
Tokat, Turkey.
E-mail: kaan.celebi52@gmail.com

** Karadeniz Technical University
Orthopaedics and Traumatology Department
Trabzon, Turkey

the patient and family about surgical decisions and the life expectancy and expected problems that may occur afterwards¹³. Mortality rates and predictors of mortality after hip fracture also vary between countries¹⁴.

In this study, we aimed to investigate the 1-year postoperative mortality rate and the factors affecting it after treatment with proximal femoral nail antirotation (PFNA) in patients with intertrochanteric femur fractures (IFF).

MATERIALS AND METHODS

The study was conducted in accordance with the current Declaration of Helsinki. The study was approved as a retrospective study by the ethics committee of Karadeniz Technical University Faculty of Medicine [No. (2024) 259]. The study included a retrospective review of all patients diagnosed with trochanteric femur fractures. The study included patients who applied to our clinic between 01.01.2013-01.01.2023 with trochanteric region fractures, who had no previous hip surgery, and who used intramedullary implants in fracture-related surgery. All patients underwent PFNA.

Exclusion criteria were as follows:

1. Those with unknown mortality status within two years,
2. Those with inadequate radiographic imaging during their two-year follow-up,
3. Those who did not come for their follow-up at the end of the first year,
4. Those with insufficient and missing data.
5. Those with femoral neck fracture, subtrochanteric fracture, or pathological fracture.

Between 01.01.2013 and 01.01.2023, 318 patients who underwent surgery using intramedullary implants due to intertrochanteric fractures at the KTÜ Faculty of Medicine Farabi Hospital Orthopedics and Traumatology Clinic were examined.

203 patients who met the exclusion criteria were eliminated from the study and 115 patients were included in the study.

All included patients were taken into preoperative preparation from the moment of admission. Intensive care units were prepared for the necessary patients. When the patients were suitable for surgery preparation, proximal femoral nail antirotation (PFNA) and internal fixation were applied under spinal or general anesthesia and physical therapy and rehabilitation were applied after the operation, taking precautions to prevent embolism and thrombosis.

Data on patients' age, gender, preoperative combined disease, ASA score, operation timing, and postoperative complications were collected from medical records and the time of death and causes of death of deceased patients were investigated. The injury mechanisms of the patients were divided into high-energy and low-energy injuries. Preoperative and postoperative complications were hypertension, diabetes mellitus, stroke sequelae, coronary heart disease, heart failure, chronic obstructive pulmonary disease, pneumonia, pulmonary embolism, etc. and were classified as $2 \leq$ or $2 >$ according to their presence or absence. They were classified as >2 and ≤ 2 according to the American Society of Anesthesiologists (ASA) score. They were also classified according to the time from injury to surgery. Intensive care history and duration within two weeks postoperatively, revision status after surgery, and reduction method were evaluated. Data on the patients are shown in Table 1 and Table 2. 1-year data of the patients were collected and evaluated.

Table 1. Classification of patients according to demographic data, additional comorbidities, mechanism of injury, associated fracture and postoperative intensive care hospitalization

Patients (n=115)		Number (n)	Percent (%)
Sex	Female	60	52,2
	Male	55	47,8
Comorbidities	Hypertension	71	61,7
	Diabetes mellitus	53	46,1
	Coronary artery disease	38	33
	Chronic kidney disease (CKD)	25	21,7
	Chronic obstructive pulmonary disease (COPD).	16	13,9
	Cerebrovascular diseases	12	10,4
	Congestive heart failure	11	9,6
	Thyroid gland diseases	10	8,7
	Dementia	5	4,3
	Cardiac arrhythmias	1	0,9
Trauma mechanism	Fall from height	11	9,6
	Non-vehicular traffic accident	2	1,7
	In-car traffic accident	3	2,6
	Crushing under load	2	1,7
	Gunshot wound	1	0,9
	Falling from the current level	94	81,7
Anesthesia type	Assault	2	1,7
	Spinal anesthesia	110	95,7
Anesthesia type	General anesthesia	5	4,3
Patients with additional fractures		11	9,6
Patients with post-operative intensive care admission		22	19,1

Table 2. Data on patients' operation days, postoperative intensive care unit stays, and mortality within 2 years.

