

## EPIDEMIOLOGIC CHARACTERISTICS OF GERIATRIC OSTEOPOROTIC HIP FRACTURES AND PATIENT OUTCOME

### Original Article

## GERİATRİK OSTEOPOROTİK KALÇA KIRIKLARINDA EPİDEMİYOLOJİ VE HASTA SONUÇLARI

Beliz Bilgili

*Marmara University School of Medicine,  
Department of Anesthesiology and  
Reanimation, Istanbul, Turkey*

Murat Haliloglu

*Marmara University School of Medicine,  
Department of Anesthesiology and  
Reanimation, Istanbul, Turkey*

Kadir Karismaz

*Marmara University School of Medicine,  
Department of Intensive Care, Internal  
Medicine, Istanbul, Turkey*

Bulent Tanriverdi

*Bakirkoy Sadi Konuk Teaching and Research  
Hospital, Department of Orthopaedics and  
Traumatology, Istanbul, Turkey*

Mehmet Erkilinc

*Bakirkoy Sadi Konuk Teaching and Research  
Hospital, Department of Orthopaedics and  
Traumatology, Istanbul, Turkey*

Cevdet Avkan

*Bakirkoy Sadi Konuk Teaching and Research  
Hospital, Department of Orthopaedics and  
Traumatology, Istanbul, Turkey*

### Corresponding Author

Beliz Bilgili

*Marmara University Pendik Training and Research  
Hospital Fevzi Cakmak Mah. Mimar Sinan Cad. No:  
41 34000 Ust Kaynarca, Istanbul, Turkey  
Tel: +90 536 218 79 27  
Email: belizbilgili@gmail.com*

### ABSTRACT

**Introduction:** Osteoporotic hip fractures have become a current major problem with increasing life expectancy. In order to decrease morbidity and mortality, preventive measures and early health care interventions are very important. The aim of this study is to present the epidemiologic profile of the geriatric proximal femur fractures and to specify and determine the factors that effect the patient outcomes.

**Materials and Methods:** The patients aged over 65 with hip fractures have been included in this retrospective, observational study. The factors regarding demographic features, fracture types, treatment outcomes, time to surgery, comorbidities, red blood cell transfusion requirement, intensive care unit admission, the length of anesthesia and the operation have been investigated.

**Results:** Eight hundred sixty-four (571 female, 293 male) have been included in the study. The average age of the patients was 81,6. The most frequent comorbidity was hypertension (464 patients, 53%), 829 patients were diagnosed as osteoporosis according to Singh index, sixty-six patients (7,6%) were died during the 1 month period. Whereas the one year mortality rate was 28,5% (246 patient), the overall mortality rate was 38%. Age, collum femoris fracture, accompanying pulmonary diseases and central nervous system diseases, delayed time to surgery and intensive care admission increase 1-year mortality.

**Conclusion:** With an increased proportion of elderly individuals in the general population, the number of elderly hip fracture patients continue to increase. In order to minimize

complications, geriatric hip fracture patients should be operated on as soon as possible, and a multidisciplinary treatment process should be planned precisely.

**Key words:** Elderly, Hip fracture, Mortality

## ÖZET

**Amaç:** Beklenen yaşam süresindeki artışla birlikte osteoporotik kalça kırıkları ciddi bir sorun olarak karşımıza çıkmaktadır. Mortalite ve morbiditenin azaltılabilmesi için önleyici tedbirler ve erken evre tedavi çok önemlidir. Bu çalışmada geriatrik proksimal femur kırıklı hastaların epidemiyolojik profilini ortaya koymak ve tedavi sonucunu belirleyen faktörlerin saptanması amaçlandı.

**Materyal ve Method:** Altmış beş yaş üstü kalça kırıklı hastalar retrospektif, gözlemsel olarak planlanan bu çalışmaya dahil edildi. Hastaların demografik özellikleri, kırık tipleri, tedavi sonuçları ve sağ kalım üzerine etki eden faktörler araştırıldı.

