


One-Year Mortality Rates Following Fracture of the Femoral Neck Treated With Hip Arthroplasty in an Aging Saudi Population: A Trauma Center Experience

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Abstract

Introduction: Femoral neck fracture is a common problem in elderly patients, and it is managed with either total hip arthroplasty or hemiarthroplasty with very good outcomes. However, the reported 1-year mortality rate is as high as 33%. **Material and Methods:** This study was a retrospective cohort study. The electronic patient records were searched for all physiologically old patients with displaced femoral neck fractures that were managed with either hemiarthroplasty or total hip arthroplasty. The primary aim of this study was to estimate morbidity and mortality rates at 30 days and 1 year. The secondary outcome was to determine major complications and factors influencing mortality. **Results:** From January 2017 to December 2018, a total of 99 patients were included in the study. Of those, 57 were female patients. The mortality rate was 15.2%. The significant predictors of death included the age at the time of surgery, readmission within 30 days of initial admission, acute renal impairment, and the need for preoperative medical intervention. Patients treated with total hip arthroplasty had lower mortality rates than those treated with hemiarthroplasty ($P = .017$). **Discussion:** To the best of our knowledge, this is the first study conducted in Saudi Arabia to report detailed perioperative-related complications and outcomes following neck of femur fractures. The results of our study confirm the persistently high morbidity and mortality associated with this patient group. **Conclusion:** Efforts should be aimed at optimizing preoperative medical management, which is vital to ensure early identification of medically unfit patients.

Keywords

total hip replacement, hemiarthroplasty, mortality, femoral neck, fractures

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Introduction

Femoral neck fractures represent a common problem in the geriatric population. An estimated 1.66 million femoral neck fractures have been reported worldwide, and this figure is expected to approach 6.26 million by 2050.¹ The 30-day mortality rate after such fractures in the geriatric population is reportedly 9.6%, while the 1-year mortality rate can be as high as 33%.²⁻⁴ In Saudi Arabia, the incidence of femoral neck fractures in patients aged 55 and above has been estimated to be about 2.4/1000; however, only limited data is available regarding the mortality rate.⁵ Despite its high incidence and its impact on an increased risk of death, greater number of health complications, and reduced quality of life, the way in which these injuries are managed in the elderly population remains uncertain.⁶

Methods of treatment depend on many factors, including the patient's age, activity levels prior to injury, time elapsed before

surgery, comorbid conditions, as well as the fracture type. Generally, femoral neck fractures in elderly patients are treated with hemiarthroplasty or total hip arthroplasty, depending on

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the level of activity prior to the fracture and whether the patient had preexisting hip osteoarthritis.⁶ However, closed reduction and internal fixation is considered as a valid treatment option in nondisplaced femoral neck fractures since 33% neck of femur fractures in elderly population are treated in that way.⁶ Anyway, total hip replacement following femoral neck fracture has been associated with improved functional outcome scores and reduced pain, when compared with hemiarthroplasty.⁴ However, with total hip replacement, there are inherent risks associated with a longer operative time, increased blood loss, and higher dislocation rate.

The primary aim of this study was to estimate the morbidity and mortality rates at 30 days and 1 year following hip arthroplasty in patients with fractures of the femoral neck. Also, we aimed to determine major complications and factors influencing mortality.

Material and Methods

Study Design

This retrospective cohort study was conducted at a trauma care center in Riyadh, the capital city of Saudi Arabia. It was approved by the Research Ethics Board of that center. The electronic patient records were searched for all patients who had sustained femoral neck fractures that were managed with either hemiarthroplasty or total hip arthroplasty.

Patients

From January 2017 to December 2018, a total of 99 patients were included in the study. Inclusion criteria were as follows: patients older than 50 years, with signs of hip osteoarthritis, who sustained a femoral neck fracture, and were treated with either hemiarthroplasty or total hip arthroplasty with a minimum of a 1-year follow-up. The exclusion criteria were patients younger than 50 years, treated with methods other than hemiarthroplasty or total hip arthroplasty.

All patients included in the study gave informed consent for either hemiarthroplasty or total hip arthroplasty at the time of admission, and the final decision was taken by the senior author before the procedure based on the discussion with the patient and following factors; patients with osteoarthritic changes of the acetabulum received total hip arthroplasty, while other patients without arthritic changes received hemiarthroplasty.

