Osteoporosis Intervention Following Distal Forearm Fractures

A Missed Opportunity?

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Background: Fractures are a manifestation of osteoporosis, but therapeutic interventions to reduce the risk of recurrent fractures are not widespread.

Objective: To identify predictors of osteoporosis treatment in postmenopausal women following distal forearm fracture.

Methods: This population-based retrospective cohort study included all postmenopausal women, 45 years or older, residing in Olmsted County, Minnesota, who sustained a distal forearm fracture due to minimal trauma (a fall from standing height or under) in 1993 to 1997. Complete medical records were reviewed for each subject and Cox proportional hazards regression was used to evaluate the relationship of baseline demographic and clinical characteristics to therapeutic interventions for osteoporosis within 12 months following the fracture.

Results: A total of 343 women with a mean age of 70.5 years had a minimal trauma distal forearm fracture. Within 12 months, 83% had seen a nonorthopedic physician. Of these, 17% had a pharmacologic osteoporosis intervention and the 12-month actuarially estimated cumulative incidence of any intervention was 18% (95% confidence interval [CI], 14%-22%). In a multivariate analysis, treatment was more likely to be offered to those with a prior diagnosis of osteoporosis (relative risk [RR], 2.08; 95% CI, 1.21-3.58), previous distal forearm fracture (RR, 2.38; 95% CI, 1.30-4.34), or history of cigarette smoking (RR, 1.86; 95% CI, 1.11-3.12).

Conclusions: Effective osteoporosis interventions are underutilized among postmenopausal women who experience an osteoporotic fracture. Further work is needed to overcome barriers to optimal osteoporosis management in these women who are at high risk for future complications of osteoporosis.

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OSTEOPOROTIC fractures represent a serious and growing threat to our aging population.1 The cost of caring for individuals with these fractures was $13.8 billion in 1995,2 but since the population at risk of osteoporosis is so large,3 the potential cost of preventing these fractures is also great. Consequently, there is ongoing debate about the relative cost-effectiveness of various management strategies.4 It seems clear, however, that treatment of high-risk individuals is both cost-effective and socially important.5-7 Individuals who have already sustained a fracture are in a particularly high-risk group.8 Thus, men and women with a distal forearm fracture have a greatly increased likelihood of experiencing additional osteoporotic fractures in the future,9-12 including hip fractures that are quite costly.1 Since forearm fractures typically occur earlier in life than do hip fractures, it has been recommended for many years that interventions be targeted to this group.13-15 Several studies have confirmed that women younger than 65 years who sustain a distal forearm fracture have reduced bone densitometry compared with same-aged women without a fracture.16,17 Yet, few postmenopausal women are treated for osteoporosis following a distal forearm fracture12 despite the availability of antiresorptive agents that have been shown to be effective in preventing future fractures among those who have already experienced one.18-20 The objective of this study was to investigate the type of interventions for osteoporosis offered to a population-based cohort of postmenopausal women who had sustained a minimal trauma distal forearm fracture, placing them at high risk for future fracture, and to identify predictors of the likelihood of receiving such advice from physicians practicing in the community.
PATIENTS AND METHODS

Population-based epidemiologic research can be conducted in Olmsted County, Minnesota, because medical care is virtually self-contained within the community and there are relatively few providers. Through the resources of the Mayo Clinic and the Rochester Epidemiology Project, the details of almost all of the medical care provided to local residents are available for study.21 Using this unique medical records linkage system, we assembled a cohort composed of all postmenopausal women residing in Olmsted County who sustained a distal forearm fracture in the 5-year period 1993 to 1997. Women were identified using methods previously described.22 Following approval by the Mayo Clinic’s institutional review board, we reviewed the complete (inpatient and outpatient) medical records held by community providers of patients with any diagnosis coded to rubrics 813.4 and 813.5.23 Mayo Clinic records, for example, contain the details of every outpatient office or clinic visit, all emergency department and nursing home care, and all inpatient care at its 2 hospitals, as well as all laboratory results, radiographic reports, and pathology reports, including autopsies, and all correspondence with each patient.24 Record review was restricted to postmenopausal women aged 45 years or older at the time of fracture. Postmenopausal status was defined by the absence of menses for greater than 6 months, new identification of hot flashes, or age older than 55 years. We excluded women who were premenopausal at the time of their fracture and women younger than 55 years whose postmenopausal status could not be determined from the physician notes. We also restricted this analysis to the distal forearm fractures that resulted from no more than minimal trauma (by convention, a simple fall from standing height or under). All fractures were radiographically confirmed at diagnosis.

