



The Restrictions and Limitations Exerted During Pandemic Outbreak Did Not Affect the Ratio of the Hip Fractures in the Geriatric Population: A Comparison of the Pre-pandemic Era Versus One Year Amongst the Pandemic Outbreak

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Abstract

Objective: Although the incidence of hip fractures before and during the pandemic is similar, the effect of the epidemic on the distribution of hip fractures and its subtypes cannot be clearly explained. We aimed to elucidate the changes by comparing the number of geriatric hip fractures and the distribution of fracture types between one year of the Coronavirus disease-2019 (COVID-19) pandemic and seven years ago.

Methods: Hip fracture patients over 65 years of age was analyzed retrospectively. The period between March 11, 2020 and March 10, 2021 was called the pandemic period, and the period between March 11, 2013 and March 10, 2020 was called the pre-pandemic period. Mortality rates and fracture morphology were compared between the pre-pandemic period and the pandemic period.

Results: There was no significant difference in the age distribution between pre-covid (80.48 ± 7.38) and Coronavirus period (79.54 ± 7.92) ($p=0.163$). Likewise, no difference was found between the fracture patterns in both groups ($p=0.348$). During the pandemic period, femoral neck fractures have become dominant in the younger age group ($p=0.038$).

Conclusion: Despite the restrictions in the COVID-19 pandemic, geriatric hip fracture rates did not change. At the same time, fracture type distribution was similar to the pre-pandemic period. Pandemic restrictions may have affected hip fracture in the younger age geriatric group. However, this finding alone may not impact the management and planning of geriatric hip fractures during the pandemic.

Keywords: Geriatrics, hip fracture, morbidity, mortality, COVID-19 pandemic, femoral neck fractures

INTRODUCTION

Severe acute respiratory distress syndrome-coronavirus-2 (SARS-CoV-2), also known as 2019 new coronavirus or Coronavirus disease-2019 (COVID-19), first appeared in China on December 31, 2019, and since then, it has spread rapidly and become a pandemic all over the world (1). The effects of this pandemic were widespread, but it had a significant impact on the healthcare system. Due to its effect on healthcare system, the capacity of surgical cases has significantly decreased in orthopedic surgery

(1). Although observations show a decrease in the number of emergency department visits and decrease in the number of hip fractures, infact it is mainly resulted from stay-at-home orders, the need for hip fracture care in elderly patients still remains a source of concern (1-3).

Throughout the pandemic, orthopedic trauma services maintained their previous capacity. Patients with hip fractures in the elderly population, in particular, have continued to visit hospitals in numbers comparable to before the pandemic, even in



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areas most affected by the COVID-19 pandemic (3-6). The majority of patients with hip fractures have multiple comorbidities, and they usually developed this fracture after minor falls as a result of poor bone quality and neurologic disorders (3). Even though several studies show that the incidence of hip fractures during the pandemic period shares similar several characteristics with the pre-pandemic period, the effect of the pandemic on fracture type distribution and hip fracture rates is unclear (2,7-12).

The fracture type in geriatric hip fractures may affect the surgical procedure applied, length of postoperative hospitalization, and mortality rate (13-16). Therefore, in terms of managing this patient group in the pandemic period, exact information about fracture distribution can enhance health services. The differences in fracture types and the number of hip fractures studies could be due to two factors: Firstly, restrictions during the pandemic period may change the distribution of fracture types and the number of fractures by causing changes in these patients' activities. Secondly, since most of the studies conducted were small sample studies examining the fracture profile covering short time intervals during the pandemic period, it may have caused differences in fracture types and rates. For this reason, the aim of the study was to clarify this situation by comparing the number of geriatric hip fractures and fracture distribution in one-year period of the COVID pandemic and the 5-year period preceding the pandemic.

METHODS

Study Design and Ethical Consideration

This study was a monocentric, observational, descriptive, and retrospective study. All patients in this study were those who applied to the emergency department of our tertiary hospital or were transferred from outer centers. Approval was received by the University of Health Sciences Turkey, Prof. Dr. Cemil Taşcıoğlu City Hospital Ethics Committee (number: 191, date: 03.05.2021). Patients with hip fractures were examined between the dates of March 11, 2016, and March 11, 2021. Dates were divided into two groups: The pandemic period, which is the one-year period between March 11, 2020, when the first COVID case was confirmed in Turkey, and March 11, 2021, and the pre-pandemic period, which is the 5-year period before pandemic between March 10, 2016, and March 10, 2020.

