

## Original Research Article

# Study of mortality rate following fixation of proximal femur fractures by gamma nail

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### ABSTRACT

**Background:** Proximal femur fractures, are prevalent in elderly individuals due to osteoporosis. These fractures are significant causes of morbidity and mortality worldwide. Surgical treatment typically involves fixation techniques like the gamma nail, a cephalomedullary implant designed to provide stable fixation with minimal soft-tissue trauma. However, despite these advancements, the mortality rates post-surgery remains high, with early mortality reaching 7-10% and one-year mortality between 20-30%. Identifying risk factors for mortality in patients undergoing gamma nail fixation is crucial to improve patient outcomes and guide surgical decision-making. The primary aim of the study was to evaluate the mortality rate following Gamma Nail fixation for proximal femur fractures in elderly patients at Elhadra University Hospital. The study sought to correlate various preoperative factors, including age, comorbidities, and mobility scores, with mortality outcomes to better predict patient prognosis.

**Methods:** This retrospective study included 220 patients aged 60 years or older who underwent Gamma Nail fixation for proximal femur fractures at Elhadra University Hospital between January 2023 and January 2024. Exclusion criteria were polytrauma patients and those younger than 60 years. Data collected included patient demographics (age, sex), preoperative medical history (comorbidities, previous surgeries, drug use), and functional status assessed using the Parker mobility score. The American society of anesthesiologists (ASA) classification and Nottingham hip fracture score (NHFS) were also recorded. Postoperative complications, including co-morbidities, intensive care unit (ICU) admissions, and mortality rates (both within 30 days and one year), were analyzed.

**Results:** The mean age of the patients was 70.98 years, with a slight majority being female (53.64%). Intertrochanteric fractures were the most common (85%), followed by subtrochanteric fractures (15%). Preoperative activity levels varied, with the majority reporting moderate activity. Cardiovascular diseases were the most prevalent comorbidity, affecting 66.33% of patients. Mortality rates were high, with 30.45% of patients dying during the study period, 8.64% of whom died within the first month. The study found that advanced age, higher ASA scores, low mobility scores, and cardiovascular comorbidities significantly correlated with higher mortality rates. Additionally, patients with higher NHFS scores ( $\geq 5$ ) and those requiring postoperative ICU care had a significantly higher mortality risk.

**Conclusions:** The study concluded that gamma nail fixation is effective for treating proximal femur fractures in elderly patients, but mortality remains high, particularly in patients with advanced age, poor preoperative functional status, and significant comorbidities such as cardiovascular diseases. The identification of high-risk patients using tools like the ASA score, NHFS, and Parker mobility score can help guide perioperative management and improve patient care. Postoperative complications, including ICU admissions, were also strongly associated with increased mortality. Further research focusing on risk factor modification and enhanced perioperative care is essential to reduce mortality in this vulnerable patient population.

**Keywords:** Fixation, Femur, Fracture, Gamma, Nail

## INTRODUCTION

Proximal femur fractures, which include fractures of the femoral neck and intertrochanteric regions, are common injuries in elderly individuals, often due to falls or trauma.<sup>1</sup> These fractures are highly associated with osteoporosis, a condition where bones become fragile and more prone to breaking. In elderly patients, the loss of bone density, combined with reduced muscle strength and balance, increases the risk of falls and fractures. The proximal femur, specifically the femoral neck, is especially vulnerable to fracture due to its anatomical location and its role in supporting the body's weight during movement.<sup>2</sup>

Hip fractures, particularly in the elderly, represent a major public health challenge. They are associated with significant morbidity, including pain, disability, and reduced quality of life, as well as mortality.<sup>3</sup> Proximal femur fractures are not only debilitating but also contribute substantially to the burden on healthcare systems. The recovery process often involves prolonged hospital stays, rehabilitation, and a considerable amount of medical care. Studies have shown that hip fractures can lead to a decline in the patient's ability to perform daily activities and can also result in long-term functional impairment.<sup>4</sup>

Surgical management is the mainstay of treatment for proximal femur fractures. Over the years, various fixation methods have been developed, including extramedullary implants such as the sliding hip screw (SHS) and intramedullary devices like the gamma nail.<sup>5,6</sup> The gamma nail, introduced in the 1980s, has become a preferred method for treating unstable intertrochanteric and subtrochanteric fractures. This device consists of a long intramedullary nail with a proximal lag screw that helps stabilize the fracture and aligns the mechanical axis of the femur. The design of the gamma nail allows for minimal disruption of soft tissues and reduced surgical time, offering several advantages over traditional fixation methods.<sup>5</sup>