Information was then gathered on each patient with respect to their index fracture and potential predictors of osteoporosis treatment. We collected demographic data (age, race, and educational history), behavioral data (cigarette smoking and alcohol use), and a variety of clinical information including premature menopause (before age 40 years), type of menopause (natural or surgical) including hysterectomy status, use of hormone replacement therapy (HRT), height loss (> 5.08 cm since age 18 years), history of osteoporotic fractures (defined as distal forearm, proximal humerus, vertebral, pelvis, proximal femur, and distal tibia/fibula fractures24), family history of osteoporosis or other relevant family history (cancer, gynecologic malignancy, and coronary artery disease), and personal medical history (including coexisting comorbidities that might influence decisions about HRT such as coronary artery disease, dementia, or history of thromboembolic disease or malignancy), as well as other relevant exposures such as diabetes mellitus, peripheral vascular disease, and corticosteroid use. We reviewed all physician encounters following the index fracture, gathering information on physician specialty and sex as well as specific recommendations for osteoporosis interventions including medications and referral for bone mineral density testing. Bone densitometry measurements were made using dual-energy X-ray absorptiometry. We categorized treatment recommendations as follows: (1) new therapeutic advice, (2) documented review of existing therapies, or (3) ongoing use of osteoporosis medication, such as HRT, without documentation of any consideration of the fracture event or mention of osteoporosis intervention.

We used χ² statistics for discrete comparisons. The cumulative incidence of intervention (1 minus survival-free-intervention) and of nonorthopedist physician visits were projected for 12 months following the distal forearm fracture using product-limit life-table methods.25 Cox proportional hazards regression models were used to assess the influence of various risk factors (or predictors) on the review or advice to begin a pharmacologic intervention for osteoporosis within 12 months of fracture. A multivariate model was developed using the stepwise process, and interactions among the significant main effects were assessed.

RESULTS

Over the 5-year period (1993-1997), 409 Olmsted County women 45 years or older experienced a distal forearm fracture. Of these, 17 women were premenopausal at the time of their fracture and menopausal status could not be established for 4 others who were younger than 55 years. In addition, 42 women whose distal forearm fracture was caused by significant trauma (usually motor vehicle crashes, falls from greater than 0.9 m, or sports-related trauma) and 3 for whom the cause could not be determined with certainty, were excluded. This left 343 women for study whose fracture resulted from only minimal trauma, ie, a fall from standing height or under without a speed greater than walking. The mean age of the cohort was 70.5 years (range, 45-99 years) and the majority of fractures (66%) occurred in women older than 65 years. We found that 98% of the subjects were white, in keeping with the demographics of the county (95% white in 1990). Medical record documentation prior to fracture averaged 39.6±19.8 years (median, 39.7 years; range, 0-82 years). These patients were subsequently followed up through their medical records in the community for 1031 person-years (mean±SD, 3.0±1.7 years; median, 3.0 years; range, 1 day to 6.7 years). However, only the first 12 months of follow-up, after the index forearm fracture, were considered in this analysis (303 of the 343 women were followed up for a full 12 months after fracture).

Within the first 6 months, most women (68%) were attended by a physician other than the treating orthopedist and an additional 15% were seen 6 to 12 months after the fracture. The timing of the nonorthopedic physician visits is shown in the Figure. Altogether, 236 women were attended by a general internist or family practitioner, 14 by some other specialist (eg, gynecologist or endocrinologist), and 8 by both types of physicians, while 85 (25%) saw only an orthopedist in the 12 months following the fracture. Only 29% of treating community physicians were female. Despite contact with several physicians in the first year after fracture, only 100 women had any documentation of osteoporosis intervention or treatment advice during this time. The actuarially estimated cumulative incidence of any pharmacologic interven-
tion was 18% at 12 months (95% confidence interval [CI], 14%-22%) (Figure). Altogether, 40 women (12%) were advised to initiate pharmacologic treatment, while 18 others (5%) were already being treated with an osteoporosis drug and this therapy was reviewed in light of the fracture. Thirty-six other women (10%) were taking pharmacologic therapy, principally estrogen (94%), prior to their distal forearm fracture, but there was no documentation of any review of the situation following the fracture. Finally, 6 women (2%) were offered only nonpharmacologic advice (including calcium or vitamin D supplementation, or weight-bearing exercise) for prevention of osteoporosis and 28 received both nonpharmacologic and more potent pharmacologic therapeutic intervention. There was no treatment or treatment advice for 72% of the 243 women whose forearm fracture was the first that they had experienced nor for 67% of the 100 women with a recurrent distal forearm fracture (Table 1).