**Bulgular:** Çalışmaya 864 hasta (571 kadın, 293 erkek) dâhil edildi. Hastaların ortalama yaşı 81,6 olarak hesaplandı. En sık eşlik eden hastalık hipertansiyonu (464 hasta, %53). Singh indeksiyle yapılan değerlendirmede 829 hastaya osteoporoz tanısı konuldu. Bir ay içerisinde 66 hasta (%7,6), bir yıl içerisinde ise 246 hastanın (%28,5) öldüğü tespit edildi. Toplam mortalite oranı ise %38 olarak hesaplandı. Yaş, kollum femoris kırığı, eşlik eden pulmoner ve santral sinir sistemi varlığı, ameliyata dek geçen süre ve yoğun bakım ünitesi ihtiyacının 1 yıllık mortaliteyi arttırdığı tespit edildi.

**Sonuç:** Genel popülasyondaki yaşlı hasta sayısının artmasına paralel olarak geriatrik kalça kırıklı hasta sayısı da artış göstermektedir. Komplikasyonların önlenmesi için bu hasta grubu mümkün olan en kısa süre içerisinde ameliyat edilmeli ve multidisipliner

yaklaşımla tedavi süreci kusursuz bir şekilde planlanmalıdır.

**Anahtar kelimeler:** Yaşlı, Kalça kırığı, Mortalite

## INTRODUCTION

Osteoporotic hip fracture, the probability of which increases with age, is a common problem among geriatrics (1). According to data from the Statistics Institute of Turkey (TUİK), it is expected that geriatric patients will comprise 10% of Turkey's total population by 2023 (2). A high percentage of mortality and morbidity, particularly observed in the first 3 months of the postoperative period, cause problems in patient care, and the majority of patients are unable to return to their pre-fracture activity levels (3,4). Accompanying medical problems, such as low physiological reserve and inability to stand surgical trauma, frequently cause complications in this patient group. It is extremely important to determine the high-risk group of geriatric patients with a fractured hip to avoid fatal complications.

Proximal femur fractures can be classified as neck, transtrochanteric, or subtrochanteric fractures according to their anatomical location (5). The treatment for all such fractures is surgery (6).

The aim of the present study was to present the epidemiological profile of geriatric proximal femur fractures operated on in one centre. The specifications of and treatment options for the fractures were analysed. In addition, precautions have been suggested to avoid such fractures.

## MATERIALS AND METHODS

### Study Design

Patients aged >65 years with hip fractures were included in this retrospective, observational study. Factors regarding demographic

features, fracture types, treatment outcomes and factors that affect the survival rates were investigated.

### Study Settings

With ethical approval from the Ethic Committee, 864 patients aged >65 years with hip fractures operated on in a single third level health centre between 2010 and 2014 were retrospectively studied. Patients <65 years with multiple fractures, fractures caused by high-energy trauma and pathological fractures were excluded from the study.

### Study Protocol

Patients' medical records were evaluated, and gender, age, diagnosis, fracture mechanism, accompanying diseases, time to operation, anaesthesia technique, amount of perioperative bleeding, transfusion requirement, intensive care follow-up, surgical technique, duration of operation and anaesthesia, postoperative complications, 1-month and 1-year mortality rates, Barthel daily activity scores, osteoporosis and time to mortality were recorded (7). The Barthel daily activity score was calculated during the patients' polyclinic assessment or by telephonic interview in case of patients with a long enough follow-up time. For osteoporosis evaluation, the Singh index was used in the patients' first pelvic X-ray (7). To calculate the mortality rate of the patients, Ministry of Internal Affairs, Citizenship and Population office records were used. Patients were checked against their citizenship number to establish whether they were dead or alive, and the dates of death of the deceased patients were determined.

### Statistical Analysis

The R v.2.15.3 (R Core Team, 2013) software was used for statistical analyses. Data are reported as the mean, standard deviation, median, Q1, Q3, frequency, percentage, minimum and maximum. The Kruskal-Wallis test was used to analyse the difference in the

non-normally distributed variables between fixation methods, with the Mann-Whitney U test used for post-hoc analysis. One-way ANOVA was used to analyse the difference in normally distributed variables between fixation methods. The Pearson chi-square test was used to investigate the association between nominal variables. The univariate and multivariate logistic regression analyses were conducted to identify predictors of 1-month and 1-year mortality, reported as odds ratios (OR) with 95% confidence intervals. Statistical significance was defined by  $p < 0.05$ .