Preoperative data were recorded, including the sex, age, medical comorbidities, American Society of Anesthesiologists (ASA) classification, whether the patient required preoperative medical intervention, whether the case was a weekend admission (defined as any admission to the orthopedic department from Thursday 16:00 to Sunday 07:30), time to surgery (defined as the number of hours from the time of arrival at the emergency department to the time of the surgery), duration of the surgery, type of surgery, and type of anesthesia administered.

Postoperative complications were identified from patients' admission histories and discharge summaries. Complications

were defined based on the diagnoses written in patients' progress notes by the treating physicians, and these were independently cross-checked with laboratory and radiological data. Two independent clinicians verified the data.

Postoperative Protocol

The postoperative protocol was the same in both groups. Each patient received 3 doses of antibiotics. Mechanical prophylaxis commenced in the recovery room, and low-molecular-weight heparin anticoagulant was administered 12 hours after the surgery and continued for 35 days. Postoperative laboratory investigations were repeated over the first 3 days postoperatively. The condition of the surgical wound, as well as any blood transfusions or complications were all documented.

Evaluation

The patients were evaluated at the outpatient clinic at 2 and 6 weeks, and at 6 and 12 months, and annually thereafter. Clinical, radiological, and laboratory evaluations were performed at each follow-up. No patients were lost to follow-up.

Statistical Analysis

The Statistical Package for Social Sciences (SPSS) version 22 (IBM SPSS Statistics for Mac, Armonk, New York) was used to manage data and process the analyses. Descriptive analyses were conducted by calculating the frequencies and percentages of categorical variables, whereas continuous variables were summarized as the mean and standard deviation. The mortality rate was calculated as the ratio of the number of reported deaths to the total number of patients. Analytical statistics determined the predictors of mortality. All tests were considered to yield a significant difference at a *P* value of .05 or less.

Results

Among the 99 patients enrolled, 57 were female and 42 were male. The mean follow-up was 18.4 months (range, 12-24 months). The mean age at presentation was 71 years. A total of 43 patients (43.4%) were admitted on the weekend. Most patients (75.8%) were ASA classification 3. Furthermore, 91 patients (91.9%) underwent the surgical procedure 48 hours after admission. Among the patients, 75.8% underwent hemiarthroplasty and 24.2% underwent total hip arthroplasty. A total of 62 patients (62.6%) were subjected to general anesthesia, and the mean duration of surgery was 84 minutes. The mean hospital stay was 15 ± 9 days (range, 4-47 days; Table 1).

Details of the comorbidities of 85 patients (85.9%), who reported a history of other medical conditions, are presented in Table 2. A total of 37 patients (37.4%) required preoperative medical intervention and optimization including any infection, cardiac conditions, hypovolemia, correction of electrolytes, delirium, requiring blood transfusion, or requiring medical review on admission.

Table 1. Baseline Characteristics of the Study Sample.

Variables	Categories	n	%
Gender	Female	57	57.6
	Male	42	42.4
Age at the time of surgery	Mean + SD (min-max)	71 ± 10 (50-98)	
Weekend admission	No	56	56.6
	Yes	43	43.4
ASA classification	1	0	0.0
	2	16	16.2
	3	75	75.8
	4	8	8.1
	5	0	0.0
Time to surgery, hours	≤ 24	4	4.0
	24 to 48	4	4.0
	> 48	91	91.9
Duration of surgery ^a	Mean + SD (min-max)	84 ± 43 (25-176)	
Type of surgery	Hemiarthroplasty	75	75.8
	THA	24	24.2
Type of anesthesia	General anesthesia	62	62.6
	Spinal anesthesia	35	35.4
	Epidural	2	2.0

Abbreviations: ASA, American Society of Anesthesiologists; SD, standard deviation; THA, total hip arthroplasty.

^aIn minutes.

Table 2. Medical Comorbidities of the Study Sample.

Variables	Categories	n	%
Congestive cardiac failure	No	99	100.0
	Yes	0	0.0
Ischemic heart disease	No	91	91.9
	Yes	8	8.1
Atrial fibrillation or other cardiac arrhythmia	No	97	98.0
	Yes	2	2.0
Hypertension	No	32	32.3
	Yes	67	67.7
COPD/pulmonary fibrosis	No	99	100.0
	Yes	0	0.0
Asthma	No	95	96.0
	Yes	4	4.0
Diabetes mellitus	No	48	48.5
	Yes	51	51.5
Chronic renal impairment	No	81	81.8
	Yes	18	18.2
Acute renal impairment	No	95	96.0
	Yes	4	4.0
Cerebrovascular disease	No	89	89.9
	Yes	10	10.1
Dementia	No	91	91.9
	Yes	8	8.1
Malignancy	No	97	98.0
	Yes	2	2.0
Others ^a	No	93	93.9
	Yes	6	6.1

Abbreviation: COPD, chronic obstructive pulmonary disease.

