Management of Fragility Hip Fractures: Our Institutional Experience

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Abstract
Introduction: Approximately 320,000 fragility hip fractures are sustained in the United States annually, resulting in substantial morbidity and mortality as well as significant economic burden on the health-care system. Nevertheless, a majority of these patients are not screened and do not receive treatment for osteoporosis. The objective of this study was to evaluate rates of osteoporosis screening and treatment in our institution and compare them to those reported in the literature. Methods: This was a retrospective cohort study of 191 patients ages 50 and older who sustained osteoporotic hip fractures. Primary outcome measures were percentage of patients who (1) underwent bone health laboratory workup during admission, (2) were started on vitamin D, calcium, and/or a bisphosphonate, (3) received bone mineral density testing, and (4) followed up with a primary care doctor or endocrinologist. Secondary outcomes measures were (1) whether gender, race, or age influenced our primary outcomes and (2) whether obtaining in-hospital laboratory workup led to increased rates of further screening and treatment. Results: Fifty-six (29.3%) patients received full laboratory workup, 48 (25.1%) were prescribed vitamin D and calcium, 11 (5.7%) were prescribed a bisphosphonate, 13 (6.8%) underwent bone mineral density testing, and 41 (21.5%) followed up with primary care or endocrinology. Discussion: Women were more likely to be treated with vitamin D and calcium. Outcomes were similar regardless of race. Younger patients were more likely to undergo laboratory testing, bisphosphonate therapy, and bone mineral density testing. Initiating workup during admission did not lead to increased rates of outpatient treatment. Conclusion: Despite nationwide efforts to improve, rates of osteoporosis screening and treatment following hip fracture are suboptimal. Rates at our institution are similar to those reported in previous studies. There were disparities between gender and age groups. Future studies are needed to evaluate whether more recently implemented policies lead to better osteoporosis screening and management.

Keywords: osteoporosis screening, osteoporosis management, hip fracture, fragility fracture

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Introduction
Osteoporotic hip fractures are a major health-care concern in the United States and worldwide due to high rates of associated morbidity, mortality, and medical costs. The estimated annual incidence of fragility fractures is over 2 million, which exceeds the combined annual incidence of stroke, myocardial infarction, and breast cancer.¹ Hip fractures comprise a small percentage of fragility fractures, about 14% but are responsible for 72% of costs related to osteoporotic fracture management.² This is estimated to cost Medicare US$18 billion dollars each year, equivalent to expenditure for cardiovascular disease and asthma.³ More importantly, there is a significant increase in morbidity and mortality in elderly patients who sustain hip fractures. There is a 25% to 30% mortality rate in the first year following a hip fracture.⁴ In those who survive, more than half do not return to their preinjury level of function,⁵ and 1 in 4 patients rely on long-term nursing home care.⁶ Despite the numerous and substantial consequences of fragility fractures, less than 20% of Americans are tested, let alone treated, for osteoporosis following a hip fracture.⁷ These patients remain at risk for sustaining additional fractures leading to worsening morbidity and increased risk of mortality.

In 2005, the American Orthopaedic Association founded the Own the Bone project in order to improve osteoporosis...
management. They sought to assess current practices and pilot quality improvement measures to prevent secondary fractures. Their study outcomes included rates of counseling patients on vitamin D and calcium supplementation, smoking cessation, and weight-bearing exercises; obtaining bone mineral density (BMD) tests; initiating pharmaceutical interventions; and recommending follow-up with patients' primary care doctors. Their pilot study in 2008 revealed significant improvements in counseling and educating patients, but there was no change in obtaining BMD scans or starting pharmacotherapy. It demonstrated the willingness of orthopedic surgeons to make efforts to prevent secondary fractures, but it did not necessarily result in improving osteoporosis treatment. A follow-up study in 2011 evaluated differences in osteoporosis management when interventions were either initiated during admission or deferred to the outpatient setting. Initiating pharmacotherapy during admission seemed to lead to increased rates of BMD testing at the 6-month postoperative time point. An additional follow-up study in 2016 showed improved results compared to the initial pilot. After implementing more aggressive secondary prevention measures, rates of BMD testing and/or initiation of pharmacotherapy occurred for 53% of patients.