### RESULTS

A total of 864 (571 females and 293 males) patients were included in the present study. The average age of the patients was 81.62 (66-103) years. The cause of fracture in 632 patients was a simple fall in the house, and for 232 patients, a fall while walking on the street. The majority of the in-house falls were either in the bathroom or bedroom. Fracture in 604 patients (70%) occurred during the day.

One hundred twelve patients (13%) had no accompanying diseases. The most frequent comorbidities were hypertension (464 patients, 53%), diabetes (126, 14%), chronic obstructive lung disease (112, 13%), Alzheimer's disease (52, 0.06%) and thyroid dysfunction (85, 0.09%). In all, 205 patients (23%) had more than one systemic disease.

A total of 549, 143, 50, 181 and 209 patients had cardiovascular, pulmonary, renal, central nervous system and endocrine diseases, respectively (Table 1).

In 293 patients, there was a previously diagnosed and treated osteoporosis. Following examination of the patients' pelvic X-rays, 829 patients were diagnosed with osteoporosis according to the Singh index.

In all, 165 patients were identified as not taking any medication. The most frequently used antihypertensive drug was captopril. One hundred fifty-two patients were taking alendronate sodium, calcium and vitamin D for osteoporosis.

A total of 300 patients had collum femoris fracture, 526 had intertrochanteric fracture and 38 had subtrochanteric fracture. Hemiarthroplasty was the surgical choice for 321 of these fractures, internal fixation (dynamic hip screw or proximal femoral nail) for 310 and external fixation for 233.

Epidural anaesthesia was used for 0.7% (6) of the cases, general anaesthesia for 20.5% (177), combined anaesthesia (epidural and spinal) for 2.9% (25) and spinal anaesthesia for 75.9% (656).

Blood transfusion was required for 91 (10.5%) patients; 48 patients (5.6%) were followed up in the intensive care unit. The average hospital stay and time to operation were 13.2 and 7.5 days, respectively (Table 1).

A total of 24 patients (0.027%) died early in the postoperative period during the hospital stay, and 246 died during the follow-up period after they were discharged. Sixty-six patients (7.6%) died during the first month (1-month period), and the 1-year mortality rate was 28.5% (246 patients). The overall mortality rate was 38% (330). When the patients who died early in the postoperative period were evaluated, 19 were >80 years of age, 11 had chronic kidney (renal) failure, 7 had diabetes, 14 had coronary artery disease and 21 had multiple systemic diseases. Fourteen of these patients underwent endoprosthesis, eight underwent internal fixation and two underwent external fixation.

Gender, cardiovascular disease, pulmonary disease, renal disease, central nervous system disease and endocrine system disorders, time to operation, amount of postoperative

bleeding, duration of operation, duration of anaesthesia, anaesthesia technique, transfusion requirement, fixation method and complications had no effect on 1-month mortality ( $p > 0.05$ ). A 1-year increase in age increased the 1-month mortality risk by 1.04-fold [OR (95% CI): 1.04 (1.01–1.07),  $p = 0.017$ ]. The 1-month mortality rate of patients with collum femoris fracture was 0.52-fold higher compared with cases with ITF [OR (95% CI): 0.52 (0.29–0.95),  $p = 0.034$ ]. Among the cases with STF and ITF, there was no difference in terms of the mortality rate (Table 2).

To evaluate the compound effects of the significant or nearly significant ( $p < 0.200$ ) variables observed with 1-month mortality in univariate analysis, a multivariate logistic regression analysis was conducted. Age, blood transfusion requirement and intensive care unit requirement had no effect on 1-month mortality in multivariate analysis ( $p > 0.05$ ) (Table 3).

