



# Effects of postoperative osteoporosis treatment on subsequent fracture and the 5-year survival rates after hemiarthroplasty for hip fracture

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## Abstract

**Summary** According to the literature, only 20–30% of patients are screened for osteoporosis after a hip fracture. Osteoporosis treatment may have a potential protective effect on the 5-year mortality rate. Our results demonstrated that 5-year survival is higher in patients who received osteoporosis treatment after hemiarthroplasty for hip fracture compared with those who did not.

**Purpose** This study aims to investigate the status of osteoporosis treatment in patients who underwent hemiarthroplasty for an osteoporotic hip fracture and to compare subsequent fractures and the 5-year survival rates of these patients with those who did not receive the osteoporosis treatment.

**Methods** Patients > 65 years of age who underwent hemiarthroplasty for an osteoporotic hip fracture were included in this retrospective multicenter study. Patients who died within 12 months postoperative, who were lost to follow-up, and those with malignancy and secondary osteoporosis were excluded. Group I comprised patients who had no postoperative osteoporosis screening and treatment, and Group II comprised those who received the screening and treatment.

**Results** A total of 460 of 562 patients (82%) did not receive osteoporosis treatment after hip fracture. No significant difference was observed between the groups in terms of subsequent fracture numbers and fracture sites ( $p = 0.296$  and  $0.240$ , respectively). Mean 5-year survival rate was significantly higher in Group II ( $p = 0.002$ ).

**Conclusions** According to our results, elderly patients who underwent hemiarthroplasty for an osteoporotic hip fracture were not commonly screened or treated for osteoporosis. Our results demonstrated no significant difference between the groups in terms of subsequent fracture. However, we observed a significant high 5-year survival rate among patients who received the osteoporosis treatment.

**Keywords** Osteoporosis · Hip fracture · Hemiarthroplasty · Mortality · Survival

## Introduction

The number of hip fractures, especially in the geriatric population, is continuously increasing with a cumulative mortality rate varying from 20 to 40% [1–5]. In addition, the economic impact of hip fractures is increasing the financial burden on the government and society because of the long hospital stay, implants cost, and accompanied comorbidities [6–9].

A history of osteoporotic fracture is a well-proven risk factor that doubles the risk of subsequent fractures [10–12]. However, according to the literature, only 20–30% of patients are screened for osteoporosis after a hip fracture [13]. In patients with a hip fracture, findings regarding the association between osteoporosis treatment and mortality reduction are interesting with important clinical significance. Some studies

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have reported that in those who receive osteoporosis treatments, the subsequent fracture rate effectively decreases by up to 50% and fracture-associated mortality decreases by 10% [14, 15]. Therefore, all osteoporotic hip fractures should be considered for potential adverse consequences, and an early treatment of osteoporosis should be appropriately initiated after the surgery.

To date, we could not find any study evaluating the effect of osteoporosis treatment on subsequent fractures and 5-year survival rate after a hemiarthroplasty procedure for hip fracture. Elderly patients who underwent hemiarthroplasty for a hip fracture are commonly encountered by physicians, and it is important to determine the effects of osteoporosis screening and treatment on subsequent morbidity and mortality in this specific patient population. Therefore, the aim of this study was to investigate the osteoporosis treatment status of patients who underwent hemiarthroplasty for an osteoporotic hip fracture and compare subsequent fractures and the 5-year survival rates of patients who received the osteoporosis treatment with those who did not. We hypothesized that postoperative osteoporosis treatment may have a potential protective effect on mortality rate, as previously reported in the literature.

