Orthopedic Surgeon’s Awareness Can Improve Osteoporosis Treatment Following Hip Fracture: A Prospective Cohort Study

Sang-Rim Kim1, Yong-Chan Ha2, Yong-Geun Park1, Sung-Rak Lee3 and Kyung-Hoi Koo4

1Department of Orthopaedic Surgery, Jeju National University College of Medicine, Jeju; 2Department of Orthopaedic Surgery, Chung-Ang University College of Medicine, Seoul; 3Department of Orthopaedic Surgery, Cheju Halla General Hospital, Jeju; 4Department of Orthopaedic Surgery, Seoul National University College of Medicine, Seoul, Korea

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Address for Correspondence:
Yong-Chan Ha, MD
Department of Orthopaedic Surgery, Chung-Ang University College of Medicine, 29 Heukseok-ro, Dongjak-gu, Seoul 156-755, Korea
Tel: +82.2-6299-1577, Fax: +82.2-822-1710
E-mail: hayongch@naver.com

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INTRODUCTION

Osteoporosis is a common skeletal disease in elderly population, and osteoporosis-induced fractures are serious problems that pose considerable social and economic burdens in developed and developing countries (1-4). Osteoporosis is associated with low-energy fragility fractures which occur commonly in the hip, wrist, or vertebra. Of these, hip fractures are the most serious and have high rates of mortality and morbidity (3, 4). The history of hip fracture indicates a 5% risk of another hip fracture within a year, a 17 to 21% risk of any fracture within 16 to 21 months, and a 29% risk of another hip fracture in the following 20 yr (5, 6).

However, treatment for osteoporosis in patients older than 50 yr is not always instituted because of the asymptomatic and slowly progressive nature of the disease. Many patients will not be evaluated and/or treated until it is recognized in conjunction with a fragility fracture (7-9). However, even after hip fracture the rate of diagnosis and treatment of osteoporosis is still low at 5% to 25% (10-13).

Several studies have shown that osteoporosis treatment after a hip or any fragility fracture reduces the risks of subsequent fractures and mortality (14-16). It is known that a perioperative intervention program increased the percentage of patients in whom osteoporosis was addressed following a hip fracture. The role of orthopedic surgeons has been highlighted as part of the solution to recurrent fractures (17). Nonetheless, some orthopedic surgeons believe osteoporosis management after a hip fracture is not their responsibility (18-20). However, recent studies showed that active participation of orthopedic surgeons in the management of osteoporosis after a hip fracture improves treatment rates (21-23).

Through retrospective Jeju-cohort study at 2005, we found low rates of detection of osteoporosis (20.1%) and medication for osteoporosis (15.5%) in those who experienced hip fracture. This study was to determine the orthopedic surgeons’ awareness could increase the osteoporosis treatment rate after a hip fracture and the patient barriers to osteoporosis management. We prospectively followed 208 patients older than 50 yr who were enrolled for hip fractures during 2007 in Jeju-cohort. Thirty four fractures in men and 174 in women were treated at the eight hospitals. During the study period, orthopedic surgeons who worked at these hospitals attended two education sessions and were provided with posters and brochures. Patients were interviewed 6 months after discharge using an evaluation questionnaire regarding their perceptions of barriers to osteoporosis treatment. The patients were followed for a minimum of one year. Ninety-four patients (45.2%) underwent detection of osteoporosis by dual energy x-ray absorptiometry and 67 (32.2%) were prescribed medication for osteoporosis at the time of discharge. According to the questionnaire, the most common barrier to treatment for osteoporosis after a hip fracture was patients reluctance. The detection and medication rate for osteoporosis after hip fracture increased twofold after orthopedic surgeons had attended the intervention program. Nevertheless, the osteoporosis treatment rate remains inadequate.

Key Words: Hip Fractures; Orthopedic Surgeon; Osteoporosis; Treatment
management group and none management group, and 3) the patient barriers to osteoporosis management after a hip fracture.

