Survey of spine surgeons on attitudes regarding osteoporosis and osteomalacia screening and treatment for fractures, fusion surgery, and pseudoarthrosis

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Received 11 August 2008; accepted 6 February 2009

Abstract

BACKGROUND CONTEXT: Osteoporosis and osteomalacia are significant risk factors for fracture and spine instrumentation failure. Low-energy fractures are becoming increasingly more common because of an increase in life expectancy and age of the population. Decreased bone density is an independent risk factor for instrumentation failure in spinal fusion operations.

PURPOSE: To assess the awareness and practice patterns of spine surgeons regarding metabolic bone disorders and osteoporosis with emphasis on fracture care and arthrodesis.

STUDY DESIGN/SETTING: Questionnaire study.


OUTCOME MEASURES: Respondent reported frequencies of diagnostics, screening, and treatment methods for patients with low-energy spine fractures, pseudoarthrosis, and those undergoing spinal arthrodesis.

METHODS: A ten-question survey was administered to orthopedic surgeons and neurosurgeons who treated spine fractures and degenerative spine conditions in their practice. The survey was given to those who were attending a continuing medical education spinal disorders conference. The survey asked about treatment patterns with respect to osteoporosis and osteomalacia workup and treatment for patients with low-energy spine fractures, pseudoarthrosis, and those undergoing spinal arthrodesis.

RESULTS: Of the 133 surgeons to whom the questionnaire was distributed at this meeting, 114 questionnaires were returned that corresponds to a response rate of 86%. Twenty-one surveys were excluded because of incomplete biographical information, resulting in a total of 93 completed questionnaires that were available for analysis. When treating patients with low-energy spine fractures, 60% checked dual-energy X-ray absorptiometry (DEXA) and 39% checked metabolic laboratories (vitamin D, parathyroid hormone [PTH], and calcium [Ca]). Before instrumented fusion, 44% of those queried checked DEXA and 12% checked metabolic laboratories (vitamin D, parathyroid hormone [PTH], and calcium [Ca]). Before noninstrumented fusion, 22% checked DEXA and 11% checked metabolic laboratories. Before addressing pseudoarthrosis, 19% checked DEXA and 20% checked metabolic laboratories.

CONCLUSIONS: Despite of the large number of elderly patients undergoing spine care and the high incidence of osteoporosis and/or osteomalacia in this population, a large portion of the spine surgeons who responded to the survey reported that they do not perform routine...
Introduction

Osteoporosis and osteomalacia are significant risk factors for fracture and spinal instrumentation failure because of decreased bone density [1–4]. Decreased serum vitamin D leads to increased bone turnover and bone loss of patients with known vertebral osteoporosis [5,6]. There is mounting evidence to suggest that large numbers of patients in the general population are vitamin D deficient or insufficient, sometimes reaching rates of up to 98% [7–9]. There is also a strong association between fracture risk and decreased serum vitamin D levels [10,11].

Low-energy fractures of the spine are the most common type of osteoporotic fractures in the human population [12]. The presence of a fragility fracture puts a patient at a disproportionately higher risk of another fragility fracture [13]. Compared with those without vertebral fractures, those with a vertebral fragility fracture, have a five times greater likelihood of fracturing another vertebra [13]. Despite increasing awareness of osteoporosis among patients and doctors there is still a gap in the number of patients who present with osteoporotic fractures and those who are treated for the underlying cause of their fracture [3,12,14–26]. The general awareness of osteomalacia among spine surgeons is also unknown. The spine surgeon who takes care of a patient at the time of presentation with a fracture is in a unique position to recognize pathologic fractures and institute proper therapy or referrals for definitive long-term fracture prevention care [14–16,19,20,22,27–29].