Despite the advancements in surgical techniques and fixation devices, the mortality rate following proximal femur fractures remains high. Mortality is particularly elevated in the elderly population, with early mortality rates within 30 days post-surgery reported to be as high as 7-10%, and one-year mortality rates ranging between 20% and 30%.<sup>7</sup> Factors contributing to this high mortality include advanced age, the presence of multiple comorbidities, and poor functional status before the fracture. Additionally, postoperative complications such as infections, deep vein thrombosis (DVT), and respiratory failure contribute to the increased risk of mortality in these patients.<sup>8</sup>

Several risk factors for mortality following proximal femur fracture surgery have been identified, including preexisting cardiovascular disease, cognitive impairment, and nutritional deficiencies.<sup>9</sup> The ASA score, which assesses a patient's general health and anesthesia risk, has

been found to correlate with postoperative outcomes.<sup>10</sup> Similarly, the NHFS is a predictive tool used to assess the risk of early mortality in hip fracture patients based on several factors, including age, comorbidities, and preoperative functional status. These tools have proven helpful in identifying high-risk patients who may require more intensive perioperative management to improve their chances of survival.<sup>11</sup>

The gamma nail offers many benefits in terms of fracture stability, early mobilization, and quicker rehabilitation. However, understanding the factors that influence mortality after the use of the gamma nail is crucial in managing patients more effectively. Identifying predictive factors for mortality can help guide clinical decisions, optimize patient care, and improve outcomes.<sup>12</sup> This study aimed to evaluate the mortality rate following gamma nail fixation for proximal femur fractures and investigate the association between various preoperative and postoperative factors and patient outcomes.

## METHODS

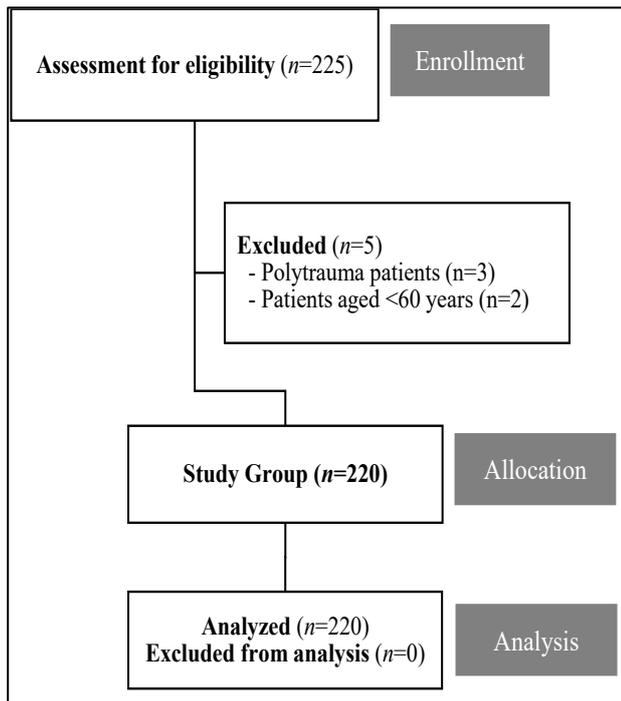
### *Study design and setting*

This study was a retrospective analysis conducted at Elhadra University Hospital, focusing on patients who underwent gamma nail fixation for proximal femur fractures between January 2023 and January 2024. A total of 220 patients met the inclusion criteria and were analyzed for the study. The inclusion criteria were as follows: patients aged 60 years or older with a diagnosed proximal femur fracture who were treated surgically with gamma nail fixation. Exclusion criteria included patients who were younger than 60 years and those with polytrauma, as their management would involve more complex considerations beyond the scope of this study. Ethical approval for the study was obtained from the research ethics committee of Alexandria faculty of medicine, and all procedures adhered to the principles outlined in the declaration of Helsinki.<sup>13</sup> Written informed consent was obtained from all participants before inclusion in the study.