Patient Population

All patients over the age of 65 years who applied with hip fractures were involved in the study. The fracture types involved in this study are trochanteric fractures, intracapsular femoral

neck fractures, and subtrochanteric fractures (proximal one-third of the femur). Patients with isolated trochanter major fractures, fractures in the middle or distal one-third of the femur, periprosthetic femur fractures, and multiple trauma-related fractures were excluded from the study.

Patient Management

The patients were those who had hip fractures that were confirmed radiologically by X-ray in the emergency department or who had been diagnosed with hip fractures in another hospital and were transferred to our hospital's emergency department. Patients were welcomed by the emergency personnel in the beginning and were examined in terms of COVID-19 symptoms. Among the suspicious cases, there were patients with fever or feverless cough or with an illness like influenza. In the first examination, physiological parameters, hematological and biochemical parameters, and thorax computed tomography were all scanned, and polymerase chain reaction (PCR) tests were performed on nasal and throat swabs routinely before the hospitalization. Patients who tested positive or had viral pneumonia findings on computed tomography were referred to an infectious diseases specialist and admitted to the COVID ward. Patients who tested negative were admitted to orthopedics and traumatology ward. In accordance with our hospital's infection control protocols, patients in the orthopedics ward who developed COVID-19 symptoms were isolated and transferred to the COVID ward with the approval of the infectious disease specialist. COVID-19 patients with hip fractures were operated on in a special COVID-19 operating room and received post-operative care in a COVID ward. Patients without COVID were operated on in a "clean" and "non-COVID" operating room and received post-operative care in a "non-COVID" orthopedics ward. Hip fracture operations were accepted as aerosol-forming procedures, and thus fully surgical personal protective equipment was dressed by operating room staff to fully protect both patients and surgeons in both areas.

All operations were performed in the lateral decubitus position. The posterolateral surgical approach was used in patients performed arthroplasty. Osteosynthesis was performed using the proximal femoral nail of Tasarımmed in intertrochanteric and subtrochanteric fractures. The prosthesis from the TST company was used in the hemiarthroplasty procedures.

Data Collection

Codes for International Classification of Diseases-10 (ICD 10), fracture of head and neck of femur, pertrochanteric hip fractures, and subtrochanteric hip fractures (S72.0, S72.1, and

572.2 respectively) were scanned in the hospital system. After considering the excluded cases, cases involved in the study were classified as pre-pandemic (n=973) and pandemic (n=142) based on the date they applied to emergency department. Patients in the pandemic group were also examined in two subgroups as COVID (+) and COVID (-).

Age, sex, fracture type (intracapsular/extracapsular), length of hospital stays, three-month mortality rates, surgical treatment applied, need for intensive care rates, length of intensive care unit stay, complication rates, and COVID-19 test data were collected.

Categorising stages were completed with three groups; youngest-elderly ones (ranging from ages 65 to 74), middle-elderly group (ranging from ages 75 to 84) and last but not least, the oldest-elderly group (aged 85 years or older) (17).

The first year of the pandemic outbreak was analysed in four quarters (1st quarter: 11.03.2020-10.06.2021, 2nd quarter 11.06.2020-10.09.2021, 3rd quarter 11.09.2020-10.12.2020 and 4th quarter 11.12.2020-10.03.2021).

During the hospitalization period, the time from the first radiological confirmation of the fracture to discharge was calculated (or in case the death, to date of death). A positive COVID-19 situation was defined as the presence of clinical symptoms and a single positive result for the detection of the SARS-CoV-2 S gene (VIASURE SARS-CoV-2 gene real-time PCR detection kit, CerTest Biotect) from nose or throat swab samples or findings compatible with COVID-19 in thorax computed tomography. The COVID-19 situation was considered negative in the absence of clinical symptoms and a negative PCR test.