Although the Own the Bone studies demonstrated very promising results, the number of participating centers is only a small percentage of the total number of hospitals in the United States. A study of 318 hospitals in the United States by Jennings et al revealed that just 6.6% of patients hospitalized with hip fractures were started on vitamin D and calcium, and only 7.3% received bisphosphonate therapy. This shows that in many institutions the management of osteoporosis after fragility fractures is still suboptimal. The purpose of our study was to assess the rates of osteoporosis screening and treatment for our fragility hip fracture patients. Primary outcomes included (1) obtaining bone health labs upon admission, (2) initiating vitamin D and calcium and/or bisphosphonate therapy, (3) obtaining BMD scans, and (4) follow-up with primary care or endocrinology. Secondary outcomes examined (1) whether obtaining laboratory workup led to increased rates of obtaining BMD scans or starting pharmacotherapy, and (2) whether there were disparities in our primary outcomes depending on gender, race, or age.

Methods
This was a retrospective study evaluating osteoporosis management of patients who underwent surgery for hip fracture from January 2012 through July 2015. Our study protocol was approved by our institutional review board. We used Current Procedural Terminology codes 27125, 27235, 27236, 27244, 27245, and 27130 to gather medical record numbers. The patients in the cohort underwent total hip arthroplasty, hemiarthroplasty, percutaneous pinning, intramedullary nailing, or plate fixation depending on the fracture pattern and patient factors. Patients younger than the age of 50 and prisoners were excluded from the study. In addition, fractures that occurred by high-energy mechanisms such as motor vehicle accident or fall from height, pathologic fractures from tumors, and atypical fracture patterns were excluded as well.

We reviewed the electronic medical records of 191 patients who met our inclusion criteria. We noted gender, race, and age at the time of surgery. We evaluated whether bone health labs were obtained during admission which consisted of levels of 25-hydroxyvitamin D, calcium, parathyroid hormone (PTH), thyroid-stimulating hormone, N-terminal telopeptide, and alkaline phosphatase. We reviewed discharge medications as well as inpatient and outpatient notes from orthopedic surgery, primary care, and endocrinology providers to see if (1) patients appropriately followed up for further osteoporosis management, (2) patients were currently taking or were started on vitamin D and calcium supplementation and/or bisphosphonates following their injury, (3) they received a BMD scan after they sustained their injury. The data were collected from the 1-year time period following the date of surgery. Chi-square analysis was performed with statistical significance indicated by $P < .05$.

Results
A total of 191 patients during the period of January 2012 and July 2015 underwent surgery for fragility hip fracture. All patients were older than 50 years of age. Seventy-one patients were male and 119 were female. Sixty-five were identified as “black or African American,” 121 as “white or Caucasian,” and 5 as “other” or “unknown.” The median age of the study population was 76 and the mean age was 75.

Of the 191 total patients, 56 (29.3%) had at least a vitamin D level drawn during admission, and 16 (8.4%) patients had a full set of fragility labs drawn. Forty-eight (25.1%) patients received vitamin D and calcium, and bisphosphonates were started on 11 (5.7%) patients. Pharmacotherapy was initiated in the outpatient setting in all instances. Forty-one (21.5%) patients followed up with their primary care doctors or endocrinologists and 13 (6.8%) underwent BMD scans.

For the 56 patients who had at least a vitamin D level drawn, 17 (30.4%) received nutritional supplementation, 3 (5.4%) were started on a bisphosphonate, 4 (7.1%) underwent BMD testing, and 9 (16.1%) followed up appropriately (Table 1).