Spine fusion operations with instrumentation have become more common over the last few decades. Rates of osteopenia and osteoporosis in patients over the age of 50 undergoing spine surgery have been reported to be as high as 46% and 31%, respectively [30]. It has been well documented that bone mineral density (BMD) is one of the main factors related to spinal instrumentation failure. The ability of screws to resist pullout from bone is directly related to the BMD [1–3]. Pseudoarthrosis can result from inadequate fixation or stability, improper biologic environment, infection, or an underlying metabolic abnormality [31]. Little is known or documented about the role of metabolic bone disease (namely vitamin D deficiency and/or secondary hyperparathyroidism) and spinal pseudoarthrosis. Although not identical to fracture healing, fusion mass healing goes through stages of endochondral ossification and membranous bone healing [32,33]. There is strong basic science and fracture healing evidence that supports a role for metabolic bone health in the process of normal fracture healing and bone mineralization [34–39]. There is also evidence to suggest that metabolic and endocrine abnormalities may play a significant role in nonunion of long bones [40].

Spine surgeons who plan to perform spinal arthrodesis or who treat pseudoarthrosis need to be aware of all risk factors for failure to optimize patient outcomes. Osteoporosis and possibly osteomalacia may be key players in the success or failure of fusion surgery.

The purpose of this study is to assess the awareness and report practice patterns of spine surgeons regarding metabolic bone disorders and osteoporosis with emphasis on fracture care and spinal arthrodesis. It is important to understand spine surgeons’ opinions regarding screening and treatment of osteoporosis and osteomalacia with respect to commonly treated spinal pathologies.

Methods

Questionnaire development and administration

A ten-question survey was administered to orthopedic surgeons, neurosurgeons, and psychiatrists who treat spine fractures and degenerative spine conditions in their practice (Appendix A). The survey asked about treatment patterns with respect to osteoporosis and osteomalacia workup and treatment for patients with low-energy spine fractures, pseudoarthrosis, and those undergoing spinal arthrodesis.

The initial series of questions asked surgeons if they routinely obtain dual-energy X-ray absorptiometry (DEXA) imaging or metabolic bone laboratories (vitamin D, parathyroid hormone [PTH], and calcium [Ca]) in the following clinical situations—before performing an instrumented or noninstrumented fusion in a suspected osteoporotic patient; as part of a pseudoarthrosis workup; or for patients who present with vertebral compression fractures or low-energy odontoid fractures. The respondents were then asked to state their rationale for obtaining or not obtaining DEXA/metallic bone laboratories in each, particular clinical scenario. If the surgeon did not routinely order DEXA for vertebral compression fractures or low-energy odontoid fractures, they were further queried if they routinely refer these patients for additional osteoporosis workup.

The survey was given to those attending a continuing medical education spinal disorders conference. The questionnaire was distributed to all of the participants attending the nineteenth Annual “Contemporary Update on Disorders of the Spine” meeting (January 2007, Whistler, British
Columbia, Canada). Although this sample population was largely comprised of orthopedic and neurological spine surgeons, there were a limited number of physical medicine and rehabilitation physicians, psychiatrists, physician assistants, nurse practitioners, and radiologists who also completed the survey; however, any data provided by these respondents were omitted from the analysis. Without exception, all of the questionnaires were immediately collected on site.

Statistical analysis

The survey data were compiled in Excel spreadsheet files and statistical testing was performed in conjunction with SPSS software (SPSS 16.0, SPSS Inc., Chicago, IL, USA). Both descriptive and inferential statistical methods were included in this analysis. The study sample was described by calculating the frequencies and percentages for categorical variables, which were subsequently compared using Chi-square testing. Statistical significance was established at a two-sided alpha level of 0.05 (p < .05).

Results

Overview and population demographics

Of the 133 surgeons to whom the questionnaire was distributed at this meeting, 114 questionnaires were returned that corresponds to a response rate of 86%. Twenty-one surveys were excluded because of incomplete biographical information, resulting in a total of 93 completed questionnaires that were available for analysis. According to the biographical information that was collected, 66% of respondents were orthopedic surgeons and 34% were neurosurgeons; in addition, 71% of these individuals affirmed that they had completed a spine fellowship. Sixty-eight percent of this population indicated that they were currently working in a private practice setting, with the remaining 32% recording a primary affiliation with an academic institution. In general, this sample population was distributed

<table>
<thead>
<tr>
<th>Category</th>
<th>Frequency (%)</th>
<th>p-value</th>
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<tr>
<td>Instrumented Fusion</td>
<td>25</td>
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<tr>
<td>Non-Instrumented Fusion</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Pseudoarthrosis</td>
<td>10</td>
<td>0.005</td>
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<tr>
<td>Vertebral Compression / Odontoid Fracture</td>
<td>20</td>
<td>0.042</td>
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**Fig. 1.** Overall frequencies (%) of the utilization of dual-energy X-ray absorptiometry scans and metabolic bone laboratories.