Statistical Analysis

For quantitative variables, including measures of central tendency, a general descriptive analysis was performed overall and by specific periods. Continuous variables were reported using means and standard deviations if they followed a normal distribution; otherwise, the median and range were used. Absolute frequency and rates were used to summarize categorical variables. Analysis of variance was used to compare continuous variables, and Pearson's chi-squared test was used to compare categorical variables. If a p value was <0.05, it was accepted as statistically significant. IBM SPSS version 25.0 (IBM Corp., Armonk, New York, USA) statistical package was used for all analyses.

RESULTS

Duration of hospitalization period and age-related data are summarized in Table 1. There was no statistically significant difference in both groups according to gender, type of fracture,

postoperative intensive care unit care requirement, and complication rates (Table 2). Fracture quantities and fracture patterns were dispersed non-significantly in all four sub-groups (Table 3). There was no statistically significant difference in the age distribution and fracture type distribution between the groups between pre-COVID and COVID periods. The fracture pattern and age distribution of the patients in the pre-pandemic and post-pandemic periods are presented in Table 4. During the pandemic period, femoral neck fractures have become dominant in the younger age group.

DISCUSSION

There was no significant difference in hip fracture patterns and fracture numbers between the pre-pandemic and pandemic periods. Moreover, other crucial data included the femoral neck fractures being the most common fracture pattern among the youngest aged hip fractures. A new strain of COVID was identified as an etiological factor for deadly pneumonia in Wuhan-China, followed by global spread. World Health Organization declared this infection as pandemic on March 11, 2020. At the same time, this is the same date that the first case in Turkey was reported. Due to the lack of preventive inoculation and therapeutic medications, public health precautions such as isolation, social distance, and quarantine were the only options for preventing the disease from spreading (18). Profound changes in social behavior and mobility during the early stages of the COVID-19 pandemic are directly associated with a significant decrease in orthopedics trauma referrals, but fragility fractures remain unaffected and service to these patients should be maintained (10). Furthermore, since these patients are typically elderly, fragile, living in nursing homes, and have multiple comorbidities, they are at a higher risk of developing a serious COVID-19 disease (19). Several cohort studies reported that there are no significant differences in time to operation, type of treatment, complications, or 30-day mortality rates among hip fracture patients admitted during the COVID-19 pandemic compared to those who admitted in the pre-pandemic period (3,5,7,20,21). Our results also support this situation.

Epidemiology is a significant way to predict the resource requirements of health services (10). Considering the burden of the COVID-19 pandemic on the health system, as well as the decisions taken and changes made in the health system, epidemiological evaluations become even more important during this period (18,22). For this reason, numerous studies on geriatric hip fractures in the COVID-19 pandemic have been conducted (1-3,7-9,18-20). Despite the fact that the majority of these studies showed that geriatric hip fractures did not decrease compared to the pre-pandemic period, the results of fracture

Table 1. Age and length of hospitalitaion of the patients included in the study

	Pre-COVID		COVID		p*
	Mean	SD	Mean	SD	
Age (year)	80.48	7.38	79.54	7.92	0.163
Postoperative hospital stay (day)	3.03	3.31	2.57	2.41	0.265
Total hospitalization period (day)	12.49	5.56	11.55	5.41	0.06
Intensive care unit stay period (day)	1.27	1.57	1.38	1.53	0.44

*Student's t-test, COVID: Coronavirus, SD: Standard deviation

Table 2. Dispersion of gender, fracture pattern, the form of surgical treatment, the requirement of ICU, complications and 3-monthly mortality rates amongst groups

	Pre-COVID		COVID		p*
	n	%	n	%	
Gender					
Female	355	36.5	55	38.7	0.604
Male	618	63.5	87	61.3	
Fracture pattern					
Intracapsular	331	34.0	54	38.0	0.348
Extracapsular	642	66.0	88	62.0	
Surgical treatment					
Proximal femoral nail	452	46.5	70	49.3	0.526
Hemiarthoplasty	521	53.5	72	50.7	
Postoperative requirement for ICU					
Present	252	25.9	42	29.6	0.353
None	721	74.1	100	70.4	
Complication					
Present	69	7.1	12	8.5	0.56
None	904	92.9	130	91.5	
90-day mortality					
Present	178	18.3	26	18.3	0.99
None	795	81.7	116	81.7	

