

# Analyzing Mid-to-Long Term Mortality Rates and Associated Factors of Geriatric Patients with Hip Fractures during the COVID-19 Pandemic: A Single Centre Prospective Study

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## ABSTRACT

**Objective:** Our objective was to evaluate the mid-to-long term mortality rates (with an average of 1-year follow-up) and associated factors of geriatric patients with hip fractures during the COVID-19 pandemic.

**Methods:** Prospectively followed-up 104 geriatric patients over 65 years old, with hip fractures during the pandemic, 89 of which underwent surgery, were evaluated. A control group of 126 geriatric patients treated for hip fractures before the pandemic was formed. Patient demographics, initial SARS-Cov-2 Reverse Transcriptase PCR test results, fracture type, type of surgery performed, length of stay (LOS) in hospital and early complications were analyzed.

**Results:** The mid-to-long term mortality rate of geriatric patients with hip fractures treated during the pandemic period was 42.3% whereas the mortality rate of the control group was calculated as 38.9% ( $p=0.599$ ). Patients that were unfit for surgery and patients with positive initial SARS-Cov-2 Reverse Transcriptase PCR test were significantly related with higher mortality ( $p<0.001$  for each). Among the geriatric patients with operated hip fractures, the presence of early complications, longer LOS in intensive care units postoperatively, and longer total LOS in the hospital were significantly related with higher mortality ( $p=0.017$ ,  $p=0.001$ , and  $p=0.045$ ; respectively).

**Conclusion:** Patients with a positive initial SARS-Cov-2 Reverse Transcriptase PCR test and deemed as unfit for surgery have higher mortality rates. On the other hand, with correct management and separation of COVID and non-COVID patients and medical staff, increased mortality may be avoidable among patients treated surgically. Unfortunately, it may not always be possible to avoid some of the related factors of increased mortality.

**Keywords:** COVID-19 Pandemic, Geriatric Patients, Hip Fracture, Mortality, Length of Stay

**Level of Evidence:** Prognostic Level 2

## COVID-19 Pandemisi Sırasında Kalça Kırığı Olan Geriatrik Hastaların Orta-Uzun Vadeli Ölüm Oranları ve İlişkili Faktörlerin Analizi: Tek Merkezli Prospektif Çalışma

### ÖZET

**Amaç:** Amacımız, COVID-19 pandemisi sırasında kalça kırığı olan geriatrik hastaların orta-uzun vadeli ölüm oranlarını (ortalama 1 yıllık takip ile) ve ilişkili faktörleri değerlendirmektir.

**Yöntemler:** Pandemi sırasında kalça kırığı nedeniyle takip edilen 65 yaş üstü 104 geriatrik hasta prospektif olarak izlendi ve 89'u ameliyat edildi. Pandemi öncesi kalça kırığı tedavisi gören 126 geriatrik hastadan oluşan bir kontrol grubu oluşturuldu. Hastaların demografik verileri, ilk SARS-Cov-2 Reverse Transkriptaz PCR testi sonuçları, kırık tipi, gerçekleştirilen ameliyat tipi, hastanede kalış süresi ve erken komplikasyonlar analiz edildi.

**Sonuçlar:** Pandemi döneminde tedavi edilen kalça kırığı olan geriatrik hastaların orta-uzun dönem mortalite oranı %42,3 iken kontrol grubunun mortalite oranı %38,9 olarak hesaplandı ( $p=0,599$ ). Ameliyat için uygun olmayan hastalar ve ilk SARS-Cov-2 Reverse Transkriptaz PCR testi pozitif olan hastalar ile daha yüksek mortalite oranları arasında anlamlı ilişki tespit edildi (her biri için  $p<0,001$ ). Ameliyatlı kalça kırığı olan geriatrik hastalarda erken komplikasyon varlığı ve ameliyat sonrası yoğun bakımda ve hastanede daha uzun süre kalmak, yüksek mortalite ile anlamlı olarak ilişkiliydi (sırasıyla;  $p=0,017$ ,  $p=0,001$  ve  $p=0,045$ ).

**Sonuç:** İlk SARS-Cov-2 Ters Transkriptaz PCR testi pozitif olan ve ameliyat için uygun olmadığı düşünülen hastalarda ölüm oranları daha yüksektir. Öte yandan, COVID ve COVID olmayan hastaların ve sağlık personelinin doğru yönetimi ve ayrılması ile cerrahi olarak tedavi edilen hastalarda artan mortalite oranları önenebilir. Ne yazık ki, artan mortalite oranıyla ilgili bazı faktörlerden kaçınmak her zaman mümkün olmayabilir.