Context

The presence of osteoporosis or osteomalacia may impact all aspects of spinal care. While education and awareness of these disorders of bone have likely improved over the years, this increased awareness on the part of spinal surgeons does not necessarily translate to an increase in their role in diagnosis and treatment.

Contribution

The authors have found that the spine surgeons participating in their survey often did not routinely aim to use DEXA scans or clinical laboratory tests to evaluate for osteoporosis/osteomalacia in cases where such diagnoses may be prognostically/therapeutically important.

Implications

Surveys, while not formally part of “evidence-based medicine,” are often used to examine the more social scientific aspects surrounding medicine. Whether those surveyed are a “representative” sample or whether the questionnaire is well constructed and/or validated, the response rate is an important consideration that readers must consider.

Certainly, this paper serves as a reminder for us to do what we can to ensure the best care of our patients; even if “best care” means simply referral to a specialist with greater experience in the diagnosis and treatment of bone disorders. One may also wonder if this paper suggests a progressive focus of spinal surgeons on surgical technique problems at the expense of basic patient care considerations.

—The Editors
relatively equally among the various cohorts in terms of the length of time in practice (29%, <5 y; 19%, 5–10 y; 19%, 10–15 y; and 32%, >15 y).

Compression vertebral compression fracture/low-energy odontoid fracture workup

Sixty percent of surgeons reported obtaining a DEXA scan for patients who presented with either a vertebral compression fracture or a low-energy odontoid fracture, whereas a significantly smaller percentage (39%) reported checking metabolic bone laboratories (p = .005; Fig. 1). Of the surgeons who reported not obtaining DEXA scans, 63% reported routinely referring these patients for osteoporosis workup. Surgeons in private practice were more likely to report obtaining DEXA scans compared with those in an academic practice (p = .025) but there were no significant differences noted between orthopedic surgeons and neurosurgeons. Fellowship training and the total duration of clinical practice also did not significantly affect the reported utilization of DEXA or metabolic bone markers.

Preoperative workup for fusions operations for patients with suspected osteoporosis

Before performing instrumented fusions, 44% of surgeons reported routinely obtaining DEXA if osteoporosis was suspected, whereas a significantly smaller percentage (12%) reported checking metabolic bone laboratory tests (p < .0001; Fig. 1). A similar trend was noted for noninstrumented fusions, as 22% of respondents reported that they obtain DEXA scans and 11% metabolic bone laboratory tests (p = .042). The difference in the frequency of surgeons who reported ordering DEXA scans before instrumented versus noninstrumented fusions was found to be significant (p = .002).

Neither were there significant differences observed in the reported use of either DEXA scans or metabolic bone laboratory tests between orthopedic surgeons and neurosurgeons, nor were there significant differences noted between surgeons in academic versus private practice. Fellowship training and the total duration of clinical practice also did not significantly affect the reported utilization of DEXA or metabolic bone laboratory tests. Of the surgeons who reported obtaining preoperative DEXA scans or laboratories, 74% did so because it altered their treatment or surgical plan and 53% did so because they would refer the patient for osteoporosis management before spinal arthrodesis.

Pseudoarthrosis workup

As part of a pseudoarthrosis workup, 19% surgeons reported routinely obtaining a DEXA scan, whereas 20% reported checking metabolic bone laboratory tests (Fig. 1). Although minimal differences were observed in reported utilization of DEXA or metabolic bone laboratory tests amongst most demographic groups, neurosurgeons were more likely than orthopedic surgeons to report obtaining metabolic bone laboratory tests (32% vs. 15%, respectively; p = .043). In addition, surgeons with less than 5 years of practice were less likely to report obtaining DEXA scans compared with surgeons with over 15 years of clinical experience (7% vs. 30%, respectively; p = .031). Sixty-three percent of surgeons who reported obtaining a DEXA scan or metabolic bone laboratory tests did so because it altered their treatment or surgical plan. Sixty-three percent of the respondents specified that they would refer the patient for treatment of osteoporosis before initiating surgical management.

