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Delayed surgical treatment of geriatric hip fractures increases the need for intensive care unit, morbidity and mortality rates

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ABSTRACT

Objective: The aim of this study was to present the intensive care admission, morbidity and mortality rates of older adults with hip fractures who could not be operated in the first 48 hours after admission, which is the recommended time in literature.

Patients and Methods: Patients aged >60 years of age with a hip fracture who were operated on in our clinic between January 2012 and June 2021 were identified. The patients were evaluated in 3 groups according to preoperative waiting time, as Group 1: 2-10 days, Group 2: 11-20 days, and Group 3: ≥21 days.

Results: Mortality within 1 year was found to be 20% in Group 1, 31% in Group 2, and 50% in Group 3 (P=0.001). Preoperative waiting time did not affect complications related to surgery infection (P=0.890), implant failure (P=0.129)]but surgeons had to deal with decubitus ulcer (P=0.016) and urinary tract infection (P=0.001). Patients with a long preoperative waiting time required preoperative intensive care (P=0.003).

Conclusion: The study results demonstrate that as the preoperative waiting period increases, the mortality rate also increases, the need for intensive care before and after the operation increases, and there is increased morbidity due to a long hospital stay.

Keywords: Hip fracture, Preoperative waiting time, Intensive care unit

1. INTRODUCTION

Hip fracture is an increasing public health problem within aging populations [1]. Worldwide, hip fractures occur in 18% of females and 6% of males [1]. Assuming no change in the age – and gender-specific incidence, it is estimated that the number of hip fractures will approximately double to 2.6 million by 2025, and to 4.5 million by 2050 [2]. Although, the incidence of hip fracture in developed countries has reached a plateau with prevention of the risk factors of the disease, it is still increasing globally [3, 4].This increasing incidence can make health services inadequate from diagnosis to treatment and treatment delays may occur.

In Turkey and many other countries of the world, health services cannot be accessed quickly and effectively. Although, some authors have stated that a delay in surgery is not a quality indicator [5], this can cumulatively lead to high rates of delayed treatment in hospitals. Due to the increasing number of people living in metropolises, it is important to develop and implement national and international treatment protocols to be able to provide the quality of treatment recommended in the literature. Tuzun et al., reported that the incidence of hip fracture has increased in the last 20 years in Turkey. By 2035, 64,000 hip fractures per year are expected [4]. Doruk et al., reported 17 years ago that mortality increased in patients with preoperative waiting time exceeding 5 days, but these data do not seem to be sufficient to establish a national follow-up plan [6]. Although, the data were established on the basis of clinics, health authorities and managers have not focussed on this subject. In addition, the prolongation of the preoperative waiting period constitutes a financial burden for healthcare units [7].

All over the world, there is an effort to treat these patients quickly and effectively, to provide a long life and to re-integrate patients into society [8]. There are clear treatment protocols in the

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literature from the moment of diagnosis to the end of treatment, but this clarity may not always be true for populations who experience disruptions in the delivery of healthcare services. The main focus of previous studies has been morbidity and mortality, because regardless of how fractures are treated, these 2 parameters are the focus of treatment [9].

Timing matters in hip fracture surgery: patients operated on within 48 hours are known to have better outcomes [6, 7, 10-16]. However, when controlled for age, American Society of Anesthesiologists (ASA) score, gender, and medical comorbidities, some authors have reported that the increases in 90-day and 1-year mortality associated with surgical delay were not significantly different from the rates of patients treated early [17-19]. Although, there is an effort to treat these patients quickly in Turkey and in many countries, the hospital and medical conditions have not reached complete maturity. The aim of this study was to present the morbidity and mortality rates of older adults with hip fractures who could not be operated in the first 48 hours after admission, which is the recommended time in literature.

2. PATIENTS and METHODS

Approval for this study was granted by the Institutional Ethics Committee (09.2021.923). All study procedures were applied in accordance with the principles outlined in the Declaration of Helsinki.

Patients were identified from the hospital database, who were aged > 60 years and underwent surgery for a proximal femoral fracture or femoral neck fracture in our clinic between January 2012 and July 2021.

The patients were separated into 3 groups according to the preoperative waiting time. Group 1 comprised patients operated between 2 and 10 days, Group 2, patients operated between 11 and 20 days, and Group 3, patients operated after 20 days.