## Patients and methods

### Study population

This retrospective multicenter study was performed with the approval of an institutional ethical review board and in accordance with the *Declaration of Helsinki*. Patients > 65 years of age who underwent cemented bipolar hemiarthroplasty for senile osteoporotic hip fractures at three centers (two state hospitals and one university hospital) between January 2013 and January 2014 were included. Hip fracture represents an intracapsular femoral neck fracture or an intertrochanteric fracture. The indications for cemented bipolar hemiarthroplasty were severe osteoporosis (Singh index  $\leq 4$ ), age > 65 years, and unstable fracture pattern for intertrochanteric fractures. Patients who underwent a proximal femoral nail for an intertrochanteric fracture were excluded to assess patients who were treated with the same method. Patients who died within 12 months after the surgery, those who were lost to follow-up, and those with malignancy and secondary osteoporosis were also excluded from the study. The reason for excluding patients who died at 1-year postoperative was to better understand the effect of osteoporosis treatment on 5-year mortality. Mortality at early postoperative period is mainly seen in patients with poor health status, and it is difficult to assess the effect of osteoporosis treatment in this population, as well as the possibility of the mortality data for these patients causing misinformation. The diagnosis of malignancy and secondary osteoporosis were determined from patients' past medical history records. From 102

patients who died in first year after hemiarthroplasty, 5 (5%) patients died in hospital, 30 (29%) patients died in postoperative 3 months, and 48 (47%) patients died in postoperative 6 months. The data of 562 patients were retrospectively examined (Fig. 1).

### Data collection

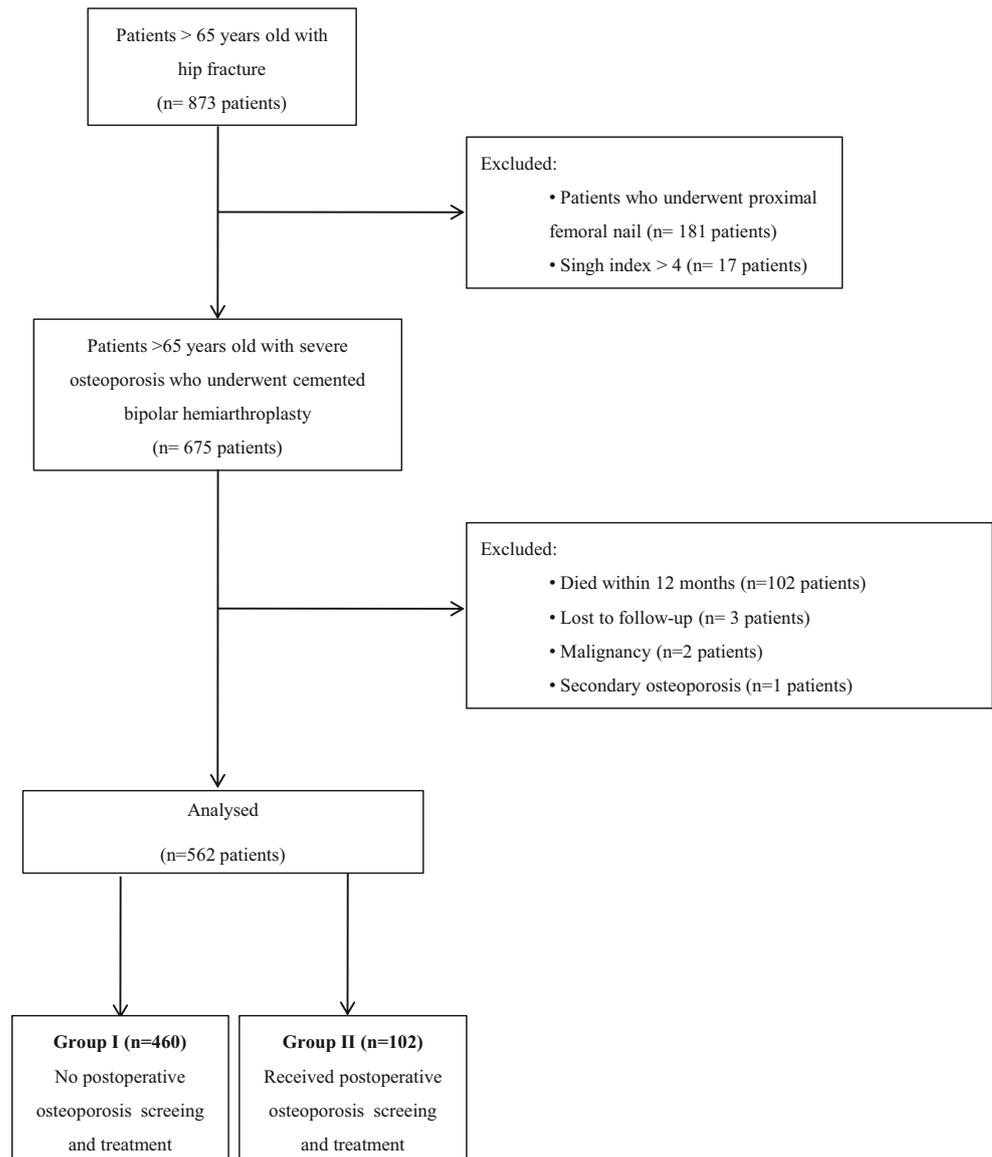
Age, gender, presence of preoperative osteoporosis treatment, and treatment agent were recorded for all patients at the initial submission of medical records. Postoperative osteoporosis screening status, postoperative and follow-up bone mineral density (BMD) *T* scores, and subsequent fractures that occurred during follow-up were recorded for each patient. Patients who died during follow-up were determined through medical records for in-hospital deaths, telephone contact with the relatives, or government insurance institutions. The last medical records were evaluated as the final control for patients who died during follow-up. Patients were categorized into two groups according to postoperative osteoporosis screening status. Patients who had no postoperative osteoporosis screening and treatment after hip fracture surgery were considered as Group I, and those who had osteoporosis screening and treatment were considered as Group II.