**Anahtar Kelimeler:** COVID-19 Pandemisi, Geriatrik Hastalar, Kalça Kırığı, Mortalite, Hastanede Kalış Süresi

**W**ith more than 200 million confirmed cases and over 4.3 million associated deaths, the COVID-19 pandemic is an ongoing major health problem worldwide (1). Although all kinds of precautions have been taken, given the density of hospitals and the number of patients, especially in areas with a higher patient burden, some disruptions regarding emergency health services are inevitable. These disruptions affect all segments of society, especially the geriatric population (2,3). Furthermore, the curfews imposed on the geriatric population in our country during last year, due to the lack of preventive vaccines and therapeutic drugs caused the daily physical activity levels, behavioral patterns, and related health conditions of geriatric patients to deteriorate (4).

The COVID-19 pandemic has affected mortality rates among geriatric patients not only by infecting and causing respiratory failures but also by causing secondary infections and increasing length of stay (LOS) in intensive care units (ICUs) (5). There is a prevailing opinion in the literature that the 30-day mortality rate of geriatric hip fractures increased significantly during the COVID-19 pandemic (6-10). Moreover, several studies have concluded that 90-days and 120-days mortality rates have also increased significantly (11-12). On the other hand, some studies in the literature have stated that a significant increase in mortality rates of hip fractures can be prevented with the right precautions (3,13). Furthermore, in a recently published meta-analysis, it was determined that the mortality rates and disease severity of COVID-19 may vary according to the geographical characteristics of the regions (14).

This study evaluated the mid-to-long term mortality rates (with an average of 1-year follow-up) of geriatric patients over 65 years old with hip fractures in our hospital during the COVID-19 pandemic; it also investigated factors affecting these rates.

## MATERIALS AND METHODS

After obtaining approval from the ethical committee (E-2-21-13), all consecutive geriatric patients with an age over 65 years, who were admitted to the study hospital—a Level-1 trauma center—with a diagnosis of pertrochanteric or femoral neck fractures between March 2020 and March 2021 were prospectively analyzed. The exclusion criteria were defined as patients with pathological fractures, subtrochanteric fractures, co-existing other fractures,

and periprosthetic fractures. After applying the exclusion criteria, a total of 104 patients were included.

To compare mortality rates, a control group consisting of geriatric patients with hip fractures in 2018 was formed retrospectively. Patients who underwent operations in 2019 were not included because the study aimed to ensure the control group was completely independent of the effects of the pandemic. Thus all the patients in the control group had a COVID-free follow-up period. Using the same exclusion criteria, 126 geriatric patients were included in the control group. The health status of the patients in the control group was evaluated using online public health management systems and calling the phone numbers included in the patients' files.

The follow-up period was determined based on the date of the initial surgery and the period between the operation date and August 2021 was used in the pandemic group. Accordingly, the average mid-to-long term follow-up period was 11.2 months (Range: 5 – 18 months) for the pandemic group. For the control group, the mid-to-long term mortality rate was calculated based on the health status of patients on their 1-year follow-up; which was comparable to the pandemic groups' average follow-up period.

Demographic data, initial SARS-Cov-2 Reverse Transcriptase PCR test result, injury mechanism, fracture type, preferred treatment modality, type of surgery performed, length of stay in the hospital, and early complications were recorded. Injury mechanisms were classified as low- or high-energy injuries. Simple falls and domestic accidents were classified as low-energy injuries while falling from stairs and pedestrian traffic accidents were classified as high-energy injuries.

Surgery is the preferred primary treatment modality for all geriatric hip fractures in our clinic. On the other hand, patients who were hospitalized in the COVID-related inpatient clinics or intensive care units (ICUs) with a positive initial SARS-Cov-2 Reverse Transcriptase PCR test result and died before they could be ready for surgery (9 patients), and patients who refused surgical treatment at the request of their family (6 patients in the pandemic group and 7 patients in the control group) could not be operated and deemed as unfit for surgery. Following the indications stated in the literature, the type of surgery was determined according to the primary surgeon's (ÖD) recommendation and the patient's general condition. Accordingly,

either proximal femoral nailing or hip hemiarthroplasty was applied to the patients (15,16). All patients, regardless of the surgical method, were mobilized with early weight-bearing that they could tolerate on the first postoperative day; also, a physiotherapist oversaw active quadriceps exercises.

Early complications were defined as complications that occurred during the hospitalization period, such as prolonged serous discharge, deep vein thrombosis/pulmonary embolism, and acute respiratory failure.