MATERIALS AND METHODS

Participants in the study were drawn from a cohort that has been monitored from 2002 to 2007 for whom the incidences of hip fractures and mortality and morbidity rates were determined after hip fracture. This large cohort was recruited on Jeju Island, the largest island in Korea, which is located southwest of the Korean peninsula. In 2007, its population was 559,258. There are 8 hospitals (one university hospital and seven general hospitals) on the island with an orthopedic department and emergency admission facilities. Jeju island is geographically isolated from Korean peninsula and patients with hip fracture usually require hospitalization, which makes ascertainment of patient follow-up easier and much reliable than other areas. This prospective cohort study was performed using the same patient database at the eight hospitals as used in our 2007 study and the same inclusion and exclusion criteria (24). Two hundred twenty-seven patients older than 50 yr with hip fractures who were admitted to one of the 8 hospitals between January 1, and December 31, 2007 were candidates for the study. Nineteen patients were excluded for the following reasons: 14 for a high-energy injury resulting from a traffic accident or fall from height, 3 because they were nonresidents, and 2 because they had a pathologic fracture. A total of 208 patients with hip fractures (107 femoral neck fractures [51.4%] and 101 intertrochanteric fractures [48.6%] [34 men and 174 women]) was enrolled in this intervention study. The mean age of the patients at the time of diagnosis was 79.1 yr (men, 72.2 yr, range, 52-92 yr; women, 80.5 yr range, 52-97 yr). The most common coexisting medical conditions at admission were hypertension and heart disease, diabetes mellitus, depression and mental illness, previous stroke, and lung disease (Table 1). Of the 208 patients, 193 underwent surgery, but 15 did not. Five patients underwent nonoperative treatment for a nondisplaced fracture and 10 patients, confirmed to be high-energy x-ray absorptiometry. After hip fracture 93 (44.7%) had died by the final follow-up of 19 months. Six of 8 hospitals used DXA to determine bone mineral densities. The other 2 hospitals treated fewer than 5 hip fractures per year, and referred patients to another hospital for DXA.

Twenty-two orthopedic surgeons who worked at the 8 hospitals were provided with 2 education sessions (in January and July 2007) and educational posters (March) and brochures (October) for increasing osteoporosis management. These education sessions involved providing information regarding the association between osteoporosis and hip fracture, the efficacy of DXA for diagnosis of osteoporosis, the effectiveness of antosteoporotic drugs, and the importance of followup for management of osteoporosis and of routine orthopedic follow-up. All orthopedic surgeons who treated hip fractures in the cohort completed the educational programs.

Hospital data evaluations were performed 6 and 12 months after discharge from the hospital, and every 6 months thereafter. From the medical records we determined diagnosis at admis-

Table 1. Patient’s demographic data

| Parameters                                | Findings                      |
|-------------------------------------------|-------------------------------|
| Number of patients                        | 208                           |
| Man:Woman (16.3%):174 (83.7%)             |                               |
| Age (yr) (mean ± SD)                      | 79.1 ± 9.1 (range, 52-99)     |
| Mean period of hospital follow-up (months)| 8.8 (range, 1-24)             |
| Diagnosis of hip fracture                 |                               |
| Neck                                      | 107 (51.4%)                   |
| Intertrochanter                           | 101 (48.6%)                   |
| Management                                |                               |
| Conservative                              | 15 (7.2%)                     |
| Operation                                 | 193 (92.8%)                   |
| Coexisting medical disease                |                               |
| Hypertension and heart problem            | 84 (40.4%)                    |
| Diabetes mellitus                         | 35 (16.8%)                    |
| Depression and dementia                   | 32 (15.4%)                    |
| Previous stroke                           | 27 (13%)                      |
| Pneumonia and COPD                        | 18 (8.7%)                     |
| Cancer                                    | 6 (2.9%)                      |
| Others                                    | 18 (8.7%)                     |
| DXA                                       |                               |
| Prior to hip fracture                     | 7 (3.4%)                      |
| After hip fracture                        | 94 (45.2%)                    |
| Osteoporosis (T-score > 2.5)              | 93 (44.7%)                    |
| Osteopenia (1 > T-score > 2.5)            | 1 (0.5%)                      |
| Bisphosphonate medication                 |                               |
| Prior to hip fracture                     | 2 (1%)                        |
| After hip fracture                        | 67 (32.2%)                    |
| Duration of bisphosphonate medication     |                               |
| < 6 months                                | 25 (12%)                      |
| ≥ 6 months                                | 42 (20.2%)                    |
| Mean period of medication (months)        | 9.5 (range, 1-24)             |

