Novel Safe Functional Motion Test Can Discriminate Risk for Vertebral Fracture in Men and Women Independent of Bone Density and Age

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Rationale for Research

Osteoporosis assessment requires a comprehensive approach.
- Standard methods of fracture risk include bone density measurement and risk assessment tools such as FRAX.[1-2] FRAX cannot be used with patients taking bone protecting medication. And, neither method addresses impaired physical performance variables such as spine loading or fall risk, which are critical to understanding fracture risk.[3-5]
- The mechanical event of a fracture occurs when loads applied to bone exceed bone strength.[6] Since a fracture event occurs with the course of everyday activity, it is important to examine behaviors that contribute to such an event including spine loading, imbalance, muscle weakness and impaired joint mobility in the context of functional activity.

Background

The Safe Functional Motion (SFM) test, a subtest of the Bone Safety Evaluation (BSE), is a physical performance measure and was developed to identify and support immediate management of risk behaviors and physical performance impairments (such as spine loading and imbalance).[7-8] The SFM comprises six domains of function: spine loading, balance, upper and lower body strength, and upper and lower body flexibility. Performance across domains is measured by observing tasks of everyday living. Testing takes approximately thirty minutes. Scores on tasks and relevant domains are totaled and divided by maximum expected performance to calculate final SFM score (Table 1). The aim of the present study was to examine the discriminative validity of the SFM for vertebral fracture (VF) prevalence.

Methods

Data collected from 2004 to 2009 from the United Osteoporosis Centers' (UOC) database were examined. Consenting patients age 40 and over with a complete SFM test were included in the analysis (n=1339). Indication for SFM test included any known osteoporosis risk factor. A higher SFM score indicates the patient is safer with movement, avoiding risk behaviors such as excessive spine loading, imbalance, muscle weakness or reduced flexibility. A multiple logistic regression analysis was performed to examine the significance of age, gender, femoral neck BMD (fnBMD) and SFM score on presence of vertebral fracture.

Results

Age, gender, and fnBMD were significantly associated with VFs. Older patients were significantly more likely to present with vertebral fractures than younger patients (p=0.0015;OR=1.225 for every 10 year increase in age). Patients with higher fnBMD scores were less likely to present with VF than patients with lower fnBMD scores (p<0.0001;OR=.774 for each .10 increase in fnBMD). The odds of having a prevalent VF were more than two times higher for males than for females (p<0.0001;OR=2.414). Furthermore, SFM was significantly associated with VFs, even after adjusting for age, gender, and fnBMD. Patients with higher SFM scores ("safer") were less likely to present with VF than patients with lower SFM scores (p<0.0001;OR=.826 for each 10 point increase in SFM score). Demographic Characteristics are included in Tables 1 and 2. Figures 1-3 present predicted probabilities from a logistic regression analysis of having a vertebral fracture, along with the 95% confidence intervals, for each of age, SFM score, and femoral neck BMD, by gender.

Table 1: SFM Final Score Calculation (Example Patient)

SFM TASKS	Spine Loading		Balance		UB Strength		LB Strength		UB Flexibility		LB Flexibility		SFM Total
Pour	1	3	4	4	2	2							
Footwear	1	1									1	1	
Newspaper	0	1	2	2							1	1	
Reach-Lift	1	1	2	2			1	1					
Sweep*	1	1	2	2									
Washer*	1	1							1	1			
Dryer*	2	2			2	2	1	1	1	1	1	2	
Sit to Floor	0	1	2	3			1	1			2	2	
Carry-Climb	2	2	6	6	2	2	1	1	1	1			
Night Walk			1	4			1	2					
Patient Total	9		19		8		4		4		5		49
Denominator Total		13		23		8		6		4		6	60
SFM Final	SFM Patient Total / SFM Denominator Total												82%

*Denotes optional tasks. If task is not a role for patient, the task points are removed from the denominator

Table 2: Demographic Statistics

Demographics	N (%) or Mean ±SD
N	1339
Female	1215 (90.74%)
Male	124 (9.26%)
Age	69.09 ± 10.9
Fracture Prevalence	**N (%)**
Vertebral Fracture Frequency	450 (33.61%)

98% of the population was Caucasian, 2% included Asian, African American, Hispanic, American Indian or other

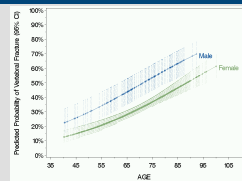| BMD/ T-score	N	Mean	Min	Max
fnBMD (gm/cm²)	1339	0.74 ± 0.13	0.32	1.29
spineBMD (gm/cm²)	1329	0.97 ± 0.2	0.01	1.92
fnT-score	1337	-1.55 ± 1.10	-4.50	3.42
spineT-score	1325	-1.79 ± 1.58	-5.83	5.9

Figures 1-3: Fracture Probability

Figure 1: Predicted Probability of Vertebral Fracture by Age and Gender
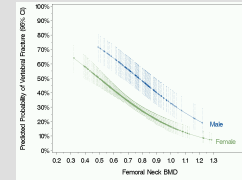

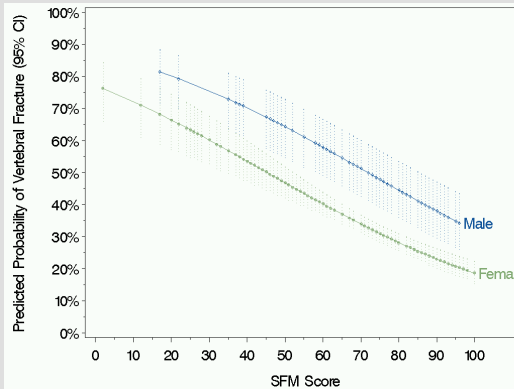Figure 2: Predicted Probability of Vertebral Fracture by Femoral Neck BMD and Gender

Figure 3: Predicted Probability of Vertebral Fracture by SFM Score and Gender

Limitations

Limitations of this study include fewer males represented in the sample and all patients in this study were patients referred to an osteoporosis clinic.

Conclusions

SFM score was a predictor of fracture independent of fnBMD and age.
- Bone density and age are accepted and important fracture risk factors. These findings suggest that evaluating physical performance with the SFM is a relevant method for assessing risk for fracture that is independent of a patient's fnBMD and age.

Significantly more males presented with VF than females.
- This may be due to the higher acuity level of the males who eventually seek consultation at UOC. The fracture and osteoporosis related acuity level of patients is elevated at UOC as evidenced by one third of patients presenting with a vertebral fracture, and 50% of patients presenting to the clinic while on bone protecting medication.

Study findings support the use of the SFM as a valid method to identify patients who are more likely to have VF.
- In a population of patients with known fracture risk, the SFM test (along with age, gender and fnBMD) can discriminate patients with or without VF.
- The SFM is a domain-weighted assessment that examines strength and flexibility while placing a stronger emphasis on spine loading and balance for prediction of fracture risk. These domains represent everyday physical performance risks for the patient with osteoporosis and may be measuring the underlying factors contributing to fracture.
- The SFM equips the clinician with a validated assessment of physical performance for the patient with osteoporosis.

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