Gender, fracture type, cardiovascular disease, renal disease, endocrine system disorders, amount of postoperative bleeding, operation time, anaesthesia time, blood transfusion requirement, fixation method and complications had no effect on the 1-year mortality rate ( $p > 0.05$ ). A 1-year increase in age increased the 1-year mortality risk by 1.04-fold [OR (95% CI): 1.04 (1.02–1.06),  $p < 0.001$ ]. Accompanying pulmonary diseases increased the 1-year mortality risk by 2.01-fold [OR (95% CI): 2.01 (1.38–2.91),  $p < 0.001$ ] and accompanying central nervous system diseases increased the risk by 1.71-fold [OR (95% CI): 1.71 (1.21–2.41),  $p = 0.002$ ]. A 1-day increase in time to operation increased the 1-year mortality risk by 1.05-fold [OR (95% CI): 1.05 (1.02–1.08),  $p = 0.001$ ]. Intensive care requirement increased 1-year mortality by 2.68-fold [OR (95% CI): 2.68 (1.49–4.81),  $p = 0.001$ ] (Table 4).

There were no statistically significant differences between 1-month and 1-

year mortality rates in terms of the fixation method ( $p > 0.05$ ).

<b>A. Demographic features</b>					<b>D. Anaesthesia technique</b>				
Age: 81.62±7.91					Spinal	Epidural	Combined	General	
					656	6 (0.7%)	25 (2.9%)	177	
					(75.9%)			(20.5%)	
Gender		Female	Male		<b>E. Blood transfusion</b>				
		571	293 (33,9%)		Yes	No			
		(66,1%)			91 (10,5%)	773 (89,5%)			
<b>B. Diagnosis</b>			<b>F. ICU</b>						
ITF	CF	STF	Yes		No				
526 (60,9%)	300 (34,7%)	38 (4,4%)	48 (5,6%)		816 (94,4%)				
<b>C. Associated diseases</b>					<b>G. Mortality rates</b>				
CV	Pulmonary	Renal	CNS	Endocrine	1-month	1-year			
549	143	50	181	209	66 (7,6%)	246 (28,5%)			
<b>H. Fixation method</b>									
PFN	DHS	EF	PHP						
99	211 (24,4%)	233 (27%)	321 (37,2%)						
(11,5%)									

Table 1. Patient characteristics and mortality rates

ITF: intertrochanteric femur fracture, CF: collum femoris fracture, STF: subtrochanteric femur fracture, CV: cardiovascular, CNS: central nervous system, ICU: intensive care unit, PFN: proximal femoral nail, DHS: dynamic hip screw, EF: external fixation, PHP: partial hip prosthesis

		1-month mortality		1-year mortality	
		OR (95% CI)	p	OR (95% CI)	p
<b>Age (years)</b>		1.04 (1.01 to 1.07)	<b>0.017*</b>	1.04 (1.02 to 1.06)	<b>&lt;0.001**</b>
	ITF	1.00	-	1.00	-
<b>Diagnosis</b>	KF	0.52 (0.29 to 0.95)	<b>0.034*</b>	1.06 (0.77 to 1.45)	0.714
	STF	0.85 (0.25 to 2.88)	0.799	0.91 (0.43 to 1.92)	0.809
<b>Pulmonary</b>	No	1.00	-	1.00	-
	Yes	1.26 (0.67 to 2.38)	0.475	2.01 (1.38 to 2.91)	<b>&lt;0.001**</b>
<b>Central nervous system</b>	No	1.00	-	1.00	-
	Yes	1.23 (0.68 to 2.21)	0.495	1.71 (1.21 to 2.41)	<b>0.002**</b>
<b>Time to operation</b>		1.00 (0.96 to 1.06)	0.847	1.05 (1.02 to 1.08)	<b>0.001**</b>
<b>ICU</b>	No	1.00	-	1.00	-
	Yes	2.61 (1.17 to 5.84)	<b>0.019*</b>	2.68 (1.49 to 4.81)	<b>0.001**</b>

Table 2. Univariate regression analysis: factors predicting 1-month and 1-year mortality

ITF: intertrochanteric femur fracture, CF: collum femoris fracture, STF: subtrochanteric femur fracture, ICU: intensive care unit.