SD, standard deviation; COPD, chronic obstructive pulmonary disease; DXA, dual energy x-ray absorptiometry.
sion, mechanism of injury, DXA, procedures performed during hospitalization, and discharge medications. Regardless of follow-up compliance, patients were asked 6 questions using a questionnaire format that addressed information provided by clinicians regarding osteoporosis, diagnosis of osteoporosis, osteoporosis medication, name of antosteoporotic medication, activity after hip fracture, and personal barriers to management of osteoporosis. Osteoporosis treatment was defined as medication including a selective estrogen receptor modulator, bisphosphonate, calcitonin therapy or hormone replacement. Seven of the 208 patients had a diagnosis of osteoporosis before hip fracture, but only 3 of these 7 were taking prescribed osteoporosis medications at the time of admission. Treatment initiation and duration were confirmed by reviewing medical records at 6 months and 12 months after discharge from hospital. Mortality status of the patients was identified from hospital records and/or interviews with patients’ families. Also, death certificates at the Statistics Korea were searched for information for patients lost to follow-up. For subgroup analysis, we analyzed demographic data between osteoporosis treatment group and nonosteoporosis treatment group.

The chi-square test was used to analyze mortality rate of osteoporosis management group and none management group, rate of osteoporosis detection, and initiation rate of osteoporosis treatment between 2005 cohort and 2007 cohort. SPSS, version 15.0 (Chicago, IL, USA), was used for the analysis.

Ethics statement
The design and protocol of this study were approved by the institutional review board at the Cheju National University Hospital (CNUH-IRB No 2008-19). Patients were informed that their medical data might be used in a scientific study and they provided consent.

RESULTS
In 2007 the rate of osteoporosis detection was greater \( P < 0.001 \) than that in 2005 (45% vs 20.1%) and the initiation rate of osteoporosis treatment also had increased (32.2% vs 15.1%) (Table 2).

Among the 22 orthopedic surgeons, who participated in this study, the physician’s detection rate and treatment rate increased in 15. Ninety-four patients (45.2%) underwent DXA during admission; hip and spine in 90, hip in 3, and spine in 1. Ninety-three of these 94 patients (99%) had osteoporosis (T score ≤ -2.5) and one had osteopenia (-2.5 < T score < -1). No patient received a DXA scan after hospital discharge during the study period. Of these 94 patients, 67 (71.3%) were prescribed only oral bisphosphonates (risedronate, 30/67 [43.5%], or alendronate, 39/67 [56.5%]) at the time of discharge. Other antosteoporotic drugs such as, selective estrogen receptor modulator, calcitonin, and hormone replacement therapy were not prescribed. Fourteen patients received once-a-day bisphosphonate and 53 received once-a-week bisphosphonate. The mean duration of time these patients were taking osteoporosis medication, was 9.5 months (range, 1-24 months), and 25 patients (37.3%) received medication for less than 6 months.

At last follow-up, the mortality rate was higher \( P = 0.044 \) in the nonmedicated groups (31/141) than in the medicated group (28/125). The median duration of time these patients were taking osteoporosis medication, was 9.5 months (range, 1-24 months), and 25 patients (37.3%) received medication for less than 6 months.

Table 3. Subgroup analysis between osteoporosis treatment group and nonosteoporosis treatment group

| Comorbidity          | Treatment group (n = 68) | Nontreatment group (n = 130) | \( P \) value |
|----------------------|--------------------------|-----------------------------|--------------|
| Hypertension and heart problem | 29 | 55 | 0.325 |
| Diabetes mellitus   | 10 | 25 | 0.325 |
| Depression and dementia | 14 | 18 | 0.325 |
| Previous stroke     | 12 | 15 | 0.325 |
| Pneumonia and COPD  | 6 | 12 | 0.325 |
| Cancer              | 2 | 4 | 0.325 |
| Others              | 6 | 12 | 0.325 |

Table 2. Comparison data of osteoporosis treatment after hip fracture or fragility fracture