The preoperative preparation information and surgical notes of the patients were obtained from the hospital registry system and the notes of the surgeons. Mortality data of the patients were obtained from the national death notification system. Significant differences were investigated between the groups in respect of mortality at 1 month, 3 months, and 1 year.

Study exclusion criteria were defined as patients who were operated in the first 48 hours, pathological fractures, subtrochanteric fractures, and patients without adequate preoperative and postoperative data documentation.

Two patients were excluded because sufficient data were not available (Figure 1 Flowchart).

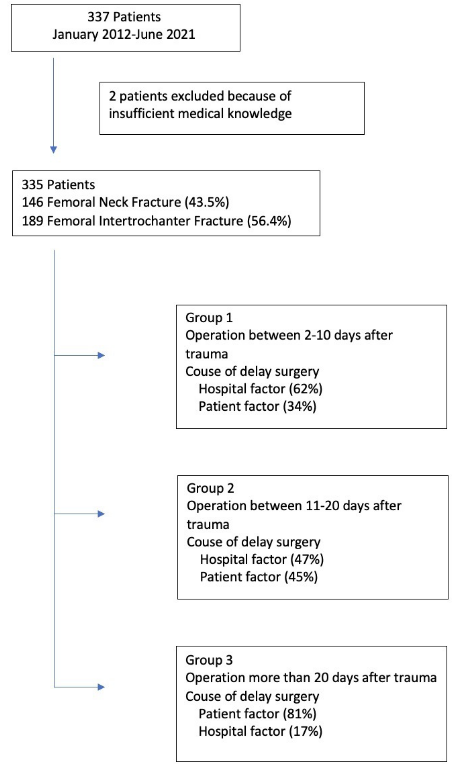

Figure 1. *Patient selection and the reasons for the delay of the operation.*

The patient demographic information (age, gender), preoperative waiting times (days) and ASA scores were retrieved from the patient registration system. The ASA score was preferred because it is fast, easy, and has good predictive value [20, 21]. The operation technique used (open reduction internal fixation (ORIF), closed reduction internal fixation (CRIF), arthroplasty (A)) and anesthesia technique (general anesthesia or regional anesthesia (including spinal, combined spinal, epidural)) were recorded.

It was recorded whether the patients were followed up in the postoperative orthopedic ward or in the anesthesia and reanimation intensive care unit (ICU). The number of days that patients were followed up in anesthesia and reanimation ICU before being transferred to the orthopedic ward was documented.

Postoperative infection and implant failure rates were documented.

Mortality status was identified using hospital records and/or by interviewing the patient’s family. A systematic search for death certificates at the National Statistical Office was conducted for patients lost to follow-up.

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Routine follow-up visits were scheduled for 6 weeks, 3, 6, 9 and 12 months, and every year thereafter. Patients unable to attend follow-up evaluations were interviewed by telephone.

Preoperative waiting time was analyzed with all other variables and its effect on the variables was investigated.

This study was conducted in a trauma centre, which is managed by the surgeons and nurses who visit and care for the patients twice a day, and geriatricians when necessary. The operations were performed by 5 surgeons and 1 mentor surgeon who participated in the study.

Statistical Analysis

Data obtained in the study were analyzed statistically using SPSS version 25.0 software (Statistical Package for the Social Sciences, Chicago, IL, USA). Kolmogorov-Smirnov and Shapiro-Wilk tests were used to evaluate the normal distribution as initial analyses. Categorical variables were stated as number (n) and percentage (%), and numerical variables as mean and standard deviation values. Chi-square test statistics were used to compare categorical data between groups. Parametric data in two independent groups were compared using the Student's t-test and the Mann-Whitney U test was applied to non-parametric data. The Kruskal-Wallis test was applied to non-parametric data in comparisons of more than two groups. Kaplan Meier analysis and the log-rank test were used for survival analysis. Independent variables that had a statistically significant effect on 1 year mortality in univariate logistic regression analysis were included in the multivariate regression analysis. The results were evaluated within a 95% confidence interval and a value of $P< 0.05$ was accepted as statistically significant.

3. RESULTS

A total of 335 patients were evaluated, comprising 133 (39.7%) males and 202 (60.3%) females with a mean age of 78.8±9 years (60-102, min-max). The fractures were determined as 146 (43.6%) femoral neck fractures, and 189 (56.4%) femoral intertrochanteric fractures. Arthroplasty was performed in 167 (49.9%) cases, closed reduction internal fixation in 132 (39.4%) and open reduction internal fixation in 36 (10.7%) (Table I).