		1-month mortality	
		OR (95% CI)	p
<b>Diagnosis</b>	ITF	1.00	-
	CF	0.51 (0.28 to 0.93)	<b>0.028*</b>
	STF	1.25 (0.42 to 3.73)	0.694

Table 3. Multivariate logistic regression analysis predicting 1-month mortality

ITF: intertrochanteric femur fracture, CF: collum femoris fracture, STF: subtrochanteric femur fracture.

		1-year mortality	
		OR (95% CI)	p
<b>Age (years)</b>		1.04 (1.02 to 1.06)	<b>&lt;0.001**</b>
<b>Pulmonary</b>	No	1.00	-
	Yes	1.68 (1.12 to 2.52)	<b>0.012*</b>
<b>Central nervous system</b>	No	1.00	-
	Yes	1.88 (1.30 to 2.72)	<b>0.001**</b>
<b>Time to operation</b>		1.04 (1.01 to 1.07)	<b>0.009**</b>

Table 4. Multivariate logistic regression analysis predicting 1-year mortality

## DISCUSSION

The present study evaluated the epidemiological profiles of geriatric patients with hip fracture. Age, accompanying pulmonary and central nervous system diseases, time to operation and intensive care unit requirement affected the 1-year mortality rate. In addition, age and fracture type affected the 1-month mortality rate.

With respect to aetiology, 94.6% of the fractures occurred after low-energy simple falls. This rate is 95% in the USA (8), 92.9% in Brasil (5) and 93.6% in Australia (9). Patients most frequently fall in the bedroom or bathroom while they are alone. For this reason, the necessary precautions must be taken to avoid falls, particularly in these parts of the house.

A total of 293 patients had previously diagnosed osteoporosis; 829 patients had osteoporosis in their pelvic X-ray according to the Singh index. This dramatic difference led us to suspect that the patients in Turkey had insufficient information regarding the outcomes of osteoporosis. Jennings et al., (10) suggested that only 2% of patients with femoral hip fractures were taking adequate osteoporosis treatment. Therefore, hospital-based osteoporosis programs are very important for the education of patients and their relatives.

There are many studies in the literature regarding the relationship between time to operation and mortality rate (11,12). Our present study is in accordance with the literature in terms of time to operation (5,9). Time to operation had no effect on the 1-month mortality rate, whereas one unit increase in time to operation (1 day) increased the 1-year mortality rate by 1.05-fold. It is generally accepted that 1-month mortality depends on accompanying diseases, whereas the 1-year mortality depends on surgical factors (12). Therefore, it is extremely

important that geriatric patients with hip fracture are operated on as soon as possible because of the increased risk of 1-year mortality.

The requirement for intensive care may be inevitable because the clinical condition of geriatric patients with hip fracture may be a high risk. Because of the fact that early surgical treatment diminishes both morbidity and mortality, special units and multidisciplinary working conditions are obligatory for this group of patients. If the conditions in our country are considered, specifically designed services and hospitals for geriatric patients will definitely raise the quality of the health service.

The prevalence of associated chronic diseases in the elderly population of Turkey is 72.6–94.4% (13,14). Loğoğlu et al. (15) stated that the most common diseases in the elderly population are high blood pressure (hypertension), coronary artery disease and diabetes mellitus. All these studies have been carried out in non-traumatic patient groups. In our traumatic patient group, 13% of the patients had no accompanying systemic disease. A total of 352, 245 and 155 patients had one, two and three or more accompanying diseases, respectively. A total of 549, 143, 50, 181 and 209 patients had cardiovascular, pulmonary, renal, central nervous system and endocrine diseases, respectively. Among these, pulmonary and central nervous system diseases affected 1-year mortality. According to Statistics Institute of Turkey TÜİK data, the most important diseases that affect the mortality of elderly patients are cardiovascular system disorders (46.8%), benign and malignant tumours (17.7%) and respiratory system disorders (11.7%) (2).

