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Balanced Reach Control Systems Model

Summary

Bipedal standing balance is inherently unstable and must be actively controlled to prevent falling. This involves a complex interaction of the sensorimotor system and multi-segment musculoskeletal system. Fall risk increases with deterioration of sensorimotor and musculoskeletal elements responsible for balance due to age, neurological disorders, disease, and injury. The Balanced Reach Control System (BRCS) is a novel model to quantify whole body, volitional balance control during specific functional balance tasks. BRCS allows the quantification of fall risk so that effective fall prevention treatments may be developed for the patient.

Key Investigator
Joseph E. Barton

Field
Medical device
Rehabilitation

Technology
Medical Device
Software

Advantages
Enables precise quantification of the whole body and parts performance characteristics during a reach balance test

Guides rehabilitation intervention decisions to target specific deficits

Can serve as an out-of-balance warning device and/or as a real-time controller

Status
Available for licensing

Patent Status
US Patent 11,026,599 (issued)

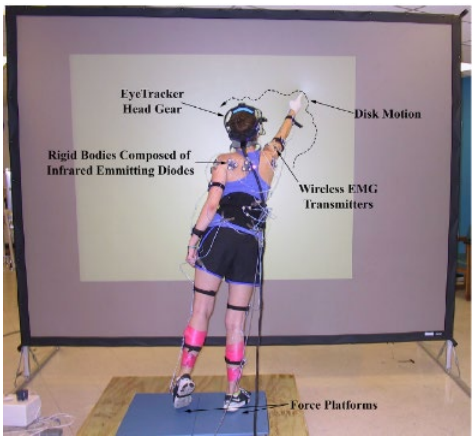
UMB Docket Reference
JB-2016-005
JB-2016-004

External Reference
Barton et al. (2016) *J Biochem Eng*. 138(12).

Market

Fall related injuries constitute two-thirds of all unintentional injuries leading to death in older adults. Half of all fall patients over 65 that are hospitalized do not survive the one year. Clinical diagnostic instruments developed to assess balance and fall risk have inherent limitations. Typically, evaluations are conducted for the outward aspects of a specific stance or simple movement. These observations are limited to cause and effect behavior and do not accurately characterize the integrated multi-segmental motor control of functional human balance. In the clinic, most balance instruments employ subjectively determined ordinal scales that do not lend themselves well to quantitative analysis and are relevant only for a narrow range of subject performance. As such, current methods for predicting fall risk are inconsistent and quantitative models with neurophysiological and biomechanical complexity are needed to enable mathematical characterization of multi-segmental motor tasks requiring functional balance control. BRCS is the first to analyze and characterize whole body balance in relevant reaching tasks, which can inform the design of therapeutic regimens to address balance deficits.

Technology



The BRCS breaks down the reaching human into five interacting components: 1) supra-brain stem processes, 2) brain stem and spinal cord processes, 3) the reaching body, 4) sensory modalities involved in balance and the higher level processes that integrate their signals to predict the body's state of balance, and 5) feed-forward sensorimotor delays and noise. The BRCS Model functions as a diagnostic instrument to assess stand and reach and step and reach balance tasks. It incorporates a 3D, 14 segment biomechanical model to represent the reaching body, allowing precise quantification of the performance characteristics of the reaching body as a whole as well as each component of the reaching motion.

Technology Status

The biomechanical model of the reaching body has been completely developed and tested in 38 young and healthy adults, showing robust measurement qualities and ability to quantify error at any of the 13 body segments (excluding the eyes), bilaterally, across 5 different levels of difficulty that represent the limits of human standing balanced reach performance. This represents the critical foundational validation and reliability. Development of the remaining components is ongoing and includes testing in selected clinical populations across the age spectrum. This work is underway with older adults at low and high fall risk, and individuals with selected medical conditions known to impair their balance.

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