Rationale for not checking metabolic bone laboratories

Of the surgeons who reported not routinely checking metabolic bone laboratory tests as part of a preoperative fusion, pseudoarthrosis, or compression/odontoid fracture workup, 33% stated that they did not think it would affect clinical management, whereas 24% said that the laboratory values did not actually treat osteoporosis. Seventeen percent of respondents reported that they were not sufficiently experienced in how to use metabolic bone laboratory test values in the clinical management of patients with osteoporosis.

Discussion

Fragility fracture

Multiple studies suggest that although the acute surgical care of fragility fractures in the United States is excellent, the postoperative medical management of patients’ underlying osteoporosis is quite poor [15,19–24,41]. Despite the extent of the problem, and emphasis on preventative medicine in today’s health-care climate, physicians who care for spine fractures frequently avoid intervening in the pathologic process [20]. A recent large study by Freedman et al. documented that 24% of patients who presented with a low-energy distal radius fracture had a DEXA or vitamin D and Ca ordered. Of this group, less than 3% had a DEXA ordered [19]. It has also been shown that the ordering of a DEXA scan by orthopedic surgeons correlated with increased treatment of patients with osteoporosis and osteoporotic fractures [12].

Awareness of these issues is mounting and government health-care quality standards are being shaped to reflect this. The Center for Medicare and Medicaid Services has recently established the Physician Quality Reporting Initiative, which links compliance with a financial reimbursement incentive. This set of reporting standards involves four categories that directly involve osteoporosis care and will be applied to spine surgeons who care for patients with fractures that are at risk for osteoporosis.

This study shows that 60% of spinal surgeons reported routinely obtaining a DEXA scan and 39% reported...
checking metabolic bone laboratory tests on presentation of a patient with a vertebral compression or low-energy odontoid fracture. Of the 40% of surgeons who reported not ordering a DEXA scan, 63% reported that they referred these patients for osteoporosis workup. Of the surgeons polled, a significantly greater number reported ordering DEXA compared with metabolic bone laboratory tests. There seems to be a decrease in the estimated utilization of metabolic bone laboratory tests, such as serum vitamin D, PTH, and Ca among the spine surgeons polled. Only 38% of surgeons reported ordering these laboratories. Of those who claim not checking metabolic bone laboratory tests in patients with low-energy fractures, about 57% remarked that the values would not aid in clinical treatment or that they would not help for osteoporosis. About 17% of those who reported not checking metabolic bone laboratory tests for fracture felt uncomfortable interpreting the results.

These findings and opinions warrant further investigation as it has been shown that there is a strong association between fracture risk and decreased serum vitamin D levels [10,11]. Decreased vitamin D levels have also been shown to cause decreased fracture strength and vitamin D supplementation can lead to increased amounts of fracture callous and callous strength during fracture healing [19,37,38]. Repletion of vitamin D and suppression of PTH at the time of fracture may reduce future fracture risk and facilitate fracture repair [42,43].

Based on recent reports in the literature, there is still significant need to improve compliance for osteoporosis and osteomalacia treatment. Multiple studies have focused on barriers to osteoporosis and metabolic bone workup and treatment among orthopedic surgeons. Surveys have found that most of the orthopedists feel an obligation to initiate a workup for a fragility fracture patient but many feel uncomfortable managing treatment and would like primary care physician input or complete management of these problems [27–29]. Additionally there seems to be some reluctance from both the patient and physician to actually assign a diagnosis of osteoporosis [23].