Preoperative waiting time ranged from 48 hours to 49 days (13.3±7.4 Mean±SD). The ASA variable of 335 patients ranged from 1-4 (2.7±0.8 Mean±SD). The ASA variable was Group 1> Group 2> Group 3 (P=0.001) (Table I).

Implant failure requiring revision surgery developed in 6 patients (1.8%), and prosthesis and implant infection requiring revision surgery in 4 patients (1.2%). There was no significant difference between the groups in terms of implant failure and infection (P>0.05). Decubitus ulcer developed in 43 patients (12.8%), 53 patients (15.8%) received treatment for urinary infection, and there was a significant difference between the groups (P=0.016, P=0.001) (Table II).

Preoperatively, 13 (3.9%) patients needed the ICU, with an increased risk from Group 1 to Group 3 (P=0.003).

***Table I.** Patients' demographics and preoperative data*

		Groups						
		2 to 10 days		11 to 20 days		>20 days		
		Number	Mean ±SD	Number	Mean ±SD	Number	Mean ±SD	P value
Age (years)		146	77.91±9.3	122	79.99±9.23	67	78.72±7.87	0.156[1]
ASA		146	2.59±0.88	122	2.85±0.83	67	3.03±0.89	0.001[1]
		Number	%	Number	%	Number	%	P value
Gender	Male	56	38.40%	46	37.70%	31	46.30%	0.468[2]
	Female	90	61.60%	76	62.30%	36	53.70%	
Type of injury	FNFx	63	43.20%	54	44.30%	29	43.30%	0.982[2]
	ITFFx	83	56.80%	68	55.70%	38	56.70%	
Type of surgery	ORIF	12	8.20%	18	14.80%	6	9.00%	0.267[2]
	Hemiarthroplasty	69	47.30%	61	50.00%	37	55.20%	
	CRIF	65	44.50%	43	35.20%	24	35.80%	
Type of anesthesia	General	107	73.30%	94	77.00%	51	76.10%	0.763[2]
	Spinal	39	26.70%	28	23.00%	16	23.90%	

[1] Kruskal Wallis [2] Pearson Chi-square

FNFc: Femoral Neck Fracture
ITFFc: Intertrochanteric Femoral Fractures
ORIF: Open reduction internal fixation
CRIF: Close reduction internal fixation
ASA: American Society of Anesthesiologists

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Table II. Postoperative complications

		Groups						
		2 to 10 days		11 to 20 days		>20 days		
		Number	%	Number	%	Number	%	P value
Wound infection	no	2	1.40%	1	0.80%	1	1.50%	
	yes	144	98.60%	121	99.20%	66	98.50%	0.890[2]
	total	146	100.00%	122	100.00%	67	100.00%	
Implant fail	no	141	96.60%	121	99.20%	67	100.00%	
	yes	5	3.40%	1	0.80%	0	0.00%	0.129[2]
	total	146	100.00%	122	100.00%	67	100.00%	
Decubitus ulcer	no	134	91.80%	106	86.90%	52	77.60%	
	yes	12	8.20%	16	13.10%	15	22.40%	**0.016[2]**
	total	146	100.00%	122	100.00%	67	100.00%	
Urinary infection	no	138	94.50%	97	79.50%	47	70.10%	
	yes	8	5.50%	25	20.50%	20	29.90%	**0.001[2]**
	total	146	100.00%	122	100.00%	67	100.00%	
	[1] Kruskal Wallis [2] Pearson chi-square							

Table III. Intensive Care Unit hospitalization rates

		Groups						
		2 to 10 days		11 to 20 days		>20 days		
		Number	%	Number	%	Number	%	P value
Preop ICU	no	145	99.30%	117	95.90%	60	89.60%	
	yes	1	0.70%	5	4.10%	7	10.40%	**0.003[2]**
	total	146	100.00%	122	100.00%	67	100.00%	
Postop ICU	no	107	73.30%	60	49.20%	31	46.30%	
	yes	39	26.70%	62	50.80%	36	53.70%	**0.001[2]**
	total	146	100.00%	122	100.00%	67	100.00%	
		Number	Mean ±SD	Number	Mean ±SD	Number	Mean ±SD	P value
Days of stay in ICU		38	2.1±1.7	56	2.1±2	29	1.7±1.3	0.279[1]
	[1] Kruskal Wallis [2] Pearson Ki-Kare							

