BTrackS: A Low-Cost, Portable Force Plate for Objectively Measuring Balance Deficits and Fall Risk

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One of the greatest challenges facing home healthcare professionals is the determination of balance deficits and fall risk, as a greater number of older adults are aging in place. Indeed, older adults are known to fall frequently (>25% of all older adults fall annually) and suffer devastating fall-related consequences such as broken bones and traumatic brain injury. Falls are the number one preventable cause of long-term disability and death in older adults (Centers for Disease Control and Prevention, 2013).

There are many clinical tests for assessing balance and fall risk in the home (e.g., Timed Up and Go, Berg Balance Test, Tinetti Balance Assessment Tool). However, these popular methods are inherently subjective and/or lack the sensitivity necessary to determine subtle balance deficits. In contrast, a "gold standard" method exists for balance and fall risk assessment in the form of a force plate medical device. Force plates objectively determine balance by sensitively measuring the "Postural Sway" of an individual. Postural sway is a biomechanical concept representing sustained oscillatory motion about a fixed postural position during standing. Scientific evidence shows that older adults with greater postural sway have increased risk of falling within the next 12 months of life (Park et al., 2014).

There has been limited in-home use of force plate technology for balance and fall risk assessment due to practical barriers. Force plate devices are often expensive, costing as much as $100,000. Second, traditional devices largely fail to deliver the portability necessary to accommodate regular home healthcare visits due to their weight, external power requirements, and structural reinforcement needs. Lastly, force plates generally lack user-friendly software protocols that are time efficient, reliable, and intuitive.

In response to these limitations, the Balance Tracking System (BTrackS) was created in 2013. BTrackS consists of a low-cost (<$2,000) and portable (<7 kg, USB-powered) force plate (FDA class 1 registered

Figure 1. BTrackS testing setup for a fall risk assessment.

device) called the BTrackS Balance Plate. Along with the plate, comes user-friendly software called BTrackS Assess Balance for the assessment of balance deficits and fall risk. Figure 1 shows the simple BTrackS testing setup whereby, an individual stands on the BTrackS Balance Plate while postural sway is measured by the BTrackS Assess Balance software. The protocol used for this assessment is the BTrackS Balance Test, which has been shown to be both ecologically valid and reliable for testing community-dwelling older adults (Levy et al., 2018). The protocol consists of four, 20-second trials of quiet standing with eyes closed, hands on the hips, and feet shoulder width apart.

Figure 2 shows the main balance and fall risk results reported following the BTrackS Balance Test. On the left of the report is the postural sway value of the individual tested, determined as the average total center of pressure path length calculated from trials 2 to 4 (trial 1 is for familiarization only). The postural sway value is then used as the basis for determining the middle result reported, which is a percentile ranking for the test. Percentile rankings are based on age and sex-based normative data from over 16,000 individuals (Goble & Baweja, 2018). Lastly, the result on the right of the report is the fall

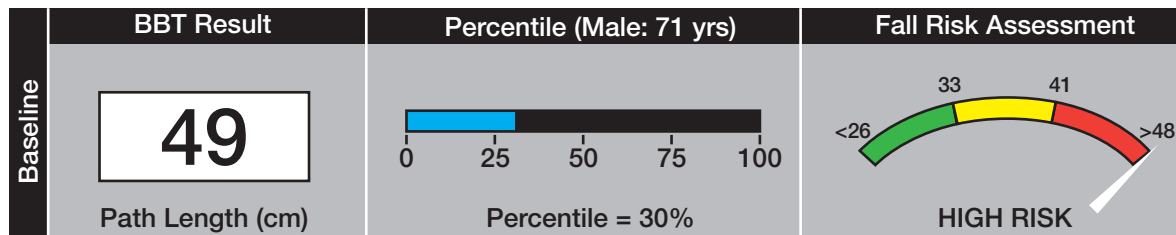| BBT Result	Percentile (Male: 71 yrs)	Fall Risk Assessment
49	0 25 50 75 100	33 41 <26 >48
Path Length (cm)	Percentile = 30%	HIGH RISK

Figure 2. BTrackS fall risk assessment results output.

risk assessment for the individual tested. Fall risk assessments are categorized as LOW, MODERATE, or HIGH based on the number of standard deviations an individual's postural sway value is from an average healthy young adult's result. Within one standard deviation or better is considered LOW risk, 1 to 2 standard deviations are MODERATE risk, and 2 or more standard deviations are HIGH risk.

According to a BTrackS internal report (Goble, 2018), the fall risk assessment of LOW for older adults equates to a 29% likelihood of falling in the next 12 months. This likelihood rises to 42% for those individuals in the MODERATE category, and to 51% for those in the HIGH category. Those individuals with MODERATE and HIGH risk assessments should be targeted for balance intervention programs implemented by physical therapists and other healthcare professionals.

With respect to balance interventions, the most recent BTrackS Assess Balance software includes biofeedback-based training protocols that allow BTrackS to also be used as a means of training postural sway. These protocols teach individuals to control body sway by requiring them to shift their weight into target zones indicated on an image of the plate in real time. More traditional exercise interventions might also be useful in mitigating fall risk through a reduction in postural sway. For example, a recent study showed that the resistance-based "GeriFit" program reduced postural sway in 100% of older adults who were categorized as having high risk by BTrackS at baseline (Goble et al., 2017).

In summary, BTrackS is an evidence-based tool that provides an objective and reliable measure of balance deficits and fall risk. Given its low cost and portability, it can be feasibly integrated into any home therapy program, while potentially offering a significant return on investment through medical insurance reimbursement possibilities. Further, BTrackS is intuitive to use and supports rapid test administration. Taken together with the cost burden associated with fall injuries, BTrackS can help home healthcare professionals provide an improved standard of care and establish the need for medically necessary therapy interventions. ♠

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