Fifty-four women were already receiving therapy for osteoporosis treatment or prevention prior to their forearm fracture (estrogen in 48, raloxifene in 5, and alendronate in 1). Among the 48 women who were receiving HRT at the time of their fracture, 35 (73%) were younger than 65 years and 13 (27%) were 65 years old or older (P<.001). There was no review of this therapy following fracture in 34 of these women; 8 had been taking therapy for osteoporosis, while 26 had some other indication for treatment (13 for menopause symptoms, 4 for prevention of heart disease, and 9 for unspecified reasons). Of the 14 women who had their ongoing HRT reviewed in the 12 months after fracture, 8 (57%) had their indication for use changed to osteoporosis treatment from a prior reason for use and 6 had the osteoporosis indication reinforced given the new fracture event. Despite the introduction of nonhormonal therapies for osteoporosis between 1995 and 1997, HRT remained the most frequently recommended therapy among the 40 women who received new treatment advice following their distal forearm fracture (Table 2). There were no significant differences in recommendations offered to women of different ages (P = .41).

We examined numerous factors that we believed might be related to the treatment advice provided following a minimal trauma distal forearm fracture. Since only 6 women received nonpharmacologic advice alone, and given the likelihood that preventive advice might have been given but not necessarily documented during the busy medical interaction, we restricted the proportional hazards regression models to consideration of pharmacologic advice that was either new or ongoing treatment that was specifically reviewed following the fracture. A large number of variables were not significant predictors of a recommendation for pharmacologic treatment as follows: age, ethnicity, loss of height (> 5.08 cm since age 18 years), premature menopause (before 40 years of age), type of menopause (natural or surgical), hysterectomy status, past HRT, family history of osteoporosis, other family history (cancer, gynecologic malignancy, or coronary artery disease), and personal medical history (diabetes mellitus, coronary artery disease, peripheral vascular disease, history of thromboembolic disease, dementia, history of malignancy, or corticosteroid use in the last 5 years) or alcohol consumption. Additional factors that were not significant included treating physician specialty and sex. The factors that were significant in univariate regression modeling were prior osteoporotic fracture, past distal forearm fracture, previous diagnosis of osteoporosis, prior estrogen use, greater than high school education, or ever cigarette use (Table 2).
These data demonstrate that evaluation of osteoporosis was not part of routine follow-up care after a minimal trauma distal forearm fracture in postmenopausal women. The actuarial cumulative incidence rate of any pharmacologic therapeutic recommendation in the 12 months following the fracture was a modest 18%. This was a considerable improvement from earlier years, when only 12 of 1414 women in this community who had a distal forearm fracture in the 20-year period (1975-1994) were started on HRT in the 12 months following fracture.\(^*\) The present study provides data from a 5-year population-based sample, with correlation to medical record information in which barriers could be identified. Other studies have reported similar results. In a study of 80 postmenopausal women who experienced a Colles fracture (the most common type of distal forearm fracture) in 1995 to 1996, only 8% received a pharmacologic intervention for osteoporosis.\(^*\) Pal et al\(^*\) surveyed 82 individuals (87% women) after a fracture that occurred in 1996 and found that only 34 (41%) reported receiving information about osteoporosis from their physician; 11% of the women received advice regarding estrogen and 15% were advised to begin a treatment with bisphosphonate. Similarly, Torgeson and Dolan\(^*\) studied 300 women, identified through the British General Practice Research Database, who had osteoporotic fractures in 1995 (100 hip, 100 wrist, and 100 vertebral), and found that only 5% who sustained a distal forearm fracture were receiving osteoporosis treatment 12 months after the fracture. In their study, only 4% who sustained a hip fracture and 39% who sustained a vertebral fracture received osteoporosis interventions after fracture. In a claims data study of 1162 women older than 55 years sustaining a distal forearm fracture from 1994 to 1997, Freedman et al\(^*\) reported that 24% of this sample filled a prescription for an approved osteoporosis medication. Kamel et al\(^*\) described very low rates of intervention even after medical consultation in a study of 170 hip fracture patients (in whom minimal trauma was the cause in more than 90%), in whom only 1% received osteoporosis pharmacologic intervention.

The choice of therapeutic interventions in this cohort was predominantly estrogen, whereas in other settings, the use of non-HRT agents has been more prominent. Cole and Paushock\(^*\) found that non-HRT treatment was more often used than estrogen for women with increased risk of fracture. Torgeson and Dolan\(^*\) showed that etidronate was the most commonly used treatment for individuals with vertebral fractures in the United Kingdom. Unfortunately, the benefit of HRT, the preferred choice among physicians and patients in this community, is lessened by the traditionally poor long-term compliance with this therapy.\(^*\) Data from clinical trials suggest that adherence for treatment with bisphosphonates and selective estrogen receptor modulators may be as high as 75%;\(^*\) however, it remains to be seen whether compliance will be as high in routine clinical practice.