Patients (n=115)	Mean±Sd	Median	Min-Maks
The duration between fracture and operation day			
	3,26±3,12	2	0-25
Post-operative intensive care unit admission day (n=22)			
	2,68±2,12	2	1-8
		Number(n)	Percent (%)
Etiology of mortality within 2 years	Unknown	14	43,25
	Multiple organ failure- septic shock- pneumonia	9	28,12
	Pulmonary thromboembolism	4	12,5
	Kidney failure	3	9,3
	Heart failure- COPD	2	6,25

Statistical Characteristics

The analysis of the data collected in the study was done using the statistical software package SPSS 27 (Statistical Package for the Social Sciences – IBM®). Kurtosis and skewness coefficients were examined to determine the conformity of the data to normal distribution. Kurtosis and skewness values of the data between +1.5 and -1.5 were considered sufficient for normal distribution. Descriptive statistics were presented as number (n) and percentages (%) for categorical variables, and mean, standard deviation, minimum-maximum values and median for numerical variables. To evaluate the differences between the groups, the Chi-square test was used for the evaluation of categorical variables, the T test for two groups in independent groups showing normal distribution, and the Mann Whitney U test was used for two groups not showing normal distribution. The ANOVA test was used for the evaluation of more than two groups showing normal distribution and homogeneity; the Kruskal Wallis H test was used for more than two groups not showing normal distribution. The compliance of continuous variables with normal distribution was examined with the Kolmogorov-Smirnov and Shapiro-Wilk tests. The homogeneity of the variances complying with normal distribution was evaluated with the Levene value. The two-way Pearson coefficient was used for the evaluation of correlation. Fisher's Exact Test was used if more than 20% of the expected frequencies in the Chi-square test were less than 5. The 95% confidence interval and the $p < 0.05$ level were considered statistically significant

RESULTS

It was observed that 47.8% of the patients were male, 52.2% were female, and their ages ranged from 17 to 95; the mean age was 71.92 ± 15.86 and the median age was 76. Age data conformed to normal distribution characteristics.

The number of patients who died within 1 year postoperatively was 20 (17.39%), and the total number of patients who died within 2 years postoperatively was 32 (27.8%). Among the known causes, the most common cause of death was multiple organ failure - sepsis. The most common comorbid diseases were hypertension (61.7%) and type 2 diabetes mellitus (46.1%). Spinal anesthesia was applied to 95.7% of the patients. 22 patients (19.1%) were admitted to the intensive care unit postoperatively.

The patient had additional fractures. In 96 patients (83.4%), the fracture occurred with low-energy trauma. In 19 patients (16.5%), it occurred with high-energy trauma. It was seen that the age values of the patient group with intertrochanteric fractures exposed to low-energy trauma were statistically significantly higher ($p = 0.001$). It was seen that the patients who had high-energy trauma or were younger had more additional fractures ($p = 0.001$ for both values) (Table 3).

Table 3. Information on age, trauma mechanism and additional fracture status

	Presence of additional fractures		p-value
	None	Yes	
Mean Age	74,07	51,73	0,001
Trauma mechanism	High energy	9	0,001
	Low energy	94	
	Trauma mechanism		p-value
	Low energy	High energy	
Mean Age	75,90	51,84	0,001

The mean age of patients who died within 1 year was 80 and the mean age of patients who did not develop mortality within 1 year was 70. It was observed that the ages of patients who died were significantly higher than those who survived ($p = 0.001$). It was observed that 1-year mortality was higher in the patient group whose intensive care stay was 96 hours or more within two weeks after the operation ($p = 0.024$). It was observed that the time between fracture and operation, ASA score > 2 and the number of additional chronic diseases $2 \leq$ created a significant difference in 1-year mortality ($p < 0.05$ for each). (Table 4) It was observed that the gender of the patients, the reduction technique and the trauma mechanism did not cause a significant difference in 1-year mortality (Table 4).