An increase in the incidence of osteoporotic hip fracture is inevitable because life expectancy of the population is much longer than it has previously been (16). To decrease

mortalities and morbidities, the treatment, care and rehabilitation course of such patients must be precisely implemented. In our present study, it was observed that 330 patients died. The 1-month mortality rate was 7.6%, and the 1-year mortality rate was 28%, which are in accordance with the literature (17,18).

In terms of fracture type, the 1-year mortality rate was higher in the collum femoris fracture group. Although some publications state that intertrochanteric femur fractures have a higher 1-year mortality risk (19), there also exist studies that claim that the type of fracture has no effect on mortality (20). In our study groups, the type of fracture had an effect on 1-month mortality, whereas it had no impact on 1-year mortality. Some studies claim that internal fixation has advantages in terms of reduced mortality (21,22), although some contrary views exist (23,24). In our present study, the fixation method had no effect on mortality rate.

When inadequate physical reserve in geriatric patients is considered, follow up in intensive care may be inevitable. Postoperative complications and intensive care requirement have previously been shown to increase mortality by 1.85-fold (25). In our present study, the patients followed up in intensive care had a 2.68-fold increased 1-year mortality rate.

The limitations of our present study are its retrospective nature and being a single centre study. Multicentre epidemiological studies are likely to obtain more valuable data for patients. However, evaluating multiple variables in 864 patients in a single centre is the major strength of our study.

In conclusion, collum femoris fracture, age, pulmonary and central nervous system disorders, time to surgery and intensive care follow-up had effects on the mortality of geriatric hip fracture patients. Geriatric hip fracture patients should be operated on as soon as possible, and a multidisciplinary

treatment process should be planned to achieve better outcomes.

## REFERENCES

- 1) Keene GS, Parker MJ, Pryor GA. Mortality and morbidity after hip fractures. *BMJ* 1993; 307:1248-50. (PMID:8166806).
- 2) Aydemir B. Statistics Institute of Turkey. *Elderly statistics 2014*. In: Birol Aydemir (Ed). 1st edition, TÜİK Press, Ankara, Türkiye 2015; 1-91.
- 3) Cooper C. Epidemiology and definition of osteoporosis. In: Compston JE, ed. *Osteoporosis: new perspectives on causes, prevention and treatment*. London: Royal College of Physicians of London 1996; 1-10.
- 4) Bentler SE, Liu L, Obrizan M, et al. The aftermath of hip fracture: discharge placement, functional status change, and mortality. *Am J Epidemiol* 2009; 170:1290-9. (PMID: 19808632).
- 5) Daniachi D, Netto Ados S, Ono NK, Guimarães RP, Polesello GC, Honda EK. Epidemiology of fractures of the proximal third of the femur in elderly patients. *Rev Bras Ortop* 2015; 50: 371-7. (PMID:26401497).
- 6) Parker MJ, Khan RJ, Crawford J, Pryor GA. Hemiarthroplasty versus internal fixation for displaced intracapsular hip fractures in the elderly. A randomised trial of 455 patients. *J Bone Joint Surg Br* 2002; 84: 1150-5. (PMID:12463661).
- 7) Singh M, Nagrath A, Maini PS. Changes in trabecular pattern of the upper end of the femur as an index of osteoporosis. *J Bone Joint Surg Am* 1970; 52: 457-67. (PMID:5425640).
- 8) Stevens JA, Sogolow ED. Gender differences for non-fatal unintentional fall related injuries among older adults. *Inj Prev* 2005; 11: 115-9. (PMID:15805442).
- 9) Chia PH, Gualano L, Seevanayagam S, Weinberg L. Outcomes following fractured neck of femur in an Australian metropolitan teaching hospital. *Bone Joint Res* 2013; 2: 162-8. (PMID:23950158).
- 10) Jennings LA, Auerbach AD, Maselli J, Pekow PS, Lindenauer PK, Lee SJ. Missed opportunities for osteoporosis treatment inpatients hospitalized for hip fracture. *J Am Geriatr Soc* 2010; 58: 650-7. (PMID:20398147).
- 11) Colais P, Martino MD, Fusco D, Perucci CA, Davoli M. The effect of early surgery after hip fracture on 1-year mortality. *BMC Geriatrics* 2015; 15: 141. (PMID:26510919).
- 12) Bohm E, Loucks L, Wittmeier K, Lix LM, Oppenheimer L. Reduced time to surgery improves mortality and length of stay following hip fracture: results from an intervention study in a Canadian health authority. *Can J Surg* 2015; 58: 257-63. (PMID:26204364).
- 13) Ünsaldı ÜE, Piyal B. Evaluating the chronic diseases and activity restriction in a group of subjects of aged 65 years and over that applied to Çubuk Health Center. *Türkiye*



