Utility of Serial Vertebral Fracture Assessment

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ABSTRACT

Guidelines have recently been published for initial performance of Vertebral Fracture Assessment (VFA), but little is known regarding the frequency or clinical indications for repeat or "serial" VFA examination. As such, the purpose of this study was to investigate the utility of serial VFA in men. Between January 2004 and October 2006, 1600 male veterans had VFA performed utilizing the indications for initial VFA in conjunction with their clinically-indicated DXA exam at a VAMC; 350 had a follow-up VFA using the aforementioned guidelines. Of these, 75 men have had 3 VFA exams; 11/75 (14%) have had new vertebral fractures identified on subsequent exams, while for the other 86% fracture diagnosis remained stable (whether they had a fracture identified on the initial VFA or not). None of the 11 men with new vertebral fracture experienced a clinical non-vertebral fracture over this same time period. The new fracture group and the group with stable fracture status were similar in their demographics, lifestyles, medical background and ethnicity at first and third VFA. As could be expected, femoral neck and total femur BMD was lower ($p < 0.05$) in the new fracture group. Height loss was numerically, but not statistically ($p = 0.56$) greater in the group with new fracture. In this small cohort, the use of oral glucocorticoids and/or bisphosphonates did not differ between groups. In conclusion, lower BMD, low back pain, recent history of low trauma fracture and greater spine deformity index may prove to be reasonable indications for serial VFA in men, however larger studies are required to further evaluate its utility.

INTRODUCTION

For both men and women, vertebral fractures adversely affect quality of life. Moreover, the presence of a prior vertebral fracture is a strong independent risk factor for future vertebral and non-vertebral fractures. As such, knowledge of vertebral fracture status is important for fracture risk estimation. VFA offers advantages over spinal radiographs including lower radiation exposure, patient convenience, cost effectiveness and ease of directly integrating knowledge of bone density and fracture status into prediction of future fracture probability.

Though guidelines for performance of initial VFA are published, there is limited knowledge regarding when and how often follow-up VFA should be performed. Therefore, this study investigated the utility of serial VFA in a population of men referred for clinically indicated bone density measurement who have also had three serial VFA exams. Additionally, the applicability of height loss, BMD and spine deformity index (SDI) as potential indications for performing follow up VFA in men were explored.

METHODS

Subjects and Study Design

- 1600 men referred for clinically indicated bone mass measurement and for whom VFA was indicated at the Wm. S. Middleton VAMC between February 2004 and October 2006
- Applying published indications for VFA performance, VFA was obtained on 75 men at 3 timepoints (Scan 1, 2 and 3)
- Medical histories were obtained by the DXA technologists prior to scanning
- Height and weight measurements were done in stocking feet using a Heightronic™ stadiometer and a SRScales™ scale, respectively (QuickMedical, Snoqualmie, WA)
- This study was evaluated by the University of Wisconsin Health Sciences IRB and determined to be exempt from formal IRB review

Data Acquisition

- Two ISCD-certified technologists performed all examinations using a GE Healthcare (Madison, WI) Lunar Prodigy densitometer
- Acquisition and analysis of the lumbar spine, proximal femur, distal radius and VFA were performed in routine clinical manner using software versions 9.0, 9.1 or 9.3
- Occasionally a right decubitus position was utilized if the patient was unable to lie on his left side or to enhance vertebral visualization
- One clinician interpreted all DXA and VFA scans using the Genant visual semi-quantitative approach to identify fractures; vertebral morphometry was not performed
- World Health Organization (WHO) classification system was applied
  - Osteoporosis: T-score ≤ -2.5
  - Osteopenia: -2.5 < T-score < -1.
- Diagnostic categorization determined by the lowest T-score at the L1-4 spine, femur neck, total femur or 1/3 radius and the manufacturer's male normative database

Statistical Analysis

- Numerical data (height, weight, BMI, historical height loss, BMD and SDI) analyzed using Student's t-test (Microsoft Excel)
- Ordinal data (medical and fracture history, steroid and bisphosphonate use, osteoporosis diagnosis) analyzed using Chi-square and Fisher's exact test with StatsDirect software (Cheshire, UK)

RESULTS

Fracture Groups

- New Fracture group: 11 men had a fracture identified on VFA at visit 2 or 3 that was not identified on scan 1
- Stable Fracture group: 64 did not have any new fractures identified on scans 2 or 3 that were not present on scan 1

Demographic/Historical Data

- Age and BMI did not differ between the new fracture and stable fracture groups (Table 1)
- Historical factors including ambulatory status, falls, tobacco/alcohol use, transplantation and fracture after age 50 did not differ between the new fracture and stable fracture groups (Table 1)
- Height loss from the time of VFA 1 to VFA 3 was numerically, but not statistically greater in those with new fracture (Table 1)
- Use of oral glucocorticoids and/or bisphosphonates did not differ between the new and stable fracture group (Figure 1)