Before surgery, patients' preoperative functional status was assessed through the Parker mobility score. This score evaluates a patient's ability to perform daily activities, including indoor and outdoor mobility, and whether they require assistance for these activities. The preoperative mobility scores were categorized into low, moderate, or high levels. In addition, the ASA score was used to assess the patient's overall health status and surgical risk, while the NHFS was utilized to predict the risk of early mortality following the fracture.

The preoperative medical history was thoroughly reviewed to identify any significant comorbid conditions, which are common in elderly individuals with hip fractures. Drug history was also recorded to understand the medications being taken, particularly antihypertensives, antidiabetic

agents, and anticoagulants, as these can affect surgical outcomes.



**Figure 1: Flow chart of total number of study sample.**

The surgical procedure involved the use of the gamma nail, which is an intramedullary nail designed to fixate proximal femur fractures with minimal soft tissue disruption. The nail is inserted through a small incision made over the greater trochanter and is then positioned in the femoral canal. A guide wire is used to insert the nail, and a lag screw is placed through the femoral head to stabilize the fracture. The gamma nail offers biomechanical advantages, including improved stability for unstable fractures, and allows for earlier weight-bearing and quicker rehabilitation. Postoperative management included early mobilization and functional outcome assessment using the Parker mobility score to track recovery.

Postoperatively, patients were monitored for complications, including infections, DVT, respiratory issues, and other adverse events. In particular, ICU admission and the occurrence of postoperative bed sores or delayed union were carefully documented. Mortality data was recorded both for early (within 30 days) and late (within one year) deaths. The relationship between these outcomes and various preoperative factors such as age, ASA score, NHFS, Parker mobility score, and comorbid conditions were analyzed to identify significant predictors of mortality following gamma nail fixation.

### Statistical analysis

Data analysis was performed using IBM SPSS software version 26.0 (IBM Corp., Armonk, NY, USA).<sup>14</sup>

Qualitative data were presented as frequencies and percentages, while quantitative data were analyzed using mean and standard deviation for normally distributed data. A chi-square test was used to assess the association between categorical variables, and a t test was used for continuous variables. A p-value of less than 0.05 was considered statistically significant, and the study aimed to identify key factors that could influence patient outcomes and guide clinical decision-making.

### RESULTS

The study included 220 patients who underwent gamma nail fixation for proximal femur fractures at Elhadra University Hospital from January 2023 to January 2024. The age of the patients ranged from 61 to 95 years, with a mean age of 70.98 years ( $\pm 8.93$ ). The majority of the patients were elderly, with a median age of 70 years. In terms of gender distribution, 53.64% of the patients were female, while 46.36% were male.

The fractures occurred on the left side in 54.09% of patients ( $n=119$ ), while 45.91% of patients had right-sided fractures ( $n=101$ ). The most common type of fracture was intertrochanteric, which accounted for 85% of the cases ( $n=187$ ), while subtrochanteric fractures were less frequent, comprising 15% of the sample ( $n=33$ ).

Preoperative functional assessment revealed that 44.09% of the patients ( $n=97$ ) had a moderate level of activity prior to the fracture, 32.73% ( $n=72$ ) had a high level of activity, and 23.18% ( $n=51$ ) had a low level of activity.

In terms of comorbidities, cardiovascular diseases were the most prevalent, affecting 66.33% of the patients ( $n=146$ ). Other common medical conditions included metabolic and endocrine disorders (35.45%,  $n=79$ ), neurological and cognitive disorders (5.00%,  $n=11$ ), and respiratory diseases (5.00%,  $n=11$ ). A smaller proportion of patients had conditions such as malignant diseases (4.54%,  $n=10$ ), musculoskeletal and vascular disorders (3.63%,  $n=8$ ), and renal diseases (2.26%,  $n=5$ ).

The ASA classification revealed that the majority of patients were classified as ASA III (32.37%,  $n=71$ ), indicating moderate to severe systemic disease. ASA II (29.09%,  $n=64$ ) and ASA I (26.82%,  $n=59$ ) patients, who had less severe comorbidities, made up a smaller proportion of the study group. A smaller percentage of patients were classified as ASA IV (11.82%,  $n=26$ ).