Statistical analyzes were performed using SPSS 26.0 software. The compliance of the variables to normal distribution was examined by visual (histogram and probability graphs) and analytical (Kolmogorov-Smirnov/Shapiro-Wilk tests) methods. For normally distributed variables, descriptive analyzes were defined using mean and minimum-maximum values. Student's T and Mann-Whitney U Tests were used to compare the means of the groups. Whether there was a difference between the groups in terms of frequencies was compared using the Chi-Square Test. Fisher's Exact Test was used when the observed values did not meet the Chi-Square assumption. The situations where the P-value was below 0.05 were considered statistically significant.

## RESULTS

Although the mid-to-long term mortality rates of geriatric patients with hip fractures treated during the pandemic period increased in comparison with the pre-pandemic period (42.3% vs. 38.9%), no significant difference was observed between the two groups ( $p=0.599$ ). Comparison of mortality rates and related factors of pandemic and control groups can be seen in Table 1.

Patients that were deemed as unfit for surgery and patients with positive initial SARS-Cov-2 Reverse Transcriptase PCR test results were significantly related with higher mortality ( $p<0.001$  for each). Mortality-associated factors of all admitted geriatric patients with hip fractures can be seen in Table 2.

Among the geriatric patients with operated hip fractures, presence of early complications, longer LOS in ICU postoperatively, and longer total LOS were significantly related with higher mortality in the mid-to-long term ( $p=0.017$ ,  $p=0.001$ , and  $p=0.045$ ; respectively). Mortality-associated factors of geriatric patients with operated hip fractures can be seen in Table 3.

Two patients (1.9%) from the pandemic group and three patients (2.4%) from the control group had pulmonary embolisms and anticoagulant therapy was started at the therapeutic dose. Four patients in the control group (3.2%) had electrolyte imbalance postoperatively, were treated in line with the recommendations of the internal medicine department. Among the geriatric patients with operated hip fractures ( $n=89$ ), six patients (6.7%) had respiratory complications, such as severe dyspnea, requiring postoperative ICU admissions and 16 patients (18%) had prolonged serous discharge. However, while no respiratory complications were observed in the control group, 11 patients (9.2%) had prolonged serous discharge. No secondary surgery was required in any patient.

Among the patients that were deemed as unfit for surgery in the pandemic group ( $n=15$ ), 14 patients (93.3%) had severe respiratory complications requiring ICU admissions, which resulted in the death of patients.

## DISCUSSION

Although few studies are stating the contrary, the prevailing opinion in the literature is that the mortality rate of geriatric patients with hip fractures during the COVID-19 pandemic is higher, especially in the short term (6-10). On the other hand, the number of studies examining the medium- and long-term outcomes and mortality rates of geriatric patients with hip fractures during the pandemic period is relatively lower (11,12). Furthermore, some reports have stated that the mortality rates and disease severity of COVID-19 may vary according to the geographical characteristics of the regions (14). To our knowledge, this is one of the first studies in the literature analyzing the mid-to-long term mortality rate of geriatric patients with hip fractures in our region. Our most important finding was that even though the mortality rate of geriatric patients with hip fractures increased during the pandemic (42.3% vs. 38.9%), it was not statistically significant ( $p=0.599$ ). On the other hand, a significant relationship was found between the positive initial SARS-Cov-2 Reverse Transcriptase PCR test result and mortality rate ( $p<0.001$ ). Among the geriatric patients with operated hip fractures, a significant relationship was found between longer LOS in ICU postoperatively, longer LOS in hospital, and the presence of early complications with mid-to-long term mortality.

		Pandemic Group (N=104)		Control Group (N=126)		P
		Patients (N)	Rate %	Patients (N)	Rate %	
Gender	Female	74	71.2	87	69	0.729
	Male	30	28.8	39	31	
Mean Age (years)		81.3 (65-99 years)		82.4 (65-96 years)		0.301
Follow-up Period (months)		11.2 (5-18 months)		N/A		N/A
Side	Right	60	57.7	71	56.3	0.838
	Left	44	42.3	55	43.7	
Fracture Type	Femoral Neck	48	46.2	59	46.8	0.919
	Pertrochanteric	56	53.8	67	53.2	
Injury Mechanism	Low-Energy	98	94.2	118	93.7	0.855
	High-Energy	6	5.8	8	6.3	
Initial PCR Test	Negative	83	79.8	N/A	N/A	N/A
	Positive	21	20.2			
Preferred Treatment Modality	PFN	18	17.3	29	22.7	0.055
	Hemiarthroplasty	71	68.3	92	71.9	
	Unfit for Surgery	15	14.4	7	5.5	
Mortality	Survivor	60	57.7	77	61.1	0.599
	Non-survivor	44	42.3	49	38.9	