| Author               | Study design     | Trial subject                     | Intervention | Outcomes (control) | Outcomes (intervention) |
|----------------------|------------------|-----------------------------------|--------------|--------------------|-------------------------|
| Cranney et al. [26]  | Prospective RCT  | PCPs and patients                 | Education    | BMD scan 26% (36/141) | BMD scan 53% (64/123) |
|                      | 2008             |                                   |              | Osteoporosis Tx 10% (15/146) | Osteoporosis Tx 28% (35/126) |
| Gardner et al. [21] | Prospective RCT  | PCPs and patients                 | Education    | BMD scan 17% (6/36) | BMD scan 33% (12/36) |
|                      | 2005             |                                   |              | Osteoporosis Tx 17% (6/36) | Osteoporosis Tx 28% (10/36) |
| Majumdar et al. [27] | Prospective RCT  | Physician and patients            | Education    | BMD scan 29% (32/110) | BMD scan 80% (88/111) |
|                      | 2007             |                                   |              | Osteoporosis Tx 22% (24/110) | Osteoporosis Tx 51% (56/110) |
| Mikli et al. [22]   | Prospective RCT  | Orthopedic surgeon and patients   | Education    | BMD scan 29% (7/24) | BMD scan 100% (26/26) |
|                      | 2008             |                                   |              | Osteoporosis Tx 29% (7/24) | Osteoporosis Tx 58% (15/26) |
| Streeten et al. [23] | Prospective design and retrospective review | Orthopedic team | Osteoporosis consultation | BMD scan 3.2% (1/31) | Osteoporosis Tx 52.8% (28/53) |
| Current study       | Prospective before and after study | Orthopedic surgeon               | Education    | BMD scan 20.1% (35/174) | BMD scan 45% (94/208) |
|                      |                  |                                   |              | Osteoporosis Tx 15.5% (27/174) | Osteoporosis Tx 32.2% (67/208) |

SD, standard deviation; COPD, chronic obstructive pulmonary disease.

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Our observations suggest the rate of detection and treatment of osteoporosis after a hip fracture among patients treated in our study was more than twofold greater than that in 2005. We used a simple, yet effective and easily applied intervention method in this study. Our study also highlights the importance of the orthopedic surgeon’s role as a first-line healthcare provider for patients with osteoporosis who have a fracture, because these patients regularly attend scheduled visits for radiologic and clinical evaluations after surgery. Interventions targeting clinicians with a view toward increasing treatment rates have been studied (22, 26, 27). Comparative studies conducted on orthopedic surgeon and physician-based interventions for improving osteoporosis management after hip fracture show awareness of orthopedic surgeon has a greater effect on osteoporosis management rates after hip fracture (20, 23). In particular, Miki et al. (22) reported the effects of osteoporosis management initiated by an orthopedic team and by primary care physicians (22). The osteoporosis treatment rate 6 months after hip fracture was higher for the orthopedic team (58%) than for the primary care physicians (29%) (22). Our study also showed an improved medication rate of osteoporosis from 15% to 32%. However, the osteoporosis treatment rate 6 months after hip fracture was still lower than those reported in other intervention studies (22, 23, 27).

In addition, even after the educational program, the physician’s detection rate and treatment rate of osteoporosis did not increase in seven (32%) out of the 22 orthopedic surgeons, who participated in this study. More effective educational campaign and reminiscence of osteoporosis treatment are warranted. This may have been attributable to the high mortality rate (10.6%) within the first 6 months and the high lost-to-follow-up rate (40%) in our study. However, of the 129 patients who were followed for more than 6 months, 32.6% (42/129) remained on osteoporosis medication. The other possible reason concerns differences between intervention modalities. In the current study, orthopedic surgeons only underwent education sessions, whereas previous studies have involved multimodal approaches, including nurse management programs, standardized algorithms, and monitoring of adherence to treatment (20, 22, 23).

Table 4. Survey questionnaire and response rates

| Question                                                                 | Response                          | Number (% of patients with medication (n = 56)) | Number (% of patients without medication (n = 81)) | Number (% of questionnaires (n = 137)) |
|-------------------------------------------------------------------------|-----------------------------------|-----------------------------------------------|--------------------------------------------------|---------------------------------------|
| Have you heard the diagnosis of osteoporosis from your doctor?          | Yes                               | 26 (46.4)                                     | 29 (35.8)                                       | 55 (40.1)                            |
|                                                                         | No                                | 30 (53.6)                                     | 52 (64.2)                                       | 82 (59.9)                            |
| Was bone mineral density examined at the hospital?                      | Yes                               | 25 (44.6)                                     | 24 (29.6)                                       | 49 (35.8)                            |
|                                                                         | No                                | 27 (48.2)                                     | 50 (61.7)                                       | 77 (56.2)                            |
| Have you received an antosteoporosis drug?                              | Yes                               | 40 (71.4)                                     | 0                                               | 40 (29.2)                            |
|                                                                         | No                                | 16 (28.6)                                     | 73 (90.1)                                       | 89 (60)                              |
| Why do not you start osteoporosis treatment?                            | Do not think it is a necessity    | 0                                             | 47 (58)                                         | 47 (34.3)                            |
|                                                                         | to treat osteoporosis             |                                               |                                                 |                                       |
|                                                                         | Economic reason(s)                | 0                                             | 4 (4.9)                                         | 4 (2.9)                              |
|                                                                         | Transportation problem(s)         | 0                                             | 4 (4.9)                                         | 4 (2.9)                              |
|                                                                         | Medical insurance problem(s)      | 0                                             | 1 (1.2)                                         | 1 (0.7)                              |
|                                                                         | Other(s)                          | 0                                             | 14 (17.3)                                       | 14 (10.2)                            |