ICU: Intensive care unit

Postoperatively, 137 (40.9%) patients were followed up in the ICU, and 198 (59.1%) patients were followed up in the orthopedics and traumatology ward. There was an increased risk from Group 1 to Group 3 for the need for postoperative intensive care follow-up (P=0.010). The median length of stay in the postoperative ICU was 5 days (1-11 days, min-max). There was no difference between the groups in respect of ICU stay (P= 0.279) (Table III).

The 1st month, 3rd month, and 1st year mortality rates of the whole group were 9%, 16%, and 30% respectively, and there was a

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significant difference between the groups in all 3 periods. For the 1st month, the mortality of Group 1 patients was 3.4%, and 19% for Group 3 patients. The risk increased significantly from Group 1 to Group 3 (P=0.001). The 1-year mortality rate was 20.5% for Group 1 patients, and 50.7% for Group 3 patients, showing a significantly increased risk from Group 1 to Group 3 (P=0.001). The median time from operation to death was 412 days for Group 1, 409 days for Group 2, and 206 days for Group 3 (P=0.037) (Table IV).

When the equality of survival distributions for the different groups was examined with the Log Rank (Mantel-Cox) test, there was a significant difference between the groups (P=0.001).

In the Kaplan-Meier Survival analysis, the mean estimated survival time was found to be 1774 days in Group 1, 1304 days in Group 2, and 958 days in Group 3. As the waiting time increased, so the estimated survival time decreased (Figure 2).

In the univariate logistic regression analysis, independent variables that had a statistically significant effect on 1-year

Table IV. *Postoperative survival rates and overall survival*

		Groups						
		2 to 10 days		11to 20 days		>20 days		
		Number	%	Number	%	Number	%	P value
Mortality 1st month	live	141	96.60%	110	90.20%	54	80.60%	**0.001²**
	dead	5	3.40%	12	9.80%	13	19.40%	
	total	146	100.00%	122	100.00%	67	100.00%	
Mortality 3rd month	live	133	91.10%	103	84.40%	45	67.20%	**0.001²**
	dead	13	8.90%	19	15.60%	22	32.80%	
	total	146	100.00%	122	100.00%	67	100.00%	
Mortality 1st year	live	116	79.50%	84	68.90%	33	49.30%	**0.001²**
	dead	30	20.50%	38	31.10%	34	50.70%	
	total	146	100.00%	122	100.00%	67	100.00%	
Mortality	no	86	58.90%	42	34.40%	17	25.40%	**0.001²**
	yes	60	41.10%	80	65.60%	50	74.60%	
	total	146	100.00%	122	100.00%	67	100.00%	
		Number	Mean ±SD	Number	Mean ±SD	Number	Mean ±SD	P value
Days until postop death		60	551.2±555	80	520.6±487.9	50	367.3±499.2	**0.037¹**

¹ Kruskal Wallis test ² Pearson chi-squared test

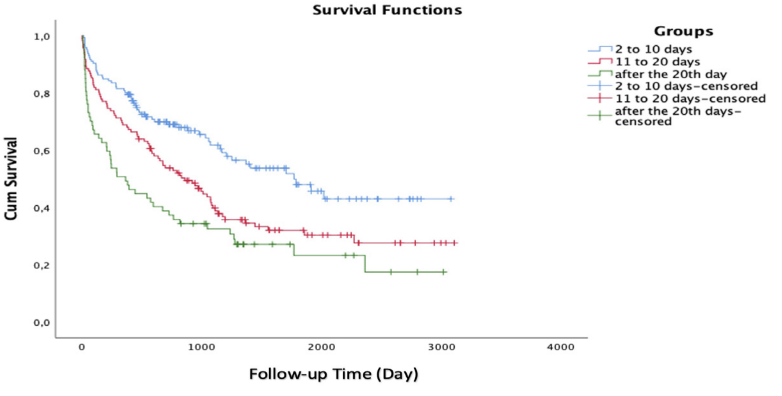

Figure 2. *The cumulative survival distribution of the groups according to preoperative waiting times as operations performed at 2-10 days, between 11-20 days and after 20 days.*

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mortality were included in the multivariate binary logistic regression analysis and the model was found to be significant (P=0.001). The model explained 10% of the variance in the dependent variable. The independent variables of preoperative waiting time and age were determined to significantly change the dependent variable of mortality. For preoperative waiting time, the OR was 1.068 and for age, the OR was 1.051 (Table V).