Although hip and spine fractures are more commonly associated with the diagnosis of osteoporosis, low bone mineral density also predisposes to distal forearm fractures.\(^*\) In our cohort, only a small number (5%) had bone densitometry testing, but the majority (65% at the femur and 71% at the spine) of those tested had a T score below −1, which is considered by many to be a therapeutic threshold following a low-impact fracture.\(^*\) Indeed, 43% had a T score below −2.5 at the spine, which may actually underestimate the prevalence of osteoporosis as osteoarthritis can falsely elevate spine density readings. Other studies have similarly shown that women with dis-

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**Table 3. Predictors of Pharmacologic Interventions for Osteoporosis Offered Following Minimal Trauma Distal Forearm Fracture**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Univariate</th>
<th>Multivariate</th>
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<tbody>
<tr>
<td>Prior distal forearm fracture</td>
<td>2.67 (1.48-4.81)</td>
<td>2.38 (1.30-4.34)</td>
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<tr>
<td>Prior osteoporotic fracture</td>
<td>1.95 (1.16-3.28)</td>
<td>. . .</td>
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<tr>
<td>Diagnosis of osteoporosis</td>
<td>2.28 (1.34-3.88)</td>
<td>2.08 (1.21-3.58)</td>
</tr>
<tr>
<td>Ever cigarette smoker</td>
<td>1.73 (1.03-2.89)</td>
<td>1.86 (1.11-3.12)</td>
</tr>
<tr>
<td>Prior estrogen use</td>
<td>2.17 (1.28-3.66)</td>
<td>. . .</td>
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<tr>
<td>Higher than high school education</td>
<td>1.84 (1.08-3.14)</td>
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\(^*\)Data are given as risk ratio (95% confidence interval). Ellipses indicate not applicable.
tal forearm fractures have lower bone density than age-matched controls. More important, there is strong epidemiologic evidence that distal forearm fractures predispose to future fractures. In fact, pooled rates from several studies have shown a 3.3-fold increase in future wrist fractures, a 1.7-fold increase in future vertebral fractures, a 1.9-fold increase in future hip fractures, and a 2.4-fold increase for all nonspine fractures together. In our population, the risk of another distal forearm fracture was elevated 2.6-fold and the risk of a subsequent vertebral fracture was increased more than 5-fold.

In this study, the majority of clinical factors examined did not explain barriers to osteoporosis intervention or at least assessment after low-impact fracture. The factors that related to prior fracture, especially a prior distal forearm fracture, and previous diagnosis of osteoporosis were independent predictors. A higher level of education and history of cigarette smoking were also associated with a higher likelihood of receiving advice about osteoporosis after the minimal trauma index fracture.

In general, the occurrence of a distal forearm fracture did not appear to be routinely recognized by physicians or patients as a manifestation of osteoporosis and, therefore, did not commonly trigger a workup for osteoporosis. Since the primary outcome in this study was whether a discussion about osteoporosis took place after a low-impact trauma fracture, and some recommendations (such as calcium and vitamin D supplementation and exercise) may not be consistently recorded, we may have underestimated nonpharmacologic interventions. This study suggests that there is a deficit, but it is not clear where the barrier is, at the physician level or in the patient's willingness to accept this type of preventive therapy. This is not unique to distal forearm fractures, but is likely to be a problem with all postmenopausal women and elderly men who sustain any low-impact fracture. Indeed, a survey of orthopedists in Britain reported little attention to osteoporosis, and similar concerns have been raised by the American Society of Orthopedists who are considering the timeliness of intervention after fracture. Likewise, in the Third National Health and Nutrition Examination Survey, 17% of 2314 women had osteoporosis documented at the proximal femur, yet only 5% of these reported having been told by a physician that they had osteoporosis. Clearly, we need to further explore barriers to osteoporosis prevention in patients who have already sustained a low-impact fracture.

One way to lessen the impact of osteoporotic fractures on costs is to target individuals who are at highest risk, but it has proven a challenge to identify patients in whom the benefits of therapy are greatest and most cost-effective. Based on existing evidence, a consensus panel of experts from the National Osteoporosis Foundation developed treatment thresholds to facilitate management of postmenopausal women, addressing the impact of risk factors, including a previous low-impact fracture. Our aim is to improve awareness of the risk that a minimal trauma fracture carries. Elderly women who sustain a fracture may be more receptive than nonfracture patients to education about osteoporosis, and it is of utmost importance that these high-risk women receive appropriate evaluation and treatment for osteoporosis.

The responsibility should rest with any physician caring for the postfracture patient, especially those who are coordinating the care, managing the rest of the medical issues on a regular basis, and educating patients with respect to their health risks. Effective communication of therapeutic options is essential, since our patients may be reluctant to accept therapy that may carry some risk.

In addition, we need further investigation into the nature of physician and patient barriers to the provision of appropriate interventions following a minimal trauma fracture. Strategies need to be developed to improve the care of postmenopausal women after a fracture. Given the early opportunity when nearly 100% of patients are treated by the orthopedist, these strategies should be multidisciplinary, including diagnostic evaluations and close follow-up to assist patients to accept and adhere to the best therapy over time.

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REFERENCES