**Spinal fusion**

A recent study on patients over 50 years of age undergoing spine surgery found that among the male patients, 46.1% had osteopenia and 14.5% had osteoporosis. Among the female patients, there were 41.4% with osteopenia and 51.3% with osteoporosis [30]. The incidence of osteoporosis increased with increasing age and the study concluded that the rate of patients over 50 years old who are offered spine operations and who have osteoporosis is also increasing [30].

Vertebral bone quality may have a substantial impact on ability to obtain fusion following instrumented arthrodesis of the spine, particularly in elderly patients. Poor bone quality has been implicated in the failure of internal fixation constructs, as the fixation quality of a pedicle screw is dependent on the bone-screw interface and is positively correlated with BMD [44–46]. Inadequate purchase of the pedicle screw into the vertebral body may result in loosening of the screw, possibly leading to loss of deformity correction and/or nonunion.

In this study, 44% of surgeons reported obtaining DEXA scans before instrumented fusions, whereas significantly fewer respondents reported obtaining DEXA before noninstrumented fusions (22%). Of the surgeons who reported obtaining preoperative DEXA scans and/or metabolic bone laboratory tests, 74% did so because they said it altered their treatment or surgical plan. Of the surgeons who reported obtaining preoperative DEXA scans or metabolic bone laboratory tests 53% reported that they would refer the patient for osteoporosis management before spinal arthrodesis. Some respondents also remarked that they preferred to perform noninstrumented fusions in patients who had DEXA proven osteoporosis.

It should be noted that while osteoporosis treatment is unlikely to cause significant gains in bone mass in the short- or long-term, the treatment of underlying metabolic bone disorders such as vitamin D deficiency can typically be performed in 6 to 12 weeks. With proper treatment patients can have secondary hyperparathyroidism reversed and can have a high bone turnover state normalized in a relatively timely fashion. Thus, a patient’s generalized state of high bone turnover that exists when a patient has secondary hyperparathyroidism can be improved and may be a desired scenario before undergoing elective spinal fusion.

There was also a significant difference between the number of physicians who use DEXA versus metabolic bone laboratory tests in the preoperative workup of fusion patients. This again highlights that there may be a greater comfort level on acceptance of DEXA and the information that this test provides, compared with metabolic bone laboratory tests for spine surgeons. The respondents commented that these laboratories may not alter their treatment plan or they are not comfortable with interpretation and utilization. Based on this survey it appears that there is more comfort among spine surgeons with the use of DEXA scans in the preoperative screening of patients slated for spinal arthrodesis. There also appears to be no widely accepted consensus that workup for osteoporosis or osteomalacia is necessary for preoperative fusion patients.

**Pseudoarthrosis**

Although vertebral bone quality may affect the efficacy of internal fixation in spinal arthrodesis, osteoporosis has also been postulated as a discrete risk factor in the development of pseudoarthrosis. Okuyama et al. reported that the mean BMD of patients with union was found to be significantly greater than those with nonunion after spinal fusion [47]. It is conceivable that the limitations in the quality of autograft, in addition to inadequate screw purchase and potential instrumentation failure, may place the osteoporotic patient at a higher risk of pseudoarthrosis. Limited reports have claimed that there is little relationship between
pseudoarthrosis and metabolic bone health [48]. One study reported that 14 of 24 pseudoarthrosis patients had decreased BMD but the authors were unable to show a causative relationship between osteoporosis, metabolic bone disease, and pseudoarthrosis [48]. There is mounting evidence to suggest that unexplained long bone nonunions may be at least partially attributable to metabolic or endocrine abnormalities. Brinker et al. reported on a series of 37 patients who met one of the three criteria: 1) history of unexplained long bone nonunion; 2) history of multiple low-energy fractures currently with a nonunion; or 3) history of pubic ramus or sacrum nonunion. These patients were selected from a consecutive series of 683 patients with nonunion. They found that 31 of 37 of these patients had an endocrine or metabolic abnormality, the most common of which was vitamin D deficiency [40]. It is not known how many more patients within the original 683 patients may have had endocrine or metabolic abnormalities. But it is possible that even those patients who did not meet one of the above criteria also had metabolic deficiencies.