*N: number of patients, P: Statistical significance value, N/A: non-applicable, PCR Test: SARS-Cov-2 Reverse Transcriptase PCR Test, PFN: proximal femoral nail.*

		Mid-to-long Term Mortality		
		Survivor (N = 60)	Non-survivor (N = 44)	P
Age (years)		80.6 (65-97 years)	82.2 (68-99 years)	0.401
Gender	Female	44 (73.3%)	30 (68.2%)	0.567
	Male	16 (26.7%)	14 (31.8%)	
Initial PCR Result	Negative	57 (95%)	26 (59.1%)	<0.001
	Positive	3 (5%)	18 (40.9%)	
Injury Mechanism	Low-Energy	55 (91.7%)	43 (97.7%)	0.397
	High-Energy	5 (8.3%)	1 (2.3%)	
Fracture Type	FNF	25 (41.7%)	23 (52.3%)	0.284
	PFF	35 (58.3%)	21 (47.7%)	
Treatment Modality	PFN	14 (23.3%)	4 (9.1%)	<0.001
	Hemiarthroplasty	45 (75%)	26 (59.1%)	
	Unfit for Surgery	1 (1.7%)	14 (31.8%)	

*N: number of patients, P: Statistical significance value, PCR Test: SARS-Cov-2 Reverse Transcriptase PCR Test, FNF: femoral neck fractures, PFF: pertrochanteric femoral fractures, PFN: proximal femoral nail.*

Table 3: Mid-to-long term mortality rate and associated factors of geriatric patients with operated hip fractures

		Mid-to-long Term Mortality		
		Survivor (N = 59)	Non-survivor (N = 30)	P
Age (years)		80.5 (65-97 years)	83.1 (68-99 years)	0.174
Gender	Female	43 (72.9%)	21 (70%)	0.775
	Male	16 (27.1%)	9 (30%)	
Initial PCR Result	Negative	57 (96.6%)	26 (86.7%)	0.174
	Positive	2 (3.4%)	4 (13.3%)	
Injury Mechanism	Low-Energy	54 (91.5%)	30 (100%)	0.163
	High-Energy	5 (8.5%)	0	
Fracture Type	FNF	25 (42.4%)	16 (53.3%)	0.327
	PFF	34 (57.6%)	14 (46.7%)	
Surgery Type	PFN	14 (23.7%)	4 (13.3%)	0.248
	Hemiarthroplasty	45 (76.3%)	26 (86.7%)	
Early Complications	No	48 (81.4%)	17 (56.7%)	<b>0.017</b>
	Yes	11 (18.6%)	13 (43.3%)	
Preop. LOS in Clinic (days)		3.6 (0-17 days)	3.9 (0-10 days)	0.365
Postop. LOS in Clinic (days)		6.8 (2-23 days)	6.3 (0-31 days)	0.110
Preop. LOS in ICU (days)		0.4 (0-7 days)	0.5 (0-15 days)	0.535
Postop. LOS in ICU (days)		0.8 (0-11 days)	3.9 (0-21 days)	<b>0.001</b>
Total LOS (days)		11.4 (4-26 days)	14.6 (2-37 days)	<b>0.045</b>

*N: number of patients, P: Statistical significance value, PCR Test: SARS-Cov-2 Reverse Transcriptase PCR Test, FNF: femoral neck fractures, PFF: pertrochanteric femoral fractures, PFN: proximal femoral nail, Preop: Preoperative, Postop: Postoperative, LOS: Length of Stay, ICU: Intensive Care Unit.*

Among all admitted geriatric patients with hip fractures treated during the pandemic, positive initial SARS-Cov-2 Reverse Transcriptase PCR test result is significantly related to mid-to-long term mortality rate ( $p < 0.001$ ). Our finding is consistent with the literature. Since coronavirus infection has a mortal course in the geriatric population, the mortality rate of geriatric patients with hip fractures would inevitably increase during the COVID-19 pandemic (3,5-10). In our study, the fact that patients who were deemed as unfit for surgery had a higher mortality rate ( $p < 0.001$ ) is a result rather than a cause. That is, although our preferred treatment modality in geriatric hip fractures is always surgical, as mentioned before, patients who were diagnosed with COVID-19 when they were first admitted to the hospital and died before they could be operated and patients who refused to be operated were categorized as unfit for surgery. On the other hand, positive SARS-Cov-2 Reverse Transcriptase PCR test result did not have an effect on mid-to-long term mortality of geriatric patients undergoing surgery ( $p = 0.163$ ). Furthermore, no difference was found between pandemic and control groups in terms of mid-to-long term mortality rate ( $p = 0.599$ ). These may be due to several different variables. First of all,