Regarding postoperative outcomes, the overall mortality rate was 30.45%, with 67 patients ( $n=67$ ) dying during the study period. Of these, 8.64% ( $n=19$ ) died within the first month after surgery. The survival rate was 69.55%, with 153 patients ( $n=153$ ) surviving beyond 1 year.

Postoperative complications were also observed in the study population. The majority of patients (77.27%,  $n=170$ ) did not experience any complications. However,

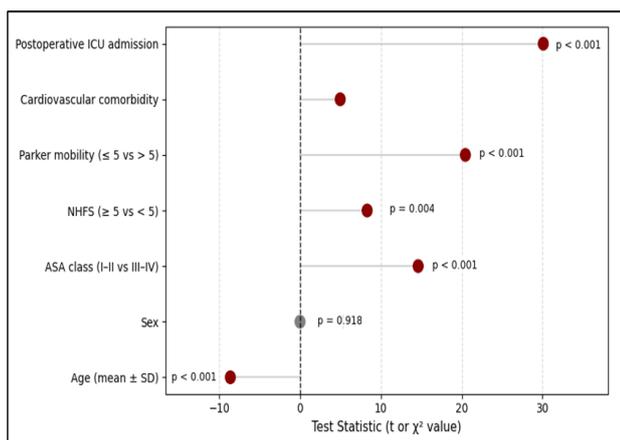
13.18% of patients (n=29) required ICU admission or observation, which indicates the severity of the postoperative course for some patients. Other complications included bed sores (2.73%, n=6), infections requiring debridement (2.27%, n=5), and respiratory failure (0.91%, n=2). There were also isolated cases of delayed union, revision surgery, and DVT, each affecting less than 1% of the patients.

When correlating various preoperative factors with mortality, advanced age was found to have a strong positive correlation with increased mortality (p<0.001). Patients classified as ASA III or IV had significantly higher mortality compared to those in ASA I or II (p=0.0001). Higher NHFS scores (≥5), which indicate a higher risk of mortality, were also significantly associated with increased mortality (p=0.004). Furthermore, a low Parker mobility score (≤5) was strongly linked to higher mortality (p<0.001). Cardiovascular comorbidity and postoperative ICU admission were also found to be significant predictors of mortality, with p=0.026 and <0.001, respectively (Table 1 and Figure 2).

**Table 1: Correlation between studied parameters and mortality among the studied patients.**

Variables	Statistical test	P value
Age (mean±SD) (in years)	t=-8.61	<0.001*
Sex	χ <sup>2</sup> =0.01	0.9179
ASA class (I-II vs III-IV)	χ <sup>2</sup> =14.62	<0.001*
NHFS (≥ 5 vs < 5)	χ <sup>2</sup> =8.31	0.004*
Parker mobility (≤ 5 vs > 5)	χ <sup>2</sup> =20.46	<0.001*
Cardiovascular comorbidity	χ <sup>2</sup> =4.98	0.026*
Postoperative ICU admission	χ <sup>2</sup> =30.10	<0.001*

\*Significant if ≤0.05.



**Figure 2: Forest plot showing correlation between studied parameters and mortality.**

## DISCUSSION

Proximal femur fractures, especially in the elderly population, are a major cause of morbidity and mortality

worldwide. These fractures are frequently caused by falls or age-related factors such as osteoporosis, which weakens the bones. Elderly individuals are particularly vulnerable due to reduced bone density, decreased muscle mass, and the presence of multiple comorbidities, which complicate recovery. As the global population continues to age, the incidence of hip fractures is expected to increase, further burdening healthcare systems and leading to a decline in the quality of life for many patients.<sup>15</sup>

Surgical intervention is considered the primary treatment for proximal femur fractures, with gamma nail fixation being one of the most commonly used techniques. Gamma nails provide stable internal fixation, particularly for unstable fractures such as intertrochanteric and subtrochanteric fractures, offering advantages over other fixation methods like DHS. Despite its effectiveness in stabilizing fractures, the mortality rate following surgery remains high, primarily due to advanced age and comorbidities. Factors such as preoperative frailty, cardiovascular diseases, and poor functional status contribute significantly to the elevated mortality rates seen in these patients. Previous studies have explored various factors affecting the outcomes of proximal femur fracture surgeries, yet mortality rates have not seen significant reductions.<sup>16,17</sup>