^aAny medical conditions apart from those listed above.

Table 3. Postoperative Complications.

Variables	Categories	n	%
Unclear causes of hypoxia ^a	No	95	96.0
	Yes	4	4.0
Acute renal impairment	No	91	91.9
	Yes	8	8.1
Oliguria	No	91	91.9
	Yes	8	8.1
Blood transfusion	No	79	79.8
	Yes	20	20.2
Pneumonia	No	97	98.0
	Yes	2	2.0
Urinary tract infection	No	93	95.9
	Yes	4	4.1
Decreased GCS	No	89	89.9
	Yes	10	10.1
RRT activation	No	91	91.9
	Yes	8	8.1
Minor surgical complication ^b	No	88	88.9
	Yes	11	11.1
Major surgical complication ^c	No	93	93.9
	Yes	6	6.1
Readmission within 30 days	No	77	79.4
	Yes	20	20.6
Others ^d	No	95	96.0
	Yes	4	4.0
Abnormal vital signs	No	42	42.4
	Preoperatively	2	2.0
	In the recovery room	2	2.0
	Postoperatively	6	6.1
	In the ER	47	47.5
Hypoxia	No	87	87.9
	Preoperatively	2	2.0
	In the recovery room	2	2.0
	Postoperatively	6	6.1
	In the ER	2	2.0
Hypothermia	No	97	98.0
	Preoperatively	0	0.0
	In the recovery room	0	0.0
	Postoperatively	0	0.0
	In the ER	2	2.0

Abbreviations: GCS, Glasgow Coma Score; ER, emergency room; RRT, rapid response team.

^aWith possible atelectasis.

^bIncluding wound hematoma and wound oozing.

^cIncluding wound infections requiring oral or intravenous antibiotics, dislocations, and periprosthetic fractures.

^dIncluding dehydration, hypotension, hypertension, urinary retention, uncomplicated falls, postoperative ileus, syncope, seizure, and electrolyte imbalances.

Moreover, 32 patients (32.2%) had postoperative complications (Table 3), among which 22 (23.2%) required postoperative medical intervention. A rapid response team (RRT), which is a team of health-care providers that responds to hospitalized patients with early signs of deterioration on nonintensive care units to prevent serious medical complications, was activated for 8.1% of the cases. Twenty patients returned and were admitted for medical attention within 30 days after the surgery. Those patients were admitted due

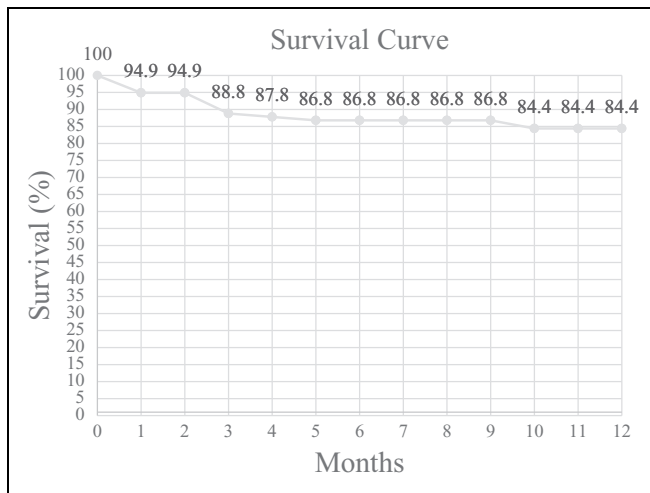


Figure 1. Kaplan-Meier survival analysis of patients with fractures of the femoral neck, which were managed with either hemiarthroplasty or total hip arthroplasty.

to nonsurgical causes which are mainly related to their past medical histories.

In addition, 15 patients died during the first year, and 5 patients died during the first 30 days after the procedure. The survival rate was 94.99% at 1 month and 84.4% at 12 months (Figure 1).

