Development of a Concise Lower Extremity Physical Performance Test Set for Return to Sport Decision-Making in Pediatric Populations

Trevor A. Lentz, PT, PhD, MPH[1]; John Magill, PT, DPT, OCS, FAAOMPT[2]; Heather Myers, PT, DPT, SCS, LAT, ATC[2]; Valentine Esposito, BS[3]; Michael Messer, PT, DPT, SCS[2]; Emily Reinke, PhD[3]; Jonathan C. Riboh, MD[3]

[1]Duke Clinical Research Institute, Durham, NC; [2]Department of Physical Therapy & Occupational Therapy, Duke University Health System, Durham, NC; [3]Duke Sports Science Institute, Duke University, Durham NC

OBJECTIVES

Physical performance tests (PPT's) are often used in return to sport decision-making following lower extremity injury or surgery. Common PPT's include the single leg stance, single leg stance on BOSU, single leg squat (SLS), SLS on BOSU, clockwise and counterclockwise quadrant single leg hop (SLH), forward SLH, timed SLH, triple crossover SLH and lower quarter Y-balance. Each of these tests assesses distinct characteristics of lower extremity performance, but administration of the full 10-item test battery is not practical in clinical settings. We can improve efficiency of clinical decision-making with PPT's in pediatric populations by foregoing tests that provided redundant information on physical performance.

The aims of this analysis are to 1) define which primary underlying components of physical performance these 10 PPT's assess, and 2) derive a reduced item set of PPTs that efficiently and accurately measures performance on each underlying component.

METHODS

Subjects:
Healthy, uninjured volunteers (n=61) between the ages 6 and 17 [mean age = 10.7 ±3.2 years; 33 females (54.1%)].

Tests:
Subjects completed two trials on each leg for each test (Figure 1) with the exception of the forward SLH, timed SLH, and triple crossover SLH. Subjects performed these tests three times. Trials were averaged trials across sides for each test. All Y-balance, timed hop and distance hop tests were normalized to leg length, and all test items were standardized prior to analysis.

Analysis:

- Item reduction used principal components analysis (PCA) with oblique rotation (Promax) on all 10 items of the test. Kaiser criterion (eigenvalue > 1) and scree plot visualization determined the optimal number of components. Items with loadings > 0.55 were considered for the reduced test item set. Cross-loaded items with < 0.25 absolute difference in loading between components were dropped. If two or more factors loading on the same component were highly correlated (r > 0.7), we dropped the item(s) with the lowest factor loading.

- Reduced item set was evaluated for internal consistency (Cronbach α) among the principal components, with a minimum criterion of 0.7 considered satisfactory.

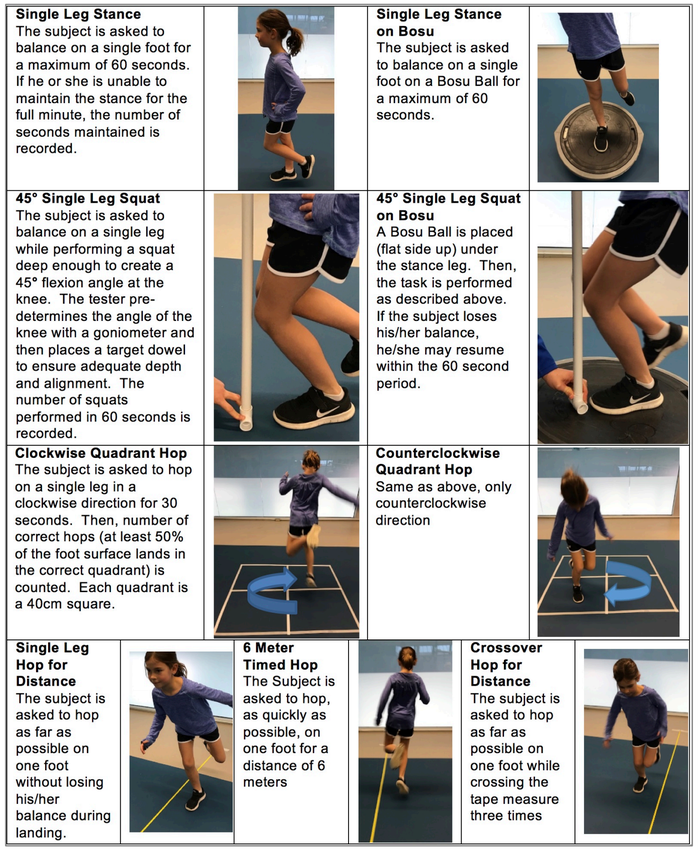

Figure 1. Physical performance test battery (Y-balance not shown)

RESULTS

PCA extracted 2 components with a cumulative response variance of 67.7%.

Component 1 (neuromuscular control/balance) included all balance, single leg squat and quadrant hop test items.

- The two quadrant hop tests were highly correlated (r=0.94) and had low factor loadings on the component (<0.78), and were not included in the reduced-item set.
- The SLS test had the lowest factor loading (0.69) and was also not included.
- The single leg stance, single leg stance on BOSU, and SLS BOSU had similar factor loadings (0.79, 0.90, and 0.88, respectively) and did not meet the correlation criterion for removal (all < 0.61).

Component 2 (Power) included the forward SLH and Crossover SLH.

- Each demonstrated high factor loadings (0.94 and 0.79, respectively) and only moderate correlation (r=0.56).
- The Timed SLH and lower quarter Y-balance did not meet the loading criterion and were not considered for the reduced-item PPT set.

The final 5-item PPT set had a cumulative response variance of 76.0%. The Cronbach α of the 3-item Component 1 (0.80), 2-item Component 2 (0.72) and overall 5-item set (0.70) were all satisfactory.

DISCUSSION

The 10 PPT's examined in this study measure two primary components of lower extremity performance: **1)*neuromuscular control/balance, and 2) power***.

The reduced item set of PPT's included: ***single leg stance, single leg stance on BOSU, SLS BOSU, forward SLH and triple crossover SLH tests***. Of these, the single leg stance on BOSU and forward SLH may be most capable of evaluating components measured by the 10 PPT's.

These findings provide clinicians with efficient options for measuring lower extremity performance for the purposes of return to sport decision making in pediatric populations. Future studies should corroborate these findings in larger samples and clinical populations. Additional research should also determine whether tests excluded from the reduced-item set provide important prognostic information for clinical outcomes.

Contact Information:
Trevor Lentz: trevor.lentz@duke.edu; Jonathan Riboh: jonathan.riboh@duke.edu