Table 4. Mortality-related data and comparison

Patients(n) :115	Mortality within 1 year		p-value
	No	Yes	
Mean Age	70,05	80,80	0,001
Average days spent in post-operative intensive care	1,15	3,75	0,026
Average days between fracture and operation	1,19	3,9	0,030
Post-operative intensive care admission within two weeks	No	89	0,032
	Yes	4	
Post-operative intensive care stay within two weeks	Less than 96 hours	16	0,024
	More than 96 hours	1	
Sex	Female	2	0,830
	Male	3	
Reduction technique	Close	50	0,520
	Open	10	
Trauma mechanism	High energy	58	0,188
	Low Energy	18	
ASA Score	> 2	77	0,011
	≤ 2	17	
Number of Additional Chronic Diseases	> 2	62	0,032
	$2 \leq$	3	

DISCUSSION

As a result of our study examining the factors affecting 1-year mortality in patients who underwent PFNA after Intertrochanteric Femur Fracture (IFF), high age, 96 hours or more of intensive care stay within two weeks post-operatively, ASA score > 2 , $2 \leq$ additional chronic disease count, and the time between fracture and operation were determined as predictive parameters for 1-year mortality. In addition, while IFF is more common in young patients, it is associated with low-energy trauma in elderly patients. ($p < 0.05$)

Intertrochanteric femur fractures are the most common type of hip fracture in the elderly and their frequency is increasing. The 1-year mortality rates after this type of fracture are high, regardless of surgery. It varies from country to country¹⁵. In our study, the number of patients who died within 1 year postoperatively was 20 (17.39%), and the total number of patients who died within 2 years postoperatively was 32 (27.8%). Some studies have been conducted on postoperative mortality after IFF, especially in elderly patients.

Age is an important predictor of post-intertrochanteric mortality¹⁶. Nasab et al.¹⁷, in their study in which they followed up intertrochanteric fractures between the ages of 60-89 for 1 year postoperatively, stated that the highest postoperative mortality was in the 80-89 age group ((63.01% mortality)) and the lowest mortality rate was in the 60-69 age group ((4.67%) mortality). Gu et al.¹⁸ showed that age was an important factor in mortality in the 1-year follow-up of 80 patients who underwent pfna after intertrochanteric fractures, and that the 1-year mortality rate increased to 47.8% in the group over 85 years of age. Intertrochanteric hip fractures were more common in women, and this was attributed to osteoporosis¹⁹. There are different views on gender regarding postoperative mortality and they differ in studies¹⁶.

Different factors affecting postoperative mortality, especially in elderly patients, have been identified. Raichandani et al.¹⁶, in their study on 266 patients and examining 2-year postoperative mortality, found patients with Charlson's co-morbidity index (CCI) greater than 4 and high age to be predictive values. Canbeyli et al.¹² examined postoperative mortality in a study with 191 patients and examined postoperative 30-day and 1-year mortality. For 30-day mortality, mortality rates were found to be higher in those who underwent general anesthesia compared to spinal anesthesia. For postoperative 1-year mortality, higher age, male gender and high ASA score were other mortality determinants. Fracture instability²⁰, prolonged intensive care unit stay²¹, hypoalbuminemia⁹, high hospital stay and late mobilization²² were found to be other important causes of postoperative mortality in the literature.

The most common known postoperative complications include lung infections and heart disease^{23,24}. Therefore, it is important to closely monitor the internal clinical status of the patient postoperatively.

Intertrochanteric femur fractures can occur most frequently in the elderly due to low-energy trauma and usually occurs after falling while doing housework. The number of fractures can be reduced with precautions, especially at home, that can be taken in the geriatric patient group. Bone fragility can be reduced with careful monitoring of osteoporosis and use of medication²⁵.

In this retrospective designed cross-sectional study, the limitations include the lack of compliance with follow-up by patients and the low sample size due to missing data. Another limitation of the study is the application of PFNA to all patients

CONCLUSIONS

In patients who underwent PFNA after intertrochanteric femur fractures, high age, 96 hours or more of intensive care stay within two weeks after surgery, ASA score >2, 2≤ number of additional chronic diseases, and the time between fracture and surgery were determined as predictive parameters for 1-year mortality. These predictive parameters will provide better information to the patient and their relatives, and more careful postoperative care of the patients. In addition, this type of fracture, which has a high postoperative mortality especially in the geriatric patient group, was most frequently seen as a fall from its own level and low-energy trauma. Therefore, osteoporosis monitoring and both indoor and outdoor precautions should be taken in the geriatric patient group.

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