The age at the time of surgery was found to be a predictor of death, as older patients were more likely to die postoperatively than younger patients ($P = .015$). In addition, readmission within 30 days of the surgical procedure was a significant predictor of death ($P = .044$). Acute renal impairment, whether preoperatively ($P < .001$) or postoperatively ($P = .004$), and postoperative oliguria ($P = .004$) were also associated with higher mortality rates. Patients who required preoperative medical intervention ($P = .002$) and had lower Glasgow Coma Scores ($P < .001$) and required RRT ($P < .001$) had higher rates of mortality. Surgical complications were also a significant predictor of death. Abnormal vital signs ($P < .001$) and hypoxia ($P < .001$) were associated with higher mortality rates. The type of surgery was a predictor of death, as patients who underwent total hip replacement had lower rates of mortality compared with those who underwent hemiarthroplasty ($P = .017$; Table 4).

Discussion

This study was a retrospective study assessing 30 days and 1-year mortality in patients suffering from fracture neck femur treated with either hemiarthroplasty or total hip arthroplasty, the survival rate was 94.9% after 30 days and 84.4% after 1 year.

Several studies have demonstrated increased mortality rates with older patients and male patients, low Mini-Mental Test scores, and the presence of comorbidities, dementia, heart failure, and advanced renal disease.⁷⁻⁹ The finding of the present study that patients treated with hemiarthroplasty had significant higher mortality rates than those treated with total hip arthroplasty is consistent with the results of a previous meta-

analysis.¹⁰ Maceroli et al showed that 30-day mortality after hemiarthroplasty and total hip replacement was 8.4% and 5.7%, respectively, and 1-year mortality reached 25.9% and 17.8%, respectively.¹⁰ However, as there were many confounding risk factors, it is difficult to support the conclusion without stratification and looking more into the effect of the various risk factors listed.

Despite the importance of perioperative interventions and their effects on both postoperative morbidity and mortality, many investigations into postoperative mortality following femoral neck fractures have not specified perioperative details or management and its impact on the results.¹¹ In the present study, most patients showed abnormal vitals on presentation to the emergency department.

Weekend admission was a significant predictor of postoperative mortality, as 86% of the patients who died were admitted during the weekend. Several studies have linked weekend admission to increased morbidity and mortality, which is commonly referred to as the “weekend effect.”¹² Reduced hospital staffing on weekends, limited operating room availability, and access to imaging modalities may affect the quality of diagnosis and management of patients admitted for traumatic conditions and emergencies. Investigators have reported an increased mortality associated with weekend admissions for stroke,¹³ subdural hematoma,¹⁴ gastrointestinal bleeding,¹⁵ atrial fibrillation, and pulmonary embolism.¹⁶ Although a retrospective study of over 350,000 patients, which exclusively investigated the effects of weekend admission for hip fractures, did not reveal any increased risk of death, an increased number of perioperative complications and other adverse short-term outcome were reported.¹⁷

Despite a previous meta-analysis showing an increased risk of mortality with delayed surgery (> 48 hours),¹⁸ no statistically significant differences were noted between early (< 48 hours) and delayed (> 48 hours) surgical intervention in the present study. Delayed surgery was not a significant predictor of in-hospital mortality following hip fractures, as per the study of Lefavre et al.¹⁹ Although a delay of more than 24 hours was a significant predictor of a minor medical complication, a delay of more than 48 hours was associated with an increased risk of a major medical complication.¹⁹ In the present study, those who required preoperative and postoperative medical interventions and medical consultation had a higher risk of death.

Moreover, the choice of general or neuraxial anesthesia was not associated with any increased risk of postoperative complications or mortality in our patient cohort, despite the contrary results of other studies.¹¹ Many studies have also linked hospital readmissions to mortality after hip fractures.²⁰⁻²² In the present study, half of the patients who eventually died had again presented to the emergency department within 30 days of the procedure.

There are several limitations of the present study. It was a retrospective study, subject to all the drawbacks associated with such study designs. Furthermore, our sample size was relatively small. Only 99 patient records were reviewed over a 2-year period. As well, the study would be more useful if it included all hip fractures treated by all fixation methods such as