*Pearson chi-square test, COVID: Coronavirus, ICU: Intensive care unit

Table 3. Distribution of fracture types and quantities by four divided quarters during the pandemic period

Pandemic periods	Fracture pattern				p*
	Extracapsular		Intracapsular		
	n	%	n	%	
1. Quarter	25	80.6	6	19.4	0.113
2. Quarter	18	54.5	15	45.5	
3. Quarter	21	58.3	15	41.7	
4. Quarter	24	57.1	18	42.5	

*Pearson chi-square test

type distribution differed (2,7-11). According to Malik-Tabassum et al. (7), Arafa et al. (11), and Scott et al. (10), the fracture type distribution was similar to the pre-pandemic period, while in the study of Egol et al. (9), the predominance of femoral neck fractures increased during the pandemic. Slullitel et al. (8) also performed fracture typing using the AO classification and found a statistical difference in fracture type between the pre-COVID and COVID periods. However, neither study discussed the

possible reasons for this (8,9). We believe that the source of the difference between these studies is the comparison of patients in the time groups that cover specific months.

Although the general finding in the literature is that the rates of geriatric hip fractures did not change in the pandemic period, there are also opposite results (2,4,7,11,23). While Arafa et al. (11) claimed an increase in hip fracture rates, Nazemi et al. (23) found

Tablo 4. Distribution between the age groups and fracture types of the patients included in the study

		Fracture pattern				p*
		Extracapsular		Intracapsular		
Periods	Geriatric age groups	n	%	n	%	
Pre-pandemic period	Youngest	146	22.8	88	26.6	0.365
	Middle	274	42.6	139	42.0	
	Oldest	222	34.6	104	31.4	
Pandemic period	Youngest	17	19.3	19	35.2	0.038
	Middle	40	45.5	25	46.3	
	Oldest	31	35.2	10	18.5	

*Pearson chi-square test

a significant decrease in hip fracture admission rates during the pandemic period. Both the theories that pandemic restrictions may lead to a decrease in these fractures due to decreased activity and the theory that elderly people being indoors alone at home may lead to an increase in these fractures are acceptable. However, during the ongoing pandemic process, more precise information about the number of fractures can be obtained over a wider period of time (18). Therefore, we believe that our study provides valuable information on the fact that geriatric hip fracture rates do not change during the pandemic period.

Although geriatric fractures usually occur in low energy traumas, high energy traumas are also a frequent cause that can not be underestimated (24-26). High-velocity traumas 68.7% resulted with extra-capsular fractures (26). Furthermore, the activity levels in the youngest age seniors group are significantly higher relative to middle and oldest aged seniors (17). The difference in the fracture patterns of younger seniors could have occurred due to pandemic-related governmental restrictions. At the same time, the fracture type of hip fractures in seniors 65 years old and older remained unaltered. This situation may be the 25.4% ratio of younger seniors composition among all the old hip fractures during a pandemic. On the contrary, this shift did not result in change in fracture profiles. Under these circumstances, we believe that the information gathered does not affect the management of hip fractures during the pandemic outbreak.

Three-month mortality rates in geriatric hip fractures represent more than 50% of the deaths associated with this disease (27-29). In many studies, mortality rates during the COVID period were evaluated at 1 month (3,5,7,21,22). In addition to including a 1-year pandemic period, our study can provide broader information with 3-month mortality rates. However, there was no difference in 3-month mortality between pre-COVID and COVID periods.

Study Limitations

The study has some limitations. The first of these is that when comparing mortality rates in the study, additional diseases, ASA scoring, and other factors that may affect mortality rates are not included in the analysis. Because the abnormal distribution of these factors between pre-COVID and COVID groups may cause bias by masking the increased mortality rates that may be caused by the COVID period. The other limitations are that the study is retrospective and monocentric, and the effect of the pandemic on the postoperative functional outcomes and quality of life of these patients is not known. However, considering that its main purpose is to investigate the effect of the pandemic on fracture rates and fracture type distribution, we believe that this study provides valuable information.

CONCLUSION

Despite the restrictions imposed during the COVID-19 pandemic, there were no changes in geriatric hip fracture rates. At the same time, fracture type distribution was similar to the pre-pandemic period. When the 3-month mortality rates were compared, they were similar between the pre-pandemic and pandemic periods.