### Statistical analysis

Statistical analysis was performed using SPSS 20.0 (SPSS Inc., IBM, NY, USA). Continuous data, such as age, follow-up time, and *T* scores are represented as means and standard deviations, whereas categorical data, such as gender, presence of osteoporosis treatment, and subsequent fractures, are represented as frequencies and percentages. The comparison of continuous data was performed by the Student *t* test, whereas the comparison of categorical data was performed by the Pearson chi-square test. Survival of the patients was calculated using the Kaplan–Meier survival analysis. The log-rank test was used to compare the 5-year survival rates of the study groups. *p* values of < 0.05 were considered as statistically significant. No sample size calculation was performed prior to the study; however, a post hoc power analysis was performed using the G\*Power software to detect the statistical power of the study.

## Results

The main characteristics and comparisons of the groups are shown in Table 1. In total, 460 of 562 patients (82%) did not receive osteoporosis screening and treatment during postoperative follow-up after hip fracture (Group I). There was no significant difference between the groups in terms of age. However, mostly female patients received postoperative

**Fig. 1** Flowchart diagram of the study

osteoporosis treatment during follow-up ( $p \leq 0.001$ ). Bisphosphonates were the most commonly used agents.

In Group II, 68 of 102 patients had postoperative consecutive BMD evaluation within 1-year interval. The mean postoperative femur neck  $T$  score was  $-2.8 \pm 0.9$  and lumbar spine  $T$  score was  $-2.9 \pm 1$ . At the second postoperative BMD evaluation after osteoporosis treatment, the mean femur neck  $T$  score was  $-2.4 \pm 0.8$  and lumbar spine  $T$  score was  $-2.5 \pm 0.9$ . There was a slight increase in both femur neck and lumbar spine  $T$  scores. According to serial BMD measurements, patients' mean BMD was below the 2.5 standard deviation (SD) postoperatively ( $T$  score  $\leq -2.5$ ); and postoperative osteoporosis treatment resulted in an increase in mean BMD measurements ( $T$  score  $\geq 2.5$ ).

The mean follow-up of our patients was  $29.9 \pm 13.4$  months. The mean follow-up time of Group II was significantly higher than that of Group I. During follow-up, it was found

that a total of 66 subsequent fractures occurred in 66 of 562 patients (12%) who underwent hemiarthroplasty for a hip fracture. No significant difference was observed between the groups in terms of subsequent fracture numbers and fracture sites ( $p = 0.296$  and  $0.240$ , respectively; Table 2).

