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Reliability and validity of selected measures associated with increased fall risk in females over the age of 45 years with distal radius fracture — A pilot study

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ABSTRACT

Study design: Clinical measurement.
Purpose: This study examined test-retest reliability and convergent/divergent construct validity of selected tests and measures that assess balance impairment, fear of falling (FOF), impaired physical activity (PA), and lower extremity muscle strength (LEMS) in females >45 years of age after the distal radius fracture (DRF) population.
Methods: Twenty one female participants with DRF were assessed on two occasions. Timed Up and Go, Functional Reach, and One Leg Standing tests assessed balance impairment. Shortened Falls Efficacy Scale, Activity-specific Balance Confidence scale, and Fall Risk Perception Questionnaire assessed FOF. International Physical Activity Questionnaire and Rapid Assessment of Physical Activity were administered to assess PA level. Chair stand test and isometric muscle strength testing for hip and knee assessed LEMS. Intraclass correlation coefficients (ICC) examined the test-retest reliability of the measures. Pearson correlation coefficients (r) examined concurrent relationships between the measures.
Results: The results demonstrated fair to excellent test-retest reliability (ICC between 0.50 and 0.96) and low to moderate concordance between the measures (low if $r \leq 0.4$; moderate if $r = 0.4–0.7$).
Discussion: The results provide preliminary estimates of test-retest reliability and convergent/divergent construct validity of selected measures associated with increased risk for falling in the females >45 years of age after DRF. Further research directions to advance knowledge regarding fall risk assessment in DRF population have been identified.

Introduction

The risk for subsequent fragility fractures in individuals who have sustained distal radius fracture (DRF) is significant and has been repeatedly described by different studies over the past 3 decades.[1–4] In particular, the risk of a hip fracture following distal forearm fracture was reported to increase by 1.4 times in females.[4] Similarly, Lauritzen et al[2] found that females with forearm fracture who are 50 years of age have an estimated 17% residual life time risk for hip fractures versus 11% in those of same age but with no history of forearm fracture. There is also a reported increase in mortality (Standardized mortality ratio of 1.2) over the 10 years following skeletal fractures.[5] Females over the age of 65 years have substantially elevated risk of depression (odd ratio of 3.33) following incident fractures.[6] Elderly females with DRF also report reduced quality of life (QOL) mainly due to fear of falling (FOF) and risk of sustaining another fracture.[7] It is also interesting to note that most individuals perceive themselves as healthy and report excellent health-related QOL (HRQOL) prior to

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their DRF.[8] This implies that wrist fracture can change the perception of some individuals about their HRQOL. Edwards et al[9] also demonstrated that elderly females with DRF are 50% more likely to experiencing functional decline compared to those without DRF in important daily tasks such as preparing meals, completing heavy household chores, negotiating 10 or more steps, shopping, and getting in and out of car. Moreover, research has shown that the economic burden of merely FOF and that of falls that do not necessarily result in fracture is significant and often underestimated compared to the falls that do result in a fracture.[7] While all individuals with DRF are not at risk of future falls and osteoporotic fractures, identifying those who may have this risk can be the starting point to establish practice guidelines to better manage the 'at risk' individuals.

Current hand therapy assessment and treatment practices for individuals with DRF are largely focused on wrist related pain and musculoskeletal disability (MSKD).[10] This is expected since most individuals may require hand therapy to restore hand functions. However, it is timely that the practice guidelines[11] are revisited to include components of fall risk assessment and appropriate management strategies. Preliminary research has shown that educational intervention alone provided in an emergency department may not be adequate to minimize the risk for falls and FOF in individuals with DRF.[12] This is possibly in part due to the fact that simple educational interventions are usually not effective, but also because measures used for assessment of balance and FOF did not have established reliability and validity in patients with DRF which may have resulted in incorrect identification of the risk level for these patients. Moreover, it is also critical to examine the other attributes such as physical activity[13] and lower extremity muscle strength[14,15] that could potentially modify the fall risk in individuals with DRF. This underscores the need to conduct a systematic stepwise knowledge building inquiry to assess and manage risk for falls and osteoporotic fractures in individuals with DRF. There are essentially two steps in this inquiry. The first step is to identify the appropriate screening tests to assess FOF, balance impairment, PA, and lower extremity muscle strength in individuals with DRF and examine their reliability and validity in these individuals. The second step is to design and test a treatment intervention aimed at preventing falls, increasing falls efficacy and balance confidence, and optimizing bone health.