Ethics

Ethics Committee Approval: Approval was received by the University of Health Sciences Turkey, Prof. Dr. Cemil Taşcıoğlu City Hospital Ethics Committee (number: 191, date: 03.05.2021).

Informed Consent: Written informed consents were obtained from all study participants.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: A.Y., M.Y., N.E., A.Ç.T., H.G., Concept: M.Y., H.G., Design: A.Y., M.A., H.G., Data Collection

or Processing: A.Y., M.Y., N.E., S.G., M.A., Analysis or Interpretation: M.Y., S.G., A.Ç.T., M.A., Literature Search: A.Y., N.E., S.G., A.Ç.T., Writing: A.Y., N.E., S.G., A.Ç.T.

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REFERENCES

- Wang KC, Xiao R, Cheung ZB, Barbera JP, Forsh DA. Early mortality after hip fracture surgery in COVID-19 patients: A systematic review and meta-analysis. *J Orthop* 2020;22:584-91.
- Zhong H, Poeran J, Liu J, Wilson LA, Memtsoudis SG. Hip fracture characteristics and outcomes during COVID-19: a large retrospective national database review. *Br J Anaesth* 2021;127:15-22.
- Tripathy SK, Varghese P, Panigrahi S, Panda BB, Srinivasan A, Sen RK. Perioperative mortality and morbidity of hip fractures among COVID-19 infected and non-infected patients: a systematic review and meta-analysis. *Chin J Traumatol* 2021;S1008-127500088-2.
- Nuñez JH, Sallent A, Lakhani K, Guerra-Farfan E, Vidal N, Ekhtiari S, et al. Impact of the COVID-19 pandemic on an emergency traumatology service: Experience at a Tertiary Trauma Centre in Spain. *Injury* 2020;51:1414-8.
- Park C, Sugand K, Nathwani D, Bhattacharya R, Sarraf KM. Impact of the COVID-19 pandemic on orthopedic trauma workload in a London level 1 trauma center: the "golden month". *Acta Orthop* 2020;91:556-61.
- Murphy T, Akehurst H, Mutimer J. Impact of the 2020 COVID-19 pandemic on the workload of the orthopaedic service in a busy UK district general hospital. *Injury* 2020;51:2142-7.
- Malik-Tabassum K, Crooks M, Robertson A, To C, Maling L, Selmon G. Management of hip fractures during the COVID-19 pandemic at a high-volume hip fracture unit in the United Kingdom. *J Orthop* 2020;20:332-7.
- Slullitel PA, Lucero CM, Soruco ML, Barla JD, Benchimol JA, Boietti BR, et al. Prolonged social lockdown during COVID-19 pandemic and hip fracture epidemiology. *Int Orthop* 2020;44:1887-95.
- Egol KA, Konda SR, Bird ML, Dedhia N, Landes EK, Ranson RA, et al. Increased Mortality and Major Complications in Hip Fracture Care During the COVID-19 Pandemic: A New York City Perspective. *J Orthop Trauma* 2020;34:395-402.
- Scott CEH, Holland G, Powell-Bowns MFR, Brennan CM, Gillespie M, Mackenzie SP, et al. Population mobility and adult orthopaedic trauma services during the COVID-19 pandemic: fragility fracture provision remains a priority. *Bone Jt Open* 2020;1:182-9.
- Arafa M, Nesar S, Abu-Jabeh H, Jayme MOR, Kalairajah Y. COVID-19 pandemic and hip fractures: impact and lessons learned. *Bone Jt Open* 2020;1:530-40.
- Yu P, Wu C, Zhuang C, Ye T, Zhang Y, Liu J, et al. The patterns and management of fracture patients under COVID-19 outbreak in China. *Ann Transl Med* 2020;8:932.
- Basques BA, Bohl DD, Golinvaux NS, Leslie MP, Baumgaertner MR, Grauer JN. Postoperative length of stay and 30-day readmission after geriatric hip fracture: an analysis of 8434 patients. *J Orthop Trauma* 2015;29:e115-20.