Of 562 patients, 524 (93%) died within 5 years of surgery. The overall 5-year survival rate was 7% with 5% for Group I and 16% for Group II. The mean survival rate was 30.7% (95% CI 29.9–31.6%) with 30.2% (29.4–31%) for Group I and 33.3% (30.6–35.9%) for Group II ( $p = 0.002$ ) (Fig. 2).

## Discussion

According to the findings of this study, patients who underwent hemiarthroplasty for a hip fracture were not

**Table 1** Baseline characteristics and comparison of the groups

	Group I ( <i>n</i> = 460)	Group II ( <i>n</i> = 102)	Combined ( <i>n</i> = 562)	<i>p</i> value
Gender				< 0.001
Female	206 (45%)	86 (84%)	292 (52%)	
Male	254 (55%)	16 (16%)	270 (48%)	
Age (years)	79.8 ± 7.8	79.5 ± 9	79.8 ± 8	0.747
Preoperative osteoporosis treatment				< 0.001
Yes	2 (0.4%)	68 (67%)	70 (12%)	
No	458 (99.6%)	34 (33%)	492 (88%)	
Osteoporosis treatment agents				
Alendronate	2	36	38	
Calcium + vitamin D	0	8	8	
Ibandronate	0	20	20	
Zoledronate	0	24	24	
Ibandronate + denosumab	0	4	4	
Denosumab	0	8	8	
Strontium ranelate	0	2	2	

*n* number of patients

commonly screened or treated for osteoporosis during the postoperative follow-ups. However, we found no significant difference between patients with and without treatment, in terms of subsequent fracture rates. Conversely, we observed significantly higher 5-year survival rates in patients who received osteoporosis treatment after the hemiarthroplasty procedure for hip fracture than those who did not receive any osteoporosis treatment.

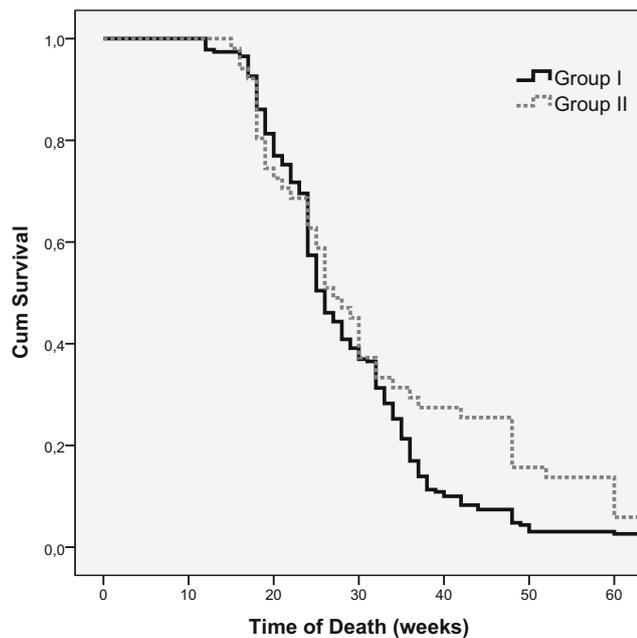
Despite a long-standing recognition of the high volume of patients with osteoporotic hip fractures treated by orthopedic surgeons, the majority of patients still fail to receive osteoporosis treatment to prevent subsequent osteoporotic fractures. There is a gap in the treatment of osteoporosis in patients with hip fractures; this gap arises because of different health care settings and demographic population in multiple countries [16]. Some studies have

reported that only 20% of patients with hip and distal radius osteoporotic fractures receive treatment for osteoporosis after the treatment of the fracture [17, 18]. Solomon et al. reported that only 21% of patients in the USA received effective drug therapy after the fracture [19]. In addition, Kim et al. mentioned low rates of osteoporosis treatment following hip fractures [20], demonstrating a need for increased awareness and intervention in this high-risk population. In a recent study by Desai et al, the authors emphasized low rates of osteoporosis treatment after a hip fracture which declines from 9.8 to 3.3% in 10 years [21]. Our findings are also consistent with the current literature that 18% of patients with a hip fracture received treatment during postoperative follow-ups. This issue is a global problem and it is also found to be similar in our region, the Middle East.