(7/67). Age (P = 0.384), comorbidity (P = 0.325), and operation (P = 0.277) in osteoporosis treatment group was not different with nonosteoporosis treatment group. However, gender (P = 0.015) and diagnosis (P = 0.008) in osteoporosis treatment group was significant with nonosteoporosis treatment group (Table 3).

One hundred thirty-seven patients completed the face-to-face questionnaire-based interview. These included 56 patients who received osteoporosis medication and 81 patients who did not. Of these 137 patients, 82 (59.9%) were not informed of their diagnosis of osteoporosis by their surgeons and 49 (35.8%) were acknowledged having DXA examination during hospital admission. Forty (71.4%) of the 56 patients who received osteoporosis medication were aware of their diagnoses. Because of the 56 (69%) of the 81 patients with osteoporosis did not receive osteoporosis medication following reasons: 47 (84%) thought that treatment was unnecessary, four had economic reasons, four had a transportation problem, and one had a medical insurance problem (Table 4).

**DISCUSSION**

Treatment of osteoporosis after hip fracture is important to prevent secondary fracture and to decrease mortality rate. However, many studies have reported low rates of osteoporosis treatment after hip fracture. Improvement of the awareness of orthopedic surgeons concerning the importance of identifying patients with osteoporosis has shown definite benefit to overcome this issue (25). This prospective intervention study was performed to determine 1) whether an education program directed at orthopedic surgeons could increase the osteoporosis treatment rate after a hip fracture, 2) whether the difference of mortality between osteoporosis management group and none management group, and 3) the patient barriers to osteoporosis management after a hip fracture.

Our observations suggest the rate of detection and treatment of osteoporosis after a hip fracture among patients treated in 2007 was more than twofold greater than that in 2005. We used a simple, yet effective and easily applied intervention method in this study. Our study also highlights the importance of the orthopedic surgeon’s role as a first-line healthcare provider for patients with osteoporosis who have a fracture, because these patients regularly attend scheduled visits for radiologic and clinical evaluations after surgery. Interventions targeting clinicians with a view toward increasing treatment rates have been studied (22, 26, 27). Comparative studies conducted on orthopedic surgeon and physician-based interventions for improving osteoporosis management after hip fracture show awareness of orthopedic surgeon has a greater effect on osteoporosis management rates after hip fracture (20, 23). In particular, Miki et al. (22) reported the effects of osteoporosis management initiated by an orthopedic team and by primary care physicians (22). The osteoporosis treatment rate 6 months after hip fracture was higher for the orthopedic team (58%) than for the primary care physicians (29%) (22). Our study also showed an improved medication rate of osteoporosis from 15% to 32%. However, the osteoporosis treatment rate 6 months after hip fracture was still lower than those reported in other intervention studies (22, 23, 27). In addition, even after the educational program, the physician’s detection rate and treatment rate of osteoporosis did not increase in seven (32%) out of the 22 orthopedic surgeons, who participated in this study. More effective educational campaign and reminiscence of osteoporosis treatment are warranted. This may have been attributable to the high mortality rate (10.6%) within the first 6 months and the high lost-to-follow-up rate (40%) in our study. However, of the 129 patients who were followed for more than 6 months, 32.6% (42/129) remained on osteoporosis medication. The other possible reason concerns differences between intervention modalities. In the current study, orthopedic surgeons only underwent education sessions, whereas previous studies have involved multimodal approaches, including nurse management programs, standardized algorithms, and monitoring of adherence to treatment (20, 22, 23). Finally, the propor-
tion of patients in whom antiresorptive therapy is contraindicated also could have affected results (28). This shows that improving the awareness of orthopedic surgeons concerning the importance of identifying patients with osteoporosis is beneficial (25). Two intervention studies after hip fracture have reported improved osteoporosis treatment rates (17, 23). Intervention methods can be classified as a nationwide medical system, patient education, and doctor awareness. Patient education programs or systemic approaches generally are considered more effective. However, doctor’s awareness should be changed before performing studies of education programs or systemic changes for patients.