- Klinikleri J Med Sci* 2002; 22: 362-8. (in Turkish).
- 14) Ergin M, Karamercan MA, Ayrancı M, et al. Epidemiological characteristics of geriatric patients in emergency departments: Results of a multicenter study. *Turkish Journal of Geriatrics* 2015; 18: 259-65. [Internet] Available from: [http://geriatri.dergisi.org/pdf/pdf\\_TJG\\_906.pdf](http://geriatri.dergisi.org/pdf/pdf_TJG_906.pdf) Accessed:09.03.2016. (in Turkish).
  - 15) Loğoğlu A, Ayrık C, Köse A, et al. Analysis of nontraumatic elderly patient presentations to the emergency department. *Tr J Emerg Med* 2013; 13: 171-80. (in Turkish).
  - 16) Kesmezacar H, Ayhan E, Unlu MC, Seker A, Karaca S. Predictors of mortality in elderly patients with an intertrochanteric or a femoral neck fracture. *J Trauma* 2010; 68: 153-8. (PMID:19797990).
  - 17) Vestergaard P, Rejnmark L, Mosekilde L. Has mortality after a hip fracture increased? *J Am Geriatr Soc* 2007; 55: 1720-6. (PMID:17916118).
  - 18) Farahmand BY, Michaëlsson K, Ahlbom A, Ljunghall S, Baron JA. Swedish Hip Fracture Study Group. Survival after hip fracture. *Osteoporos Int* 2005; 16: 1583-90. (PMID:16217590).
  - 19) Aharonoff GB, Koval KJ, Skovron ML, Zuckerman JD. Hip fractures in the elderly: predictors of one year mortality. *J Orthop Trauma* 1997; 11: 162-5. (PMID:9181497).
  - 20) Cipitria JA, Sosa MM, Pezzotto SM, Puche RC, Bocanera R. Outcome of hip fractures among elderly subjects. *Medicina (B Aires)* 1997; 57: 530-4. (PMID:9674220).
  - 21) Parker MJ, Pryor GA. Internal fixation or arthroplasty for displaced cervical hip fractures in the elderly: a randomised controlled trial of 208 patients. *Acta Orthop Scand* 2000; 71: 440-6. (PMID:11186397).
  - 22) Kesmezacar H, Oğüt T, Bilgili MG, Gökay S, Tenekecioğlu Y. Treatment of intertrochanteric femur fractures in elderly patients: internal fixation or hemiarthroplasty. *Acta Orthop Traumatol Turc* 2005; 39: 287-94. (PMID:16269874). (in Turkish).
  - 23) Bhandari M, Devereaux PJ, Swiontkowski MF, et al. Internal fixation compared with arthroplasty for displaced fractures of the femoral neck. A meta-analysis. *J Bone Joint Surg Am* 2003; 85: 1673-81. (PMID:12954824).
  - 24) Karaman Ö, Özkazanlı G, Orak MM, et al. Factors affecting postoperative mortality in patients older than 65 years undergoing surgery for hip fracture. *Ulus Travma Acil Cerrahi Derg* 2015; 21: 44-50. (PMID:25779712).
  - 25) Batsis JA, Phy MP, Mel-n LJ, et al. Effects of a hospitalist care model on mortality of elderly patients with hip fracture. *J Hosp Med* 2007; 2: 219-25. (PMID:17683089).