**Table 2** Subsequent fractures occurred during the follow-up period

	Group I ( <i>n</i> = 460)	Group II ( <i>n</i> = 102)	Combined ( <i>n</i> = 562)	<i>p</i> value
Postoperative follow-up (months)	29.1 ± 12.4	33.2 ± 16.8	29.9 ± 13.4	0.006
Subsequent fracture				0.296
Yes	52 (11%)	14 (14%)	66 (12%)	
No	408 (89%)	88 (86%)	496 (88%)	
Fracture sites				0.240
Lumbar spine	24	4	28	
Hip	16	8	24	
Wrist	12	2	14	

*n* number of patients



**Fig. 2** Kaplan–Meier survival charts of the patient groups

There are many studies in the literature documenting the consequent fracture risk after osteoporosis treatment in elderly patients following a hip fracture. Mugnier et al. showed that subsequent fracture incidence was similar in treated and untreated patients during the first year. However, 30 months after the index fracture, osteoporosis medication for  $\geq 1$  year reduced the incidence of fracture by 70% [13]. Esposti et al. found that patients receiving calcium and vitamin D supplementation in addition to osteoporosis drugs had a lower risk of subsequent fracture during the 3-year follow-up and adherence to osteoporosis medication decreased the risk of subsequent fractures [22]. However, Brozek et al. found that consequent hip fracture incidences were elevated among bisphosphonate users [23]. In the present study, there was no significant difference between the groups in terms of subsequent fracture risk. However, other comorbidities may affect the occurrence of subsequent fractures in patients treated for hip fracture. Therefore, further studies are required to obtain a higher level of evidence. The increased mortality following hip fractures has been widely reported [3, 24, 25]. Kassam et al. demonstrated that the mortality rate of patients undergoing hemiarthroplasty for a hip fracture at 1 and 5 years were 26% and 69%, respectively [26]. In elderly patients with osteoporosis, pharmacotherapy after a fracture has been shown to reduce the rate of mortality [27, 28]. Van Geel et al. reported that oral bisphosphonate treatment has a substantially lower risk for subsequent fragility fracture and mortality [29]. In a randomized double-blind study, authors showed that postoperative intravenous zoledronic acid treatment reduced subsequent fracture rates and mortality rates in patients with a hip fracture [30]. In the present study, we also found a significantly higher 5-year survival rate in patients who received

osteoporosis treatment following hemiarthroplasty for a hip fracture than those who did not receive any osteoporosis treatment. But there is still gap in the literature about the effects of hip fracture type and treatment method in terms of subsequent fracture risk and mortality rates.

The main limitation of this study was its retrospective design. Patients' health status and systemic comorbidities may affect subsequent fracture and mortality rates. Many of the known prognostic variables were not evaluated in our study. In addition to that, further surgical indications may also have an important effect on mortality and subsequent fracture rates. However, the retrospective cross-sectional design of the study prevented potential patient selection bias for the study groups. The retrospective observational design also gave valuable results regarding the rates of osteoporosis screening and treatment status. We also evaluated a large specific patient population who underwent hemiarthroplasty for hip fracture, and the minimum statistical power was calculated as 0.99 for the comparison of proportions and 0.71 for the comparison of means ( $\alpha = 0.05$ ). The main strength of this study was that this is the first study to compare the 5-year survival rates of patients who received osteoporosis treatment after hip fracture surgery and those who did not.

## Conclusion

According to the results of this large retrospective study, elderly patients who underwent hemiarthroplasty for osteoporotic hip fracture were not commonly screened or treated for osteoporosis. However, our results demonstrated no significant difference, in terms of subsequent fracture, between patients who received treatment and those who had no treatment. Furthermore, we observed a significantly higher 5-year survival rate among patients who received osteoporosis treatment compared with those who did not receive the treatment.

## Compliance with ethical standards

This retrospective multicenter study was performed with the approval of an institutional ethical review board and in accordance with the Declaration of Helsinki.

**Conflict of interest** None.

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