all, from the first days of the pandemic, our hospital was divided into two blocks as COVID and non-COVID blocks, with completely different medical staff. This may have limited the exposure of the virus thus preventing the infection to spread during the treatment process. Chiu et al (13) have mentioned a similar application in their study and achieved strict infection control. Ojeda-Thies et al (3) have concluded that hip fracture patients without an initial COVID-19 infection upon admission can be treated safely through a separated and isolated treatment protocol. Unfortunately, it is not possible to prevent exposure completely. Secondly, most of the studies reporting higher mortality rates are conducted in regions with relatively higher deaths per 1 million people. For example, Italy, the country where most of the aforementioned studies were carried out, has 2136 deaths per 1 million people whereas the number of deaths per 1 million people in our country is 656 deaths (17). Factors affecting the rate and frequency of virus spread, such as race, climate, and geographic differences may affect the mortality of geriatric patients (3). Indeed, studies are indicating that the mortality and transmission rate of COVID-19 may differ from region to region (3,14).



Literature has shown that even slight delays in the treatment of geriatric patients with hip fractures will have an increase in mortality (6). On the other hand, it is inevitable to have increased LOS during the COVID-19 pandemic, due to the need to make the general condition of the patient suitable for surgery preoperatively and treat secondary infections or other coronavirus related pathologies postoperatively. Our study has shown that increased LOS in ICU postoperatively and total LOS in the hospital have a significant relationship between mid-to-long term mortality rates ( $p=0.001$  and  $p=0.045$ , respectively). On the other hand, increased preoperative LOS in orthopedics clinics or ICU did not have a relationship with mortality ( $p=0.365$  and  $p=0.535$ , respectively), which is an expected result considering longer preoperative LOS is associated with the stabilization process of patients and making them suitable for surgery. Our findings are consistent with the literature. Sciard et al (18) reported that surgical delay did not have significant importance on mortality in medically unstable patients. Postoperative LOS, on the other hand, is associated with hospital infections, increased risk of virus exposure, prolonged serous discharge, and other hospital-related complications (19). These risks are far greater in ICU admissions.

In our study, a significant relationship between the presence of early complications and mid-to-long term mortality rate ( $p=0.017$ ) was found. Our finding is consistent with the literature. Basques et al (19) have analyzed 8434 patients and have concluded that the presence of early complications such as prolonged serous discharge or venous thromboembolism is associated with an increased 1-year mortality rate.

There are some limitations to our study. First and foremost, a relatively small number of patients were analyzed in our study. Further analyzes with multi-centered larger cohorts may yield different results. Secondly, although our patient group was formed prospectively, the control group was created retrospectively and recorded information on patient files and online public health management systems were mainly used. The third limitation is that only the initial SARS-Cov-2 Reverse Transcriptase PCR test results were analyzed in this study. Patients with clinical findings at the first admission or who were infected during their routine follow-up period were not evaluated as separate groups. Different results can be obtained with studies carried out by performing sub-group analyzes with larger patient populations. Finally, many confounding factors affect mortality rates in geriatric patients, such as comorbidities, physical behavioral patterns, nutrition, or whether or not

to stay in a nursing house. With more comprehensive studies that can consider all confounding factors, all factors affecting mortality can be understood more clearly.

## CONCLUSION

In conclusion, there was no significant increase in the mortality rate of geriatric patients with hip fractures in the mid-to-long term during the COVID-19 pandemic compared to the pre-pandemic period in our region. Patients with a positive initial SARS-Cov-2 Reverse Transcriptase PCR test result and deemed as unfit for surgery have higher mortality rates. On the other hand, with correct management and separation of COVID and non-COVID patients and medical staff, increased mortality may be avoidable among patients treated surgically. Unfortunately, it is not always possible to avoid some of the related factors of increased mortality among geriatric patients with hip fractures, such as increased LOS and the presence of early complications.

## DECLARATIONS

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### *Conflicts of Interest*

The authors have no conflicts of interest to declare that are relevant to the content of this article.

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### *Authors' Contributions*

ÖD: co-designed the study, conducted data analysis and wrote the manuscript. BG: co-designed the study, data entry, conducted data analysis and wrote the manuscript.

### *Ethical Approval*

This study was approved by the Ministry of Health and the local ethics committee (E-2-21-13).

### *Consent to Participate*

Informed consent was obtained from all individual participants included in the study.

### *Consent to Publish*

All authors agreed with the content and all authors gave explicit consent to submit the study. Patients signed informed consent regarding publishing their data.

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