We then observed outcomes when stratified by gender. For the male cohort, 21 (29.2%) had vitamin D levels drawn, while 6 (8.3%) underwent full laboratory workup. Ten (13.9%) males had vitamin D and calcium supplementation, 3 (4.2%) were started on a bisphosphonate, 5 (6.9%) received BMD scans, and 15 (20.8%) followed up appropriately for osteoporosis management. For the female cohort, 35 (29.4%) were tested for just vitamin D levels and 9 (7.6%) for the full set of labs. Thirty-eight (31.9%) females had nutritional supplementation, 8 (6.7%) were started on a bisphosphonate, 8 (6.7%) received BMD scans, and 26 (21.9%) followed up appropriately. There was a statistically significant difference between genders in receiving vitamin D and calcium therapy ($P = .005$).
We then compared outcomes by race. Eighteen (27.7%) black patients had vitamin D levels drawn, and 3 (4.6%) had full lab work completed. Fourteen (21.5%) black patients received vitamin D and calcium supplementation, 2 (3.1%) received bisphosphonate therapy, 2 (3.1%) received BMD scans, and 12 (18.5%) followed up with primary care or endocrinology. Thirty-six (29.8%) white patients had vitamin D levels obtained and 12 (9.9%) underwent full laboratory workup. Thirty-two (26.5%) white patients received appropriate nutritional supplementation, 9 (7.4%) were started on bisphosphonates, 11 (9.1%) received BMD scans, and 29 (24.0%) followed up. There were no statistically significant differences in outcomes between black and white patients.

Finally, we evaluated outcomes between 2 age groups using the median age of 76 as a cutoff. In patients ages 50 to 76 at the time of injury, 34 (37.4%) had vitamin D levels obtained and 11 (12.1%) underwent full laboratory workup. Twenty-two (37.4%) had vitamin D and calcium supplementation, 9 (9.9%) were started on a bisphosphonate, 11 (12.1%) received BMD scans, and 21 (23.1%) followed up with primary care or endocrinology. In patients ages 77 and older, 22 (22.0%) had vitamin D levels drawn and 3 (3.0%) had full lab work completed. Twenty-six (26.0%) of these patients had vitamin D and calcium supplementation, 2 (2.0%) were started on a bisphosphonate, 2 (2.0%) received BMD scans, and 20 (20.0%) followed up appropriately. Younger patients were more likely to undergo screening ($P = .020$), start bisphosphonate therapy ($P = .016$), and undergo BMD testing ($P = .019$). See Table 2 for summary of results.

### Discussion

Osteoporotic hip fractures are a major public health concern, contributing to significant morbidity and mortality for patients and considerable economic burden on the health-care system. Primary prevention remains the best method to minimize these dire social and economic consequences. Unfortunately, in the United States only a small percentage of susceptible individuals are tested or treated for osteoporosis. This leaves a large number of people at risk for sustaining fragility fractures. For those who do sustain these fractures, secondary prevention is key in reducing further morbidity and mortality.

An important step in evaluating patients with osteoporosis is identifying the cause. Rarely, there is an underlying endocrine abnormality stemming from thyroid, parathyroid, renal, or adrenal disease. However, most of the time, osteoporosis is a phenomenon of age-related bone loss with concomitant nutritional deficiencies. Up to 90% of patients with hip fractures have a vitamin D deficiency. Therefore, vitamin D and calcium have been mainstays in osteoporosis treatment and has been shown to decrease risk of fragility hip fractures. Bisphosphonates, on the other hand, inhibit bone resorption by osteoclasts. Because this is an important step in fracture healing, one could argue that bisphosphonate treatment could have an adverse effect on fracture metabolism. However, a systematic review by Kates et al showed that initiating bisphosphonate therapy following fracture was not shown to delay healing. An alternative medication to consider is teriparatide, a PTH analog. A meta-analysis of randomized control trials by Lou et al demonstrated improved fracture healing and functional outcomes in patients receiving teriparatide therapy following fragility fractures.