Recently, fall risk literature was examined to address the first step outlined above.[16] A structured literature synthesis of fall risk literature in individuals with fragility fractures was conducted to identify appropriate tests that hand therapists can use to assess risk such as balance impairment, FOF, lower extremity muscle strength, and alterations in PA in the DRF population. The tests and measures identified in this literature synthesis have mostly been tested in low functioning older adults and their utility has not been tested in relatively younger population. Given that patients with DRF are relatively younger,[17] certainly the existing evidence about these tests cannot be readily extrapolated to the DRF population. These tests require empirical validation of their measurement properties in the DRF population. In particular, the test-retest (relative and absolute) reliability, variability, and concurrent convergent/divergent validity of these tests need to be examined in the DRF population. Practice recommendations to suggest which tests are better suited for risk assessment in the individuals with DRF can only be made following a comprehensive assessment of their measurement properties in the DRF population.

Purposes of study

The purposes of this pilot work were:

1. to examine test-retest reliability of selected tests and measures assessing balance, FOF, PA, and lower extremity muscle strength in females ≥45 years with DRF,
2. to obtain preliminary estimates of the normative scores for these tests in the DRF population and determine which tests are appropriate for females ≥45 years with a DRF,
3. to examine the concurrent convergent/divergent relationships between these tests.

Methods

The potential participants were recruited from two outpatient rehabilitation settings: 1) a non-specialized outpatient rehabilitation department in a community hospital (located in Brampton, Ontario, Canada), and 2) an outpatient fracture clinic in a specialized hand surgery and rehabilitation setting (located in London, Ontario, Canada). Participants were recruited within 4 weeks of initiating hand therapy for the DRF. The inclusion criteria were: females ≥45 years whose primary language was English and who were being treated for any DRF related to a fall injury. Participants, irrespective of whether they were managed conservatively or surgically, were included in the study. Those with pre-existing balance impairment as a result of neurological or musculoskeletal (MSK) impairment and known cognitive impairment were excluded. We also excluded individuals who were already using walking aids due to pre-existing balance impairments and those who had other simultaneous fracture or MSK injury of same or other extremities from the fall that resulted in a DRF. This is because such individuals have already been deemed to be at fall risk and though hand therapists may still want to screen for their overall risk for fragility fractures, FOF, and PA, further screening for balance impairment may not be required. Participants continued rehabilitation for their DRF as required and suggested by the rehabilitation team. Approval from the affiliated research ethics boards were obtained prior to conducting this study.

The data collection session took place once the participants provided their consent. Participant information form captured demographic and injury information including age, occupation, date of injury resulting in DRF, mode of injury, type of medical treatment received, history of falls, and side dominance. The demographic and medical history questions in the participant information form captured the information required to calculate the FRAX® Score. The FRAX® tool provides percentage (%) risk of sustaining an osteoporotic fracture as well as a hip fracture over the next 10 years.[18] The osteoporotic fracture can include any of the following: a clinical spine, hip, forearm or humerus fractures.[18] The tool also allows classification of risk to determine whether further assessment (yellow flag) or treatment is required for osteoporosis.[18] The tool can be accessed at no cost to the users (http://www.shef.ac.uk/FRAX/index.jsp). The FRAX® scores were calculated without any imputation of bone mineral density data from the participants. Data collection was divided into performance-based tests (PBT) and self-reported tests (SRT). Five PBT were administered in this order: Timed Up and Go test (TUGT),[19] Functional Reach (FR),[20] Chair Stand Test (CST),[21] One Leg Standing (OLS),[22] and Isometric Lower Extremity Muscle Testing using hand held dynamometer (HHD).[23] Participants completed a total of five SRT. The shortened version of the Falls Efficacy Scale (FES-S),[24] Activities-Specific Balance Confidence (ABC) Scale,[25] and Risk Perception Questionnaire (RPQ)[26] were used for assessing fear of falls (FOF). The shorter version of the International Physical Activity Questionnaire (IPAQ)[27] and Rapid Assessment of Physical Activity (RAPA)[28] were used for assessing the physical activity. Participants first completed the PBT followed by the SRT. The PBT were completed twice during the data collection session: first immediately before the participants completed SRT and then again immediately after they completed the SRT. The data collection lasted for approximately an hour, 40 min each for the two PBT sessions and 20 min for completing the