One of the most significant findings in this study was the association between advanced age and increased mortality following surgery. The mean age of participants was 70.98 years, and older patients had a higher risk of postoperative mortality. This finding corroborates the results of Wiles et al who identified advanced age as a strong predictor of increased mortality in patients undergoing hip fracture surgery.<sup>18</sup> Older patients are more likely to have multiple comorbidities, frailty, and reduced physiological reserves, which exacerbate the risk of complications such as infections, cardiovascular events, and delayed healing. However, Badghish et al did not find as strong a correlation between age and mortality, possibly due to differences in the patient populations, which may have included younger or less frail individuals.<sup>19</sup>

The study also examined the impact of the ASA classification on mortality. Patients with higher ASA scores (III and IV) had significantly higher mortality rates, which aligns with findings by Al-Husinat et al.<sup>20</sup> Higher ASA scores indicate the presence of severe systemic diseases, such as cardiovascular diseases, diabetes, and respiratory conditions, which increase the likelihood of postoperative complications like infections and thromboembolic events. Conversely, Yoo et al noted that even patients with lower ASA scores could experience poor outcomes if complications such as surgical site infections or delayed union occurred.<sup>21</sup> Therefore, while ASA classification is a strong predictor of mortality, other factors, including complications, must also be considered.

The majority of fractures in this study were intertrochanteric (85%), consistent with the global trend

that intertrochanteric fractures are the most common type of proximal femur fracture in elderly individuals. Gamma nail fixation is particularly effective for treating these fractures, providing stable fixation and reducing the risk of malunion or implant failure compared to other methods like DHS. Despite the stable fixation offered by gamma nails, mortality remains high due to the comorbidities and frailty prevalent in the elderly population. Subtrochanteric fractures, though less common in this study (15%), are associated with more complex surgical outcomes and a higher risk of complications, as noted by Horner et al who found that patients with subtrochanteric fractures had higher rates of implant failure and postoperative complications.<sup>22</sup>

The study also highlighted the role of preoperative comorbidities in influencing mortality outcomes. A high prevalence of cardiovascular diseases (66.33%) was found in the patient population, which significantly correlated with increased mortality. This finding supports the meta-analysis by Farley et al which identified cardiovascular disease as a major comorbidity influencing mortality following hip fracture surgery.<sup>23</sup> Cardiovascular disease increases the risk of perioperative cardiac events, such as myocardial infarction or arrhythmias, which can be particularly dangerous in elderly patients undergoing surgery. Similarly, metabolic and endocrine disorders, including diabetes and hypertension, were associated with poorer postoperative outcomes, corroborating the observations of Carpintero et al who found that these conditions increase the risk of infection, delayed healing, and cardiovascular complications.<sup>24</sup>

Regarding postoperative complications, 77.27% of the patients in this study had no significant issues, which is in line with the findings by Bovbjerg et al who reported that most patients undergoing gamma nail fixation recover without significant complications.<sup>25</sup> However, ICU admission, bed sores, and infections were observed in smaller percentages, and ICU admission was significantly associated with mortality in this study. These findings are consistent with those of Yilmaz et al who found that ICU admission after surgery is a strong predictor of mortality.<sup>26</sup> Additionally, the Parker mobility score, introduced by Parker and Palmer, was found to be an important predictor of mortality, as patients with lower preoperative mobility scores faced a longer recovery period and were at higher risk of complications such as DVT, pressure ulcers, and pneumonia.<sup>27</sup>

Finally, the mortality rate observed in this study was 30.45%, with 8.64% of patients dying within the first month after surgery. These findings are similar to those of Wiles et al who reported a 30-day mortality rate of 8.3% and a one-year mortality rate of 29.3%.<sup>18</sup> The high mortality rates in this study can be attributed to the advanced age of the patients, as well as the significant burden of comorbidities, which is consistent with other studies, such as the one by Panula et al which also found

high mortality rates in elderly patients following hip fracture surgeries.<sup>28</sup>

## CONCLUSION

In conclusion, this study reinforces the importance of considering age, comorbidities, functional status, and surgical complications when evaluating mortality risk in elderly patients undergoing gamma nail fixation for proximal femur fractures. Despite advances in surgical techniques, mortality remains high in this patient population, highlighting the need for improved preoperative assessment, perioperative management, and post-surgical rehabilitation strategies to reduce complications and improve outcomes.

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