Our study found that only 19% of surgeons reported routinely obtaining DEXA and 20% reported checking metabolic bone laboratory tests for pseudoarthrosis workup. Approximately 80% of spine surgeons polled appear to not consider osteoporosis or osteomalacia workup to be a routine part of a pseudoarthrosis workup. Surgeons in this study may have had reason to suspect that other risk factors such as smoking or medical comorbidities, rather than osteoporosis, were more likely to be responsible for the development of pseudoarthrosis in their patient populations, although the survey was not able to fully elucidate this point.

The only significant differences in demographics for pseudoarthrosis workup were that neurosurgical spine surgeons reported ordering DEXA and metabolic bone laboratory tests more often than orthopedic spine surgeons and those who were in practice more than 15 years were more likely to do so compared with those in practice for 1 to 5 years.

There are several limitations to this study. Because this questionnaire required participants to assess their own practice patterns, their responses may be subjected to a recall bias, which may affect the accuracy of these results. It is also conceivable that our analysis may be confounded by a selection bias because a large proportion of the surgeons were fellowship-trained (71%) and were affiliated with academic institutions (32%) so it is unclear whether these data truly reflect the opinions and preferences of the spine community at large.

Although the orthopedic or neurosurgical spine surgeon is not often considered the typical person to practice preventative medicine because he or she often has limited and nonsustained encounters with patients, he or she is often in the best position to recognize the need for intervention and referral. The ultimate goal in the treatment of fractures and for fusion is to get them to heal as quickly as possible. Therefore, optimizing bone health should be considered for the spine specialist who treats fractures, performs fusions, and treats pseudoarthrosis. Screening tools such as DEXA and metabolic bone laboratories, and treatment modalities such as supplementation with appropriate levels of vitamin D and Ca, can be a key element in the process. It is apparent by this survey study that attitudes regarding these statements are variable. It appears that the spine surgeons polled felt that the biggest role for osteoporosis/osteomalacia screening and treatment is for patients with fragility fracture. Although many reported that they do not consider this a routine part of their practice, fewer surgeons reported utilization of osteoporosis/osteomalacia screening and treatment for preoperative spine fusion patients and even less considered it for patients with pseudoarthrosis.

In future studies it may be interesting to see how physicians approach more specific clinical scenarios. It may also be interesting to see how gender of the patient plays a role in physician workups and how patient age, comorbidities, and medications play a role in preoperative screening and treatment.

References


Appendix A

Osteoporosis Questionnaire Whistler 2007

1. Do you routinely check DEXA before doing a fusion operation if you suspect osteoporosis? (please answer “a” and “b” separately)
   a. Instrumented fusion? (Y/N)
   b. Noninstrumented fusion (Y/N)

2. Do you routinely check metabolic bone laboratories (vitamin D, PTH, and Ca) before doing a fusion operation if you suspect osteoporosis? (please answer “a” and “b” separately)
   a. Instrumented fusion? (Y/N)
   b. Noninstrumented fusion (Y/N)
3. Do you routinely check DEXA as part of a pseudoarthrosis workup?

4. Do you routinely check metabolic bone laboratories (vitamin D, PTH, and Ca) as part of a pseudoarthrosis workup?

5. Do you routinely order DEXA for patients who present with vertebral compression fractures or low-energy odontoid fractures? (Y/N)

6. If you answered “No” to question 5, do you routinely refer these patients for osteoporosis workup? (Y/N)

7. Do you routinely check metabolic bone laboratories (vitamin D, PTH, and Ca) for patients who present with vertebral compression fractures or low-energy odontoid fractures? (Y/N)

8. If the answer to question 1 or 2 was “yes”, please give a reason
   a. It alters my treatment or surgical plan (how?)
   b. I refer the patient for osteoporosis treatment first
   c. ————

9. If the answer to question 3 or 4 was “yes”, please give a reason
   a. It alters my treatment or surgical plan (how?)
   b. I refer the patient for osteoporosis treatment first
   c. ————

10. If the answer to any of questions 2, 4, or 7 was “no”, please give a reason
    a. I do not know what to do with them
    b. I do not treat those problems
    c. I do not think it would help