Bone mineral density testing is important in osteoporosis workup as well, but for more than just confirming the diagnosis. Although orthopedic surgeons consider a fragility hip fracture to be pathognomonic for osteoporosis, providers in other specialties may not fully appreciate the significance of a fragility fracture in relation to overall bone health. Primary care physicians are more likely to treat osteoporosis as a result of a positive finding on a BMD scan rather than a history of a fragility fracture. Testing BMD in patients who have sustained fragility fractures may potentially lead to increased rates of treatment in this regard.

In our study, we aimed to assess osteoporosis management following hip fracture at our institution. Our primary outcomes measured how successful we were in (1) obtaining bone health labs during admission, (2) initiating or continuing nutritional supplementation and bisphosphonate pharmacotherapy, (3) obtaining BMD scans after discharge, and (4) arranging appropriate follow-up for further osteoporosis management. Secondary outcomes measured (1) if initiating metabolic bone health workup during admission translated to increased rates of vitamin D and bisphosphonate treatment, obtaining BMD scans, and primary care or endocrinology follow-up, and (2) if our primary outcomes differed depending on gender, race, or age. This was accomplished through retrospective chart review of 191 hip fracture patients over a 2.5-year period.

We learned that at our institution, we performed poorly in all of our primary outcomes. Very few patients were appropriately managed for their underlying osteoporosis. Surprisingly, nutritional supplementation was often not initiated even when the majority of tested patients had low values. Inpatient laboratory

### Table 1. Vitamin D Testing and Osteoporosis Management.

| Vitamin D tested | No. of Patients | Vitamin D + Ca Supplementation (%) | Bisphosphonate Therapy (%) | BMD Scan (%) | Follow-Up (%) |
|------------------|----------------|----------------------------------|---------------------------|--------------|---------------|
| 56               |                | 17 (30.4%)                       | 3 (5.4%)                  | 4 (7.1%)     | 9 (16.1%)     |
| Not tested       | 135            | 31 (23.0%)                       | 8 (5.9%)                  | 9 (6.7%)     | 32 (23.7%)    |

Abbreviation: BMD, bone mineral density.
testing also did not lead to improved rates of bisphosphonate therapy, BMD testing, or follow-up. Poor compliance with appropriate follow-up may be attributed to lack of patient education by the treating orthopedic surgeon. Patients may not necessarily recognize the importance of medical treatment and secondary prevention. Unfortunately, even when patients were seen by primary care or endocrinology, rates of bisphosphonate therapy and BMD testing were low. Again, this may reflect an underappreciation of hip fractures as a sentinel sign of poor bone health.\textsuperscript{12}

Several studies have demonstrated gender disparities for osteoporosis screening—males are underscreened compared to their female counterparts.\textsuperscript{16,17} We queried whether rates of screening or treatment differed between genders in our study population. Women were more likely to be treated with vitamin D and calcium supplementation, yet there were no differences in rates of screening, bisphosphonate therapy, BMD testing, or follow-up. This bias may be due to the fact that women are 4 times more likely to have osteoporosis.\textsuperscript{18}

Evidence of racial disparities in osteoporosis screening have been documented in the literature as well. Cauley noted a 6- to 7-fold difference in screening rates between white women and black women, favored toward the former.\textsuperscript{19} The reason for this discrepancy is not fully understood. Nonetheless, it does hold clinical significance as mortality rates are higher in black women when compared to their white counterparts.\textsuperscript{19} In our study, there were no differences between racial groups regarding both inpatient and outpatient management. Notably, 5 patients were neither white nor black and were excluded from this portion of the analysis as we felt that meaningful conclusions could not be drawn from such a low number of subjects in this subset.