- Van Waesberghe J, Stevanovic A, Rossaint R, Coburn M. General vs. neuraxial anaesthesia in hip fracture patients: a systematic review and meta-analysis. *BMC Anesthesiol* 2017;17:87.
- Shetty SH, Dhond AB, Agarwal A, Kharat A, Singh A. Intertrochanteric fracture of femur in elderly – A comparative analysis between hemiarthroplasty and osteosynthesis. *Int J Orthop Sci* 2017;3:449-52.
- Gjertsen JE, Vinje T, Engesaeter LB, Lie SA, Havelin LI, Furnes O, et al. Internal screw fixation compared with bipolar hemiarthroplasty for treatment of displaced femoral neck fractures in elderly patients. *J Bone Joint Surg Am* 2010;92:619-28.
- Lee SB, Oh JH, Park JH, Choi SP, Wee JH. Differences in youngest-old, middle-old, and oldest-old patients who visit the emergency department. *Clin Exp Emerg Med* 2018;5:249-55.
- Turgut A, Arlı H, Altundağ Ü, Hancıoğlu S, Egeli E, Kalenderer Ö. Effect of COVID-19 pandemic on the fracture demographics: Data from a tertiary care hospital in Turkey. *Acta Orthop Traumatol Turc* 2020;54:355-63.
- Chui K, Thakrar A, Shankar S. Evaluating the efficacy of a two-site ('COVID-19' and 'COVID-19-free') trauma and orthopaedic service for the management of hip fractures during the COVID-19 pandemic in the UK. *Bone Jt Open* 2020;1:190-7.
- Thakrar A, Chui K, Kapoor A, Hambidge J. Thirty-Day Mortality Rate of Patients With Hip Fractures During the COVID-19 Pandemic: A Single Centre Prospective Study in the United Kingdom. *J Orthop Trauma* 2020;34:e325-9.
- Segarra B, Ballesteros Heras N, Viadel Ortiz M, Ribes-Iborra J, Martínez-Macias O, Cuesta-Peredo D. Are Hospitals Safe? A Prospective Study on SARS-CoV-2 Prevalence and Outcome on Surgical Fracture Patients: A Closer Look at Hip Fracture Patients. *J Orthop Trauma* 2020;34:e371-6.
- Vermeşan D, Todor A, Andrei D, Niculescu M, Tudorache E, Haragus H. Effect of COVID-19 Pandemic on Orthopedic Surgery in Three Centers from Romania. *Int J Environ Res Public Health* 2021;18:2196.
- Nazemi AK, Al-Humadi SM, Tantone R, Hays TR, Bowen SN, Komatsu DE, et al. Hip Fractures Before and During the COVID-19 Pandemic: Comparative Demographics and Outcomes. *Geriatr Orthop Surg Rehabil* 2021;12:21514593211003077.
- Switzer JA, Gammon SR. High-energy skeletal trauma in the elderly. *J Bone Joint Surg Am* 2012;94:2195-204.
- Basques BA, Bohl DD, Golinvaux NS, Leslie MP, Baumgaertner MR, Grauer JN. Postoperative length of stay and 30-day readmission after geriatric hip fracture: an analysis of 8434 patients. *J Orthop Trauma* 2015;29:e115-20.
- Hahnhaussen J, Hak DJ, Weckbach S, Ertel W, Stahel PF. High-energy proximal femur fractures in geriatric patients: a retrospective analysis of short-term complications and in-hospital mortality in 32 consecutive patients. *Geriatr Orthop Surg Rehabil* 2011;2:195-202.
- Abdelnasser MK, Khalifa AA, Amir KG, Hassan MA, Eisa AA, El-Adly WY, et al. Mortality incidence and its determinants after fragility hip fractures: a prospective cohort study from an Egyptian level one trauma center. *Afr Health Sci* 2021;21:806-16.
- Alegre-López J, Cordero-Guevara J, Alonso-Valdivielso JL, Fernández-Melón J. Factors associated with mortality and functional disability after hip fracture: an inception cohort study. *Osteoporos Int* 2005;16:729-36.
- Holvik K, Ranhoff AH, Martinsen MI, Solheim LF. Predictors of mortality in older hip fracture inpatients admitted to an orthogeriatric unit in oslo, norway. *J Aging Health* 2010;22:1114-31.