A Novel Performance-Based Measure Of Functional Risk For Osteoporotic Fracture Has Excellent Reliability And Good Convergent Construct Validity

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Rationale for Research

Addressing the complex issues associated with osteoporosis requires a comprehensive approach.

- Bone density (BMD) is not the only factor contributing to fracture risk. Leading bone health treatments such as bisphosphonates reduce fracture risk between 40-70% (assuming compliance with medications as is typical in clinical trials) and can take up to 3 years to have fracture risk protection.[1-6]
- Over the last decade research confirms there are risk factors independent of BMD that contribute to fracture risk. Some of examples are: oral steroid use, prior vertebral fracture and parental history of hip fracture. Fracture risk scores, such as FRAX, address these clinical risk factors and BMD scores, but do not address spinal loading and falls, which are also critical factor in understanding fracture risk.[7-8]
- Since fractures are mechanical events that occur when an applied load to the bone exceeds bone strength, it is important to understand loading behavior as a part of daily, functional activity (see Figure 1).[9]

Background

There are few performance-based tests of mobility and function for older adults. Typically these are timed measures and loads on the spine from typical daily activity are not considered. Thus these are not ideal for identifying functional risk for osteoporotic fracture. The Bone Safety Evaluation (BSE) was developed to provide a comprehensive assessment of individuals with low bone mass, to identify risk behaviors and functional performance deficits associated with fracture risk and to be helpful in making decisions regarding treatment for osteoporosis. A component of the BSE is a performance-based test, the Safe Functional Motion (SFM) test, comprised of 10 tasks which older adults typically do every day. The tester uses standardized verbal instructions and requests the patient to perform each task as they normally would at home. Six different domains (spinal loading, balance, upper limb flexibility, lower limb flexibility, upper limb strength, lower limb strength) are rated on an ordinal scale according to observed performance to generate a score between 0 and 60. As a first step, the measurement properties of the SFM need to be established.

Methods

Test Retest Reliability

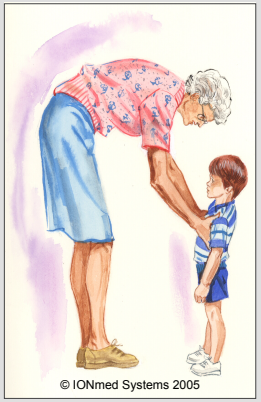
For test-retest reliability, 29 older adults with low bone mass were recruited from the northeast Georgia area. Performance on the SFM was rated by a single tester on two occasions between 3-7 days apart. Reliability of the total score and each domain was determined using the type 2,1 intraclass correlation coefficient (ICC) and standard error of the measurement (SEM).

Convergent Construct Validity

Convergent construct validity was assessed using the Spearman rho correlations of the SFM total score and each comparable domain with the total score from the Physical Performance Test (PPT), a performance based test of function for older adults.[10] Thirty-one subjects recruited from the same site.

All statistical analyses were conducted using SPSS version 16.

Figure 1



Example of a spine loading activity that patients with osteoporosis should avoid.

Table 1

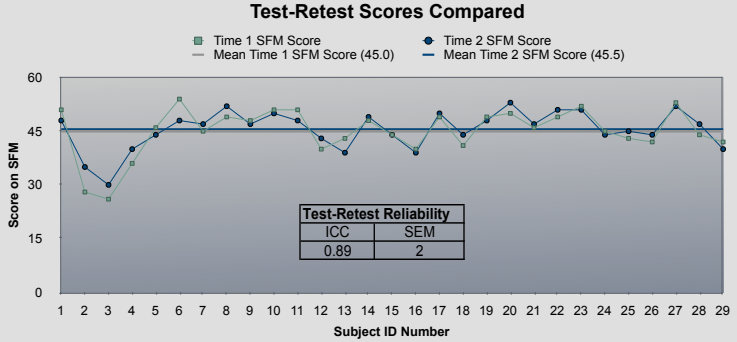
PPT Total /SFM Domain Correlation Summary

Domain	Correlation	Comments
Spine Loading Domain	-0.001	No relationship found. There are no assessments that examine behavior associated with spine compression. The lack of correlation here demonstrates that this domain may be measuring a different construct
Balance Domain	0.638***	A moderate correlation was found demonstrating the balance constructs measured by the BSE and the PPT may be similar. BSE and PPT address dynamic balance components.
Upper Body Strength Domain	0.477**	A moderate correlation was found demonstrating the upper body strength constructs measured by the BSE and the PPT may be similar. However, the BSE examines functional strength, while the PPT examines speed.
Lower Body Strength Domain	0.581***	A moderate correlation was found demonstrating the lower body strength constructs measured by the BSE and the PPT may be similar. However, the BSE examines functional strength, while the PPT examines speed.
Upper Body Flexibility Domain	0.309	The data was skewed, with all patients having normal UBF scores on the BSE. The UBF domain appears to have a ceiling effect
Lower Body Flexibility Domain	0.394*	Moderate correlation demonstrating the lower body flexibility constructs measured by the BSE and the PPT may be similar. However, the BSE examines functional flexibility, while the PPT examines speed.
SFM Total	0.559***	There is a clear relationship between performance on PPT and BSE as whole assessments. This relationship suggests that the BSE demonstrates physical performance testing constructs associated with function.

*Significant at the 0.05 level (2-tailed); ** Significant at the 0.01 level (2-tailed);

*** Significant at the 0.001 level (2-tailed)

Figure 2



Results

Test-retest reliability of the SFM is excellent (ICC = 0.89, SEM = 2.0). SFM scores at test 1 and test 2 are similar across subjects (see Figure 2)

The SFM and PPT scores were correlated (r = 0.559) and moderate to good correlations were observed for each domain which had comparable items in the PPT (r = 0.394 to 0.638) with the exception of the upper limb flexibility domain (r = 0.309, ns) (see Table 1).

Conclusions

Reliability

Scores on the SFM test are reliable and we have 95% certainty that the total score on a given day is within 4 points of the true value.

Validity

Overall, the SFM appears to be a good measure of physical performance with differences associated with the methods of measurement. The strength of the associations with PPT confirms that these tests measure different components of function.

Scoring

The SFM assesses quality of movement rather than speed, using an ordinal scale based on performance ratings as observed, while the PPT uses a measure of time to determine scoring. Time is a good measure of lower body strength, but has been more closely associated with coordination in the upper body. The SFM was designed to measure patient selection of various movement patterns that may contribute to risk for fracture.

Spine Loading

The spine loading domain appears to be measuring a new construct critical to fracture risk reduction. Spine loading has been shown to be associated with fracture in patients with osteoporosis. [11] If clinicians have a tool to estimate spine loading behavior in everyday life, they can accurately instruct a patient on how to move differently, so as to immediately reduce load during daily activity even before bone protecting medications begin to work. The SFM includes a spine loading assessment domain intended to examine spine loading behavior which has been associated with increased fracture risk.

References

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