Table V. *Factors affecting 1st year mortality logistic regression*

Factors Affecting 1st Year Mortality Logistic Regression								
	B	S.E.	Wald	df	p	OR	95% G.A OR	
							Lower	Highest
Preoperative waiting time	0.065	0.017	14.684	1	0.001	1.068	1.032	1.104
Age	0.049	0.016	9.366	1	0.002	1.051	1.018	1.084
ASA	0.241	0.156	2.383	1	0.123	1.273	0.937	1.729
Constant	-6.38	1.285	24.637	1	0.001	0.002		

4. DISCUSSION

The main focus of this study was to determine the effect of surgical delay on patient morbidity, mortality, and ICU stay. The study results showed that the 1-year mortality rate was 20.5% if the operation was performed after the first 48 hours, 31.1% after the first 10 days, and 50.7% after the first 20 days. Preoperative waiting time did not affect complications related to surgery (such as infection and implant failure) but in the longer time-frame, decubitus wounds may develop. If the operation could not be performed in the first 10 days, 1 of every 2 patients required the postoperative ICU.

There are many factors in surgical delay, including the late presentation of patients, unavailability of operating theatres, delays in health system payments, examinations, and doctor shortage. These can differ depending on which health authority the clinic is affiliated with. Chow et al., reported that the most common reasons for delayed surgery were prolonged medical review or stabilization of the patient [12]. Seigmenth et al., and Cha Y-H et al., stated that the reason for delay was always because of hospital-related causes such as unavailability of an operating theatre, surgeon, anaesthetist or theatre staff [13, 22]. Drugs that should be discontinued before the surgery on the request of the anesthesiologist, such as anti-aggregant and anticoagulant drugs (clopidogrel, dipyridamole, acetylsalicylic, etc.) as they can increase the risk of morbidity and mortality, and tests requested to evaluate the cardiac status (transthoracic echocardiography, etc.) may also prolong the waiting period [23, 24]. However, these examinations can be applied rapidly and effectively, such as bedside echocardiography. The critical point is that other branches consulted should evaluate the patient quickly and only request the necessary and effective examinations. Preoperative waiting time is a modifiable risk factor, unlike other preoperative indicators (high ASA, male gender, pre-fracture mobility, advanced age, cognitive impairment) [25]. A complete analysis of these factors could not be performed in the current study as there were multiple reasons for delay in all the patients.

Vidán et al., reported urinary infection in 15% of patients who could not be operated on for the first 5 days [26]. Johnstone et al., reported urinary infection in 48% of all patients at 48 hours postoperatively [27]. Urinary infections are more likely to occur in patients waiting longer than 48 hours, and cephalosporin prophylaxis for surgery does not reduce this risk [27, 28]. Nursing quality is decisive in urinary tract infection because inadequate skin care is an important risk factor for urinary tract infection [29]. In our clinic, importance is given to skin care with 2 nurses and 3 patient care personnel who deal with hip fractures. Another risk is that if urinary tract infection is not treated adequately, it may cause infection of the implant or endoprosthesis used in fracture stabilization [28]. The lack of difference in implant infection between the groups in the current series is perhaps due to the short-to-mid-term results of the patients. It is not known whether the infection rates would have increased if the patients in Group 3 had lived longer. It can be recommended that further studies are conducted with larger patient series to investigate the issue of urinary tract infection in hip fracture patients.

Rai et al., emphasized that early surgery reduces the risk of pressure ulcers [19]. The rate of pressure ulcers in the current study Group 1 patients was 7.6-12%, similar to data in previous studies [19, 30, 31]. The higher rate of pressure ulcers in Groups 2 and 3 than in the literature may be associated with increased mortality. As an independent risk factor, pressure ulcers have been reported to increase the 6-month mortality rate by > 2-fold [30]. The need for debridement surgery due to pressure sores in only 1 of the current study patients can be attributed to the daily visit of the wound care service in our hospital. Pressure ulcer care is important because pressure ulcers are associated with an increased length of hospital stay, higher costs, shorter life expectancy, and worse quality of life [32].