A high mortality rate, low follow-up rate, and the presence of life threatening comorbidities add to the difficulties of commencing osteoporosis treatment after a hip fracture in the elderly. However, the mortality rate of patients with osteoporosis medication in our study was lower at final follow-up than that of osteoporosis patients who did not receive medication. The randomized controlled intervention trial by Lyles et al. (16) showed that intravenous bisphosphonate reduces fracture rates and mortality. Our study also showed that these are benefits of osteoporosis medication after hip fracture. However, we could not evaluate reduction of recurrent fracture rate after osteoporosis medication because of high patient mortality, relatively small cohort size, and short follow-up duration. Nevertheless, other intervention studies have shown that osteoporosis medication after hip fracture can reduce recurrent hip fracture rates (15, 16).

The results of the patient questionnaire showed that patient education is required to encourage osteoporosis treatment after a hip fracture, because most patients were not given enough appropriate information by physicians or hospital staff either in the hospital or during follow-up. Furthermore, of the patients given osteoporosis medication, 23% could not recall their medication history or the name of the medication administered. Patients who did not receive osteoporosis medication thought commonly that such medication was unnecessary. Bogoch et al. (17) described four categories of barriers to treatment, namely, those associated with patients, physicians, orthopedic surgeons, and medical care systems. However, Kaufman et al. (25) described 10 different barriers to osteoporotic treatment after a hip fracture. Both studies emphasized the importance of the orthopedic surgeon’s role in overcoming these barriers.

Several limitations of this study should be considered. First, the medical care system in Korea is unique compared to that in other countries. All Korean nationals are legally obliged to enroll in the Korean National Health Insurance Program. Patients pay an average of 30% of all medical costs to clinics or hospitals that manage them for almost all diseases, except for those not covered by insurance, such as cosmetic surgery or some new unproven therapies, for which the patients themselves pay 100% of the total costs. All clinics and hospitals then submit data on inpatients and outpatients, including data on diagnosis and medical costs, to the Korean Health Insurance Review and Assessment Service to reimburse 70% of the total medical cost. In Korea, patients with fractures are routinely followed by orthopedic surgeons because there is no such primary-care-physician system in which patients can register with a physician who would be accountable for their continuing care and referral. Therefore, osteoporosis treatment for patients with a fragility fracture substantially depends on the responsible orthopedic surgeon (29). The findings of intervention studies regarding the effectiveness of intervention programs provided by orthopedic surgeons and primary care physicians are less likely applicable to Korean medical system (8, 22, 30). However, active participation of orthopedic surgeons in our study showed an increase of osteoporosis treatment after a hip fracture and improved outcome after that fracture. Second, this study was performed in various hospital settings in the same cohort, and two of the hospitals involved were not equipped with central DXA and referred their patients to another hospital for DXA study. Intervention studies that have investigated the treatment of osteoporosis after hip fracture involved one or two specific centers, and it is difficult to extrapolate results from other university and local hospitals. Third, 25 patients were lost in follow-up. For these patients, we were able to confirm only mortality at the Korea National Statistical office. Furthermore, these patients’ osteoporosis medication histories could not be confirmed. Fourth, the interventional education program was not validated. However, it specifically targeted overcoming barriers to osteoporosis detection, as described previously (9, 20, 23, 25). Fifth, we did not assess patient’s knowledge of osteoporosis prior to the intervention, which might have affected the rate of osteoporosis treatment after a hip fracture.

The straightforward, systematic approach described for the education of orthopedic surgeons increased osteoporosis diagnosis and treatment rates. Despite more than twofold increase in osteoporosis detection, observed between 2005 and 2007, additional intervention studies are required to further improvement of osteoporosis treatment rates after hip fracture.

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AUTHOR SUMMARY

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The osteoporosis detection and medication rate after hip fracture increased two fold after orthopedic surgeons had attended the intervention program. Nevertheless, additional efforts are required to further increase the treatment rates.