Table 4. Factors Predicting Mortality.^a

Variables	Categories	Death				P Value
		No		Yes		
		n	%	n	%	
Age at the time of surgery	Mean + SD (min-max)	69 + 14 (36-98)		81 + 7 (70-88)		<.001
Weekend admission	No	54	64.3	2	13.3	<.001
	Yes	30	35.7	13	86.7	
Requiring preoperative medical intervention	No	58	69.0	4	26.7	.002
	Yes	26	31.0	11	73.3	
Types of surgery	Hemiarthroplasty	60	71.4	15	100.0	.017
	THA	24	28.6	0	0.0	
Acute renal impairment ^b	No	84	100.0	11	73.3	<.001
	Yes	0	0.0	4	26.7	
Dementia	No	80	95.2	11	73.3	.004
	Yes	4	4.8	4	26.7	
Unclear cause of hypoxia with possible atelectasis ^c	No	82	97.6	13	86.7	.047
	Yes	2	2.4	2	13.3	
Acute renal impairment ^c	No	80	95.2	11	73.3	.004
	Yes	4	4.8	4	26.7	
Oliguria ^c	No	80	95.2	11	73.3	.004
	Yes	4	4.8	4	26.7	
Decreased GCS ^c	No	80	95.2	9	60.0	<.001
	Yes	4	4.8	6	40.0	
RRT activation ^c	No	82	97.6	9	60.0	<.001
	Yes	2	2.4	6	40.0	
Minor surgical complication	No	78	92.9	10	66.7	.003
	Yes	6	7.1	5	33.3	
Major surgical complication	No	82	97.6	11	73.3	<.001
	Yes	2	2.4	4	26.7	
Readmission within 30 days	No	68	82.9	9	60.0	.044
	Yes	14	17.1	6	40.0	
Abnormal vital signs	No	40	47.6	2	13.3	<.001
	Preoperatively	2	2.4	0	0.0	
	In the recovery room	2	2.4	0	0.0	
	Postoperatively	0	0.0	6	40.0	
	In the ER	40	47.6	7	46.7	
	In the ER	2	2.4	0	0.0	
Hypoxia	No	78	92.9	9	60.0	<.001
	Preoperatively	2	2.4	0	0.0	
	In the recovery room	2	2.4	0	0.0	
	Postoperatively	0	0.0	6	40.0	
	In the ER	40	47.6	7	46.7	
	In the ER	2	2.4	0	0.0	

Abbreviations: GCS, Glasgow Coma Score; ER, emergency room; RRT, rapid response team; THA, total hip arthroplasty.

^aOnly statistically significant values were included.

^bPreoperatively.

^cPostoperatively.

proximal femoral nail, dynamic hip screw, close reduction and internal fixation, and arthroplasties. However, to our knowledge, this is the first study conducted in Saudi Arabia to report detailed perioperative-related complications and outcomes.

Conclusion

The present study findings confirm the persistently high morbidity and mortality rates observed in patients with fractures of the femoral neck, which were managed with either hemiarthroplasty or total hip arthroplasty. Efforts should be aimed at optimization of preoperative medical management, which is

vital to ensure early identification of the medically unfit patients. The findings of the present study may be of particular interest to orthopedic surgeons, as the associated high rates of complications and mortality necessitate an integrated and multidisciplinary approach for the future prevention of adverse outcomes.

Authors' Note

All authors meet the criteria for authorship stated in the Uniform Requirements for Manuscripts Submitted to Biomedical Journals. O.A.M., F.N.S., and S.S.D. are orthopedic surgical residents of different training levels. The study was supervised by W.A.R. Ethical approval was obtained from our hospital institutional review board.