Relationship of BMD, Age and New Fracture

- Though over half of new fractures occurred in men over age 70, neither age nor BMD reliably identified those in whom new fracture would occur (Figures 2 and 3)

Relationship of SDI and New Fracture

- At baseline, the mean SDI was numerically, but not statistically higher in those who sustained new fracture (Figure 4)

Table 1: Lifestyle and Medical History

Characteristic	New Fracture on Follow -up VFA (n = 11)	No Change in Fracture Status (n = 64)	P-value
Age at VFA 1; mean (range)	69.1 (53.5 - 83.7) years	65.6 (31.6 - 89.0) years	NS
BMI at VFA 1; mean (range)	27.2 (22.4 - 37.1) kg/m^2	27.8 (17.5 - 46.5) kg/m^2	NS
Non-ambulatory	2 (19%)	15 (23%)	NS
Falls Before VFA 1	4 (36%)	9 (18%)	NS
Greater than 20 Pack Year Tobacco History	5 (45%)	23 (36%)	NS
History of Alcohol Abuse	1 (9%)	3 (5%)	NS
Solid Organ Transplant	4 (36%)	18 (28%)	NS
Fracture After Age 50	4 (36%)	28 (43%)	NS
Oral Steroid Use	4 (36%)	41 (64%)	NS
Bisphosphonate Use	7 (64%)	32 (50%)	NS
Low Back Pain at VFA 1	5 (45%)	14 (22%)	NS
Low Back Pain at VFA 3	6 (55%)	16 (25%)	0.03
Height Loss from VFA 1 to 3 (range)	0.6 (-0.4 to 5.4) inches	0.2 (-0.4 to 1.9) inches	NS

FIGURES

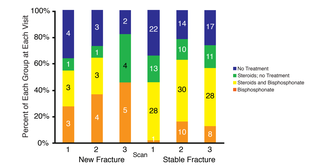

Figure 1: ***Glucocorticoid and Bisphosphonate Use.*** Use of oral glucocorticoids was common in this group of men (36% of those with new fractures and 64% of those with stable fracture status; NS). Similarly, bisphosphonate use was common with 65% of men with new fracture and 50% of the stable fracture group (NS) receiving treatment.

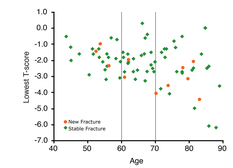

Figure 2: ***Effect of Age and BMD at Time of First VFA on Fracture.*** In this cohort, those men with lower BMD and older age appear visually to be more likely to develop new fracture in that over half (54%) of the group were age 70+. However, there was no difference in osteoporosis diagnosis ($p = 0.19$) between those with new fracture and those with stable fracture status.

FIGURES

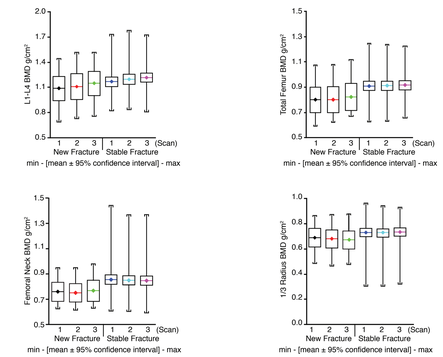

Figure 3: ***Effect of BMD on Subsequent Fracture.*** The mean BMD was numerically lower at all skeletal sites among those men who sustained a new fracture and statistically so ($p < 0.05$) at the femur neck and total femur. Data as mean, 95% confidence interval and range.

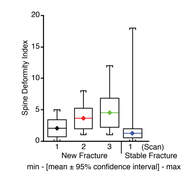

Figure 4: ***Effect of Spine Deformity Index (SDI) on Incident Fracture.*** Higher SDI is associated with higher fracture risk. In this study, SDI was greater ($p = 0.01$) at the second and third VFA in men with new fractures identified than among those in the stable group. As would be expected, the fracture group SDI is higher at the subsequent scans, while the stable fracture group SDI does not change. Note that the one man with a SDI of 18 acquired multiple fractures at an early age from trauma. Data as mean, 95% confidence interval and range.

SUMMARY

- Which patients should receive serial VFA studies has received little evaluation.
- In the cohort with new fracture, total femur and femur neck BMD was lower and spine deformity index was greater.
- However, some individuals with advanced age, very low BMD and high SDI did not sustain new fracture.
- These results are limited by sample size. Further study to determine the utility of serial VFA is indicated.
- Until further data are available, the ISCD Official Position to "Consider VFA when the results may influence clinical management" seems appropriate for both initial and subsequent VFA.