To the best of our knowledge, this is the first study to have presented a correlation between preoperative need for intensive care and preoperative waiting time in hip fractures. Low molecular weight heparin (LMWH) treatment was applied to all the current study patients, and 13 patients with a greater oxygen requirement could not tolerate room air and were applied with a mask with a reservoir due to massive embolism. The need for postoperative intensive care was different between the groups. Eschbach et al., reported the 1st year mortality of patients who had never been admitted to the ICU as 15%, and the 1st year mortality of the patients admitted to the ICU for more than 3 days was 59%. As an independent risk factor in hip fractures, hospitalization for more than 3 days has been shown to increase 1-year mortality [33, 34]. In the current series, the average ICU stay of any group was not more than 3 days. However, the high rate of ICU admission in Group 3 patients may be another reason for high mortality. Hasan et al., reported a similar rate of postoperative intensive care requirement (6%) of patients who were operated on and not operated on in the first 48 hours, and that the risk factor for intensive care was prosthetic surgery [35].

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However, this rate was different from that of the current study at < 1 in 4 of the Group 1 patients.

In the literature, the 1st year mortality has been reported to range from 9.5-20.4% in patients operated on in the first 48 hours, and 14.5-32.5% in patients who could not be operated on in the first 48 hours [11-13, 16, 36]. The 1st year mortality rate exceeding 50% in the current study Group 3 patients is above the rates reported in literature. Leer-Salvesen et al., stated that while there was no significant mortality change observed in patients who were operated on in the first 48 hours, there was an increase in mortality with a waiting time of more than 48 hours [16]. However, that study excluded patients with preoperative waiting time of ≥4 days. There are no data of patients with operations performed in the 3rd week or later with current treatment opportunities.

Maheshwari et al., reported a 1-year mortality rate of 22% in a patient group operated on within an average of 30 hours and it was stated that each 10-hour delay increased mortality by 5% [11]. These data overlap only with the Group 1 patients in the current study. The 1st year mortality in the Group 3 patients was >50%. Early surgery seems to provide a survival benefit in comparison with later intervention.

Cha Y-H et al., reported that the 1-year mortality rate was 21.2% when the delay was due to patient-related factors, and 12.6% when it was due to hospital-related factors. In the current study, the risk factors for most of Group 3 were patient-related factors [13].

A higher ASA score has been shown to be significantly correlated with late operation and high mortality [11-13, 23, 26, 37]. The current study results support these previous studies as Group 3 patients had the highest mean ASA scores. As stated by previous authors, most patients are ASA 2-3 but when the ASA value increases by 1 unit, mortality rates increase 2-fold, and mortality increases 1.5-fold for every 10-year increase in age [14, 16]. However, the current study results showed that the independent variables of preoperative waiting time and age were determined to significantly change the dependent variable of mortality.

There are many variables that can predict post-fracture mortality, most of which are not modifiable risk factors, such as high ASA, limited walking capacity before fracture, male gender, advanced age, and renal disease. However, operating on patients as soon as possible, reducing the length of hospital stay, and enabling early mobilization are modifiable risk factors [12]. The main reasons for the delay in the operations of the current study Group 1 and Group 2 patients were hospital-related (unavailability of operating theatres, etc.). This would seem to be able to be resolved with a national follow-up plan.

Limitations of this study can be said to be the retrospective, single-centre design with a low number of patients with high rates of comorbidity, who were not randomized and with no control group. However, the strength of this study is that very few articles in the last 10 years have directly reported the mortality rates of patients who could not be operated on within 48 hours after a hip fracture.

Conclusion

The results of this study have shown that as the preoperative waiting period increases, so the mortality rate of the patients increases, together with an increased need for intensive care before and after the operation, and morbidity due to a longer hospital stay.

Compliance with Ethical Standards

Ethics Committee Approval: This study was approved by the institutional ethics committee (Marmara University Medical School, Ethics Committee for Clinical Research: 09.2021-923).

Conflict of Interest: The authors declare that they have no conflicts of interest.

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Authors Contributions: YS: Study design, data analysis, writing the article, YS and ODT: Data collection, data analysis, TO and BE: Study design, writing the article, BE, OS and TO: Supervision. All authors read the article and approved the final version of the article.

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