Declaration of Conflicting Interests


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References

- Cooper C, Campion G, Melton LJ. Hip fractures in the elderly: a world-wide projection. *Osteoporos Int*. 1992;2(6):285-289. doi:10.1007/BF01623184.
- Roche JJW, Wenn RT, Sahota O, Moran CG. Effect of comorbidities and postoperative complications on mortality after hip fracture in elderly people: prospective observational cohort study. *Br Med J*. 2005;331(7529):1374-1376. doi:10.1136/bmj.38643.663843.55.
- Griffiths R, Alper J, Beckingsale A, et al. Management of proximal femoral fractures 2011: Association of Anaesthetists of Great Britain and Ireland. *Anaesthesia*. 2012;67(1):85-98. doi:10.1111/j.1365-2044.2011.06957.x.
- Haleem S, Lutchman L, Mayahi R, Grice JE, Parker MJ. Mortality following hip fracture: trends and geographical variations over the last 40 years. *Injury*. 2008;39(10):1157-1163. doi:10.1016/j.injury.2008.03.022.
- Sadat-Ali M, Al-Dakheel DA, Azam MQ, et al. Reassessment of osteoporosis-related femoral fractures and economic burden in Saudi Arabia. *Arch Osteoporos*. 2015;10(1):37. doi:10.1007/s11657-015-0240-5.
- Kim SH, Meehan JP, Lee MA. Surgical treatment of trochanteric and cervical hip fractures in the United States: 2000-2009. *J Arthroplasty*. 2013;28(8):1386-1390. doi:10.1016/j.arth.2012.09.007.
- Streubel PN, Ricci WM, Wong A, Gardner MJ. Mortality after distal femur fractures in elderly patients. *Clin Orthop Relat Res*. 2011;469(4):1188-1196. doi:10.1007/s11999-010-1530-2.
- Tarazona-Santabalbina FJ, Belenguer-Varea Á, Rovira-Daudi E, et al. Early interdisciplinary hospital intervention for elderly patients with hip fractures—Functional outcome and mortality. *Clinics*. 2012;67(6):547-555. doi:10.6061/clinics/2012(06)02.
- Maxwell MJ, Moran CG, Moppett IK. Development and validation of a preoperative scoring system to predict 30 day mortality in patients undergoing hip fracture surgery. *Br J Anaesth*. 2008;101(4):511-517. doi:10.1093/bja/aen236.
- Maceroli MA, Nikkel LE, Mahmood B, Elfar JC. Operative mortality after arthroplasty for femoral neck fracture and hospital volume. *Geriatr Orthop Surg Rehabil*. 2015;6(4):239-245. doi:10.1177/2151458515600496.
- 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(8):162-168. doi:10.1302/2046-3758.28.2000177.
- Cram P, Hillis SL, Barnett M, Rosenthal GE. Effects of weekend admission and hospital teaching status on in-hospital mortality. *Am J Med*. 2004;117(3):151-157. doi:10.1016/j.amjmed.2004.02.035.
- Saposnik G, Baibergenova A, Bayer N, Hachinski V. Weekends: a dangerous time for having a stroke? *Stroke*. 2007;38(4):1211-1215. doi:10.1161/01.STR.0000259622.78616.ea.
- Busl KM, Prabhakaran S. Predictors of mortality in nontraumatic subdural hematoma. *J Neurosurg*. 2013;119(5):1296-1301. doi:10.3171/2013.4.JNS122236.
- Ananthakrishnan AN, McGinley EL, Saeian K. Outcomes of weekend admissions for upper gastrointestinal hemorrhage: a nationwide analysis. *Clin Gastroenterol Hepatol*. 2009;7(3):296-302. doi:10.1016/j.cgh.2008.08.013.
- Deshmukh A, Pant S, Kumar G, Bursac Z, Paydak H, Mehta JL. Comparison of outcomes of weekend versus weekday admissions for atrial fibrillation. *Am J Cardiol*. 2012;110(2):208-211. doi:10.1016/j.amjcard.2012.03.011.
- Boylan MR, Rosenbaum J, Adler A, Naziri Q, Paulino CB. Hip fracture and the weekend effect: does weekend admission affect patient outcomes? *Am J Orthop (Belle Mead NJ)*. 2015;44(10):458-464.
- Klestil T, Röder C, Stotter C, et al. Impact of timing of surgery in elderly hip fracture patients: a systematic review and meta-analysis. *Sci Rep*. 2018;8(1):13933. doi:10.1038/s41598-018-32098-7.
- Lefaiivre KA, Macadam SA, Davidson DJ, Gandhi R, Chan H, Broekhuysen HM. Length of stay, mortality, morbidity and delay to surgery in hip fractures. *J Bone Joint Surg Br*. 2009;91(7):922-927. doi:10.1302/0301-620X.91B7.22446.
- Cooper Z, Mitchell SL, Lipsitz S, et al. Mortality and readmission after cervical fracture from a fall in older adults: comparison with hip fracture using national Medicare data. *J Am Geriatr Soc*. 2015;63(10):2036-2042. doi:10.1111/jgs.13670.
- Lin JCF, Liang WM. Mortality, readmission, and reoperation after hip fracture in nonagenarians. *BMC Musculoskelet Disord*. 2017;18(1):144. doi:10.1186/s12891-017-1493-5.
- Lee TC, Ho PS, Lin HT, Ho ML, Huang HT, Chang JK. One-year readmission risk and mortality after hip fracture surgery: a national population-based study in Taiwan. *Ageing Dis*. 2017;8(4):402-409. doi:10.14336/AD.2016.1228.