Younger individuals are more likely to undergo osteoporosis screening compared to older patients,\textsuperscript{20} and we found similar results in our study. Furthermore, younger patients in our population were more likely to have been started on bisphosphonates and undergone BMD scanning. This may perhaps be due to the misconceived notion that workup or treatment may have fewer benefits for older patients. There may additionally be concerns regarding polypharmacy and contraindication to medical treatment in the patients with more comorbid conditions. Interestingly, in one study by McNally et al, older patients were more likely to refuse BMD testing.\textsuperscript{20}

Our study had certain limitations. Since this was a retrospective analysis of data from electronic medical records, we more than likely underestimated the number of patients who received appropriate care. If the patient’s primary care doctor or endocrinologist is not within our hospital system, their postoperative visits and current medications may not necessarily have been documented in our charts. Fortunately, a large proportion of our patients receive care exclusively within our hospital system through a coordinated care program. We also performed a thorough review of scanned records and clinic notes in order to find mention of osteoporosis screening or treatment done at outside facilities. Thus, we felt that we did not have a significant amount of missing data points. In addition, retrospective data collection could also lead to errors from

| Table 2: Rates of Osteoporosis Screening and Treatment. |
| No. of Patients | Only Vitamin D Tested (%) | All Labs Tested (%) | BMD Scan (%) | Bisphosphonate Therapy (%) | Vitamin D + Ca Supplementation (%) |
|-----------------|---------------------------|---------------------|--------------|---------------------------|-----------------------------------|
| Total           | 191                       | 56 (29.3%)          | 16 (8.4%)    | 48 (25.1%)                | 11 (5.7%)                        |
| Male            | 72                        | 21 (29.2%)          | 6 (8.3%)     | 10 (13.9%)                | 3 (4.2%)                         |
| Female          | 119                       | 35 (29.4%)          | 9 (7.6%)     | 38 (31.9%)                | 8 (6.7%)                         |
| Black           | 65                        | 18 (27.7%)          | 3 (4.6%)     | 14 (21.5%)                | 5 (7.5%)                         |
| White           | 121                       | 36 (29.8%)          | 12 (9.9%)    | 32 (26.5%)                | 9 (7.4%)                         |
| Ages 50-76      | 91                        | 34 (37.4%)          | 11 (12.1%)   | 22 (24.2%)                | 11 (12.1%)                       |
| Ages 77+        | 22                        | 10 (45.5%)          | 5 (22.7%)    | 12 (54.5%)                | 5 (22.7%)                        |

Abbreviation: BMD, bone mineral density.
inaccurate medication reconciliation or note documentation within our system. Lastly, this study was performed at an academic center, and the findings may not be generalizable to community-based practices.

As an institution, we treated osteoporotic hip fractures themselves appropriately and expediently, but clearly improvements could be made in treating the underlying disease. The American Orthopaedic Association has made incredible efforts to improve rates of proper osteoporosis care and has shown significant improvements in their study centers. However, it is clear from Jennings et al’s study of over 51,000 patients that suboptimal fragility fracture care is still a persistent problem for most institutions in the United States. The results of our study present tremendous opportunities for learning and improvement. During the time period that we studied, a standardized policy for post-fragility fracture care did not exist, which may in part explain the sporadic rates of osteoporosis workup and treatment. Since then, we have increased education among attendings, residents, and midlevel providers in regard to optimal osteoporosis management. We established a protocol to obtain laboratory workup in all patients presenting with any fragility fracture. We use a multidisciplinary care model with our geriatric medicine colleagues who comanage our hip fracture patients. Lastly, we established a bone health clinic within our department in order to facilitate preventative care. Future studies are needed to see if these changes improve outcomes. Initiating pharmacotherapy during admission could be another change to be considered in the future.

Conclusion

Fragility fractures are responsible for significant morbidity and mortality as well as considerable costs to the health-care system. Despite the efforts of the American Orthopaedic Association, hundreds of hospitals, including our own, severely underscreen and undertreat osteoporosis. In our institution, women were more likely to be treated with vitamin D and calcium, and there was a tendency to favor workup and treatment in younger patients, but overall rates were still poor. Obtaining inpatient laboratory workup did not translate to better care in the postacute setting. We have recently implemented several new policies to improve, but future studies are needed to objectively measure if these lead to better outcomes. Significant nationwide changes must still be made in order to improve care of our fragility fracture patients.

Declaration of Conflicting Interests

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