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Systematic Review Brief: Virtual Interventions that Address Motor and Balance Impairments and Skills for Adults with Traumatic Brain Injury (TBI) (12-21)

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Systematic Review Brief: Virtual Interventions that Address Motor and Balance Impairments and Skills for Adults with Traumatic Brain Injury (TBI) (12-21)

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Abstract

Systematic Review Briefs provide a summary of the findings from systematic reviews developed in conjunction with the American Occupational Therapy Association's (AOTA's) Evidence-Based Practice Program. Each Systematic Review Brief summarizes the evidence on a theme related to a systematic review topic. This Systematic Review Brief presents findings from the theme of virtual interventions that address motor and balance impairments and skills for adults with traumatic brain injury (TBI).

Virtual Interventions that Address Motor and Balance Impairments and Skills for Adults with Traumatic Brain Injury (TBI)

Full Systematic Review Question

What is the evidence for the effectiveness of interventions to address motor and balance impairments to improve occupational performance for adults with TBI?

Current Theme Reported

Virtual Interventions for Adults with TBI

Clinical Scenario

In the United States, an estimated 1.7 million adults sustain a TBI annually, which is equivalent to approximately one new incident of TBI every 21 seconds (Center for Disease Control and Prevention [CDC], 2019; Georges & Das, 2021). In turn, over 5.3 million adults with TBI, about 2% of the population, are living with chronic disabilities (CDC, 2015). Rehabilitation for adults with TBI often focuses on improving their independence in activities of daily living, social functioning and participation, and community integration (CDC, 2015). Occupational therapy practitioners address a myriad of barriers to occupational performance, including range of motion, muscle tone, motor control, endurance, vestibular function and balance. One of the popular activities to target motor and balance impairments is virtual-reality based interventions (CDC, 2015). According to the Occupational Therapy Practice Framework: Domain and Process 4th Edition (OTPF-4), virtual intervention is defined as "*the use of simulated, real-time, and near-time technologies for service delivery absent of physical contact*" (American Occupational Therapy Association [AOTA], 2020, p.62). Hence, interventions using a virtual reality context are a form of virtual intervention within the domain of occupational therapy.

This systematic review brief was guided by the OTPF-4 to determine the types of virtual interventions which address motor and balance impairment to improve occupational performance for adults with TBI.

Summary of Key Findings

Five articles were included in the review that addressed motor and balance impairments using virtual-reality based interventions with adults with TBI (Table 1).

Bottom Line for Occupational Therapy Practice

With the continuous advancement in technology and the popularity of virtual reality systems as a source of enjoyment, occupational therapy practitioners can utilize virtual interventions (e.g., virtual reality) as a relatively affordable and easily accessible rehabilitation activity, such as the Xbox Kinect system, to address motor and balance impairments in adults with TBI (Ravenek et al., 2016). The benefits of virtual interventions are many, one of which is leveraging the enjoyment elicited through gaming and virtual reality systems to improve motivation to adhere to a high number of repeated exercises and movements (Glegg & Levac, 2018). Through neuroplasticity, a high number of repetitions is needed to produce improvement in motor skills, both in quality and timely execution of movements for functional activities and mobility (Dayan & Cohen, 2011). Thus, virtual interventions can provide the means for the high repetition and intensity essential to improvements in motor control, mobility, and balance in adults with TBI. The reviewed studies show that the most common virtual intervention dose ranges from 12-18 sessions within 4-6 weeks, and the gaming and virtual reality-based interventions can be successfully provided in clinics and at home. However, for the virtual interventions to be effective, the gaming and virtual-reality programs should be specifically chosen and graded according to an individualized treatment plan. Occupational therapy practitioners should identify

specific motor and balance impairments in adults with TBI, coupled with activity analyses and systematic grading of the gaming and virtual-reality programs to facilitate improvement in motor and balance outcomes and achievement of client-centered goals. It is important to note that the reviewed studies of virtual interventions in adults with TBI did not include measurements in occupational performance, nor did it include method of delivery through telehealth. Without measurement of occupational performance outcomes, the extent to which improvements in motor and balance skills lead to improvement in daily life activities remains unknown. Future research should expand conception of virtual interventions to be inclusive of telehealth and include occupational performance as one of the outcomes.

Note: Levels of evidence used in this review: https://www.cebm.ox.ac.uk/resources/levels-of-evidence/oxford-centre-for-evidence-based-medicine-levels-of-evidence-march-2009

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Table 1.

Virtual Interventions to Improve Motor Outcomes for Adults with TBI

Author/ Level Evidence	**Intervention**	**Statistically Significant Improvement from Intervention**
Five articles were included in the review that addressed motor and balance impairments using virtual-reality based interventions with adults with TBI. Two of the studies (one level IB and one level 2B) did not yield statistically significant improvement in motor control and/or balance outcomes. One level 1B randomized controlled trial (RCT), one level 2B pilot RCT and one level 3B pre-post pilot study provided **moderate strength of evidence** that practitioners can use gaming and virtual reality-based interventions to enhance balance, improve functional movement and mobility, decrease vestibular symptom severity and fall risks in adults with TBI		
Sessoms et.al. (2015) 1B - RCT	**Population:** 20-42 years old with a vestibular disorder related to mild TBI within the prior year **Intervention:** A virtual-reality system (Computer-Assisted Rehabilitation Environment- CAREN) that is physically and cognitively challenging in a realistic but controlled environment **Delivery Method:** Individual at a Vestibular Therapy Clinic **Dose:** 2x/week X 6 weeks of CAREN	Gait speed and vestibular symptoms
Tefertiller et. al. (2019)	**Population:** Adults with chronic moderate or severe TBI, self-report of balance deficits	None

Author/ Level Evidence	**Intervention**	**Statistically Significant Improvement from Intervention**
1B – RCT, blinded	**Intervention:** Graded virtual reality exercises using Xbox Kinect system **Delivery Method:** Individual at home **Dose:** 30-minute sessions for 3-4 x/week X 12 weeks	
Cuthbert et.al. (2014) 2B – Pilot RCT	**Population:** Adults with newly-diagnosed TBI in acute inpatient rehabilitation **Intervention:** Traditional PT with additional 8 minutes of Wii Fit balance board games and 7 minutes of Wii Sport games. **Delivery Method:** Individual at inpatient rehabilitation **Dose:** 4x/week X 4 weeks	None
Straudi et. al. (2017). 2B – Pilot RCT	**Population:** Adult with chronic TBI with balance deficit **Intervention:** Video Game Therapy that encompasses a wide range of motor activities in standing **Delivery Method:** Individual at community setting **Dose:** 3x/week X 6 weeks	Static balance while performing functional movements and mobility
Ustinova et.al. (2014)	**Population:** Adults with TBI	Fall risk, static and dynamic balance, and

Author/ Level Evidence	Intervention	Statistically Significant Improvement from Intervention
3B – Pre-posttest pilot study	**Intervention:** Virtual reality with Xbox Kinect Motion Sensor, graded games which progress from simple single-limb guided movements to complex whole-body tasks **Delivery Method:** Individual in a supervised clinic **Dose:** 50-55-minute sessions for 2-3x/week X 5-6 consecutive weeks for a total of 15 sessions	arm precision movement