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Review

Commercially available gaming systems as clinical assessment tools to improve value in the orthopaedic setting: A systematic review

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ABSTRACT

Introduction: Commercially available gaming systems (CAGS) such as the Wii Balance Board (WBB) and Microsoft Xbox with Kinect (Xbox Kinect) are increasingly used as balance training and rehabilitation tools. The purpose of this review was to answer the question, "Are commercially available gaming systems valid and reliable instruments for use as clinical diagnostic and functional assessment tools in orthopaedic settings?" and provide a summary of relevant studies, identify their strengths and weaknesses, and generate conclusions regarding general validity/reliability of WBB and Xbox Kinect in orthopaedics.
Materials and methods: A systematic search was performed using MEDLINE (1996–2013) and Scopus (1996–2013). Inclusion criteria were minimum of 5 subjects, full manuscript provided in English or translated, and studies incorporating investigation of CAG measurement properties. Exclusion criteria included reviews, systematic reviews, summary/clinical commentaries, or case studies; conference proceedings/presentations; cadaveric studies; studies of non-reversible, non-orthopaedic-related musculoskeletal disease; non-human trials; and therapeutic studies not reporting comparative evaluation to already established functional assessment criteria. All studies meeting inclusion and exclusion criteria were appraised for quality by two independent reviewers. Evidence levels (I–V) were assigned to each study based on established methodological criteria.
Results: 3 Level II, 7 level III, and 1 Level IV studies met inclusion criteria and provided information related to the use of the WBB and Xbox Kinect as clinical assessment tools in the field of orthopaedics. Studies have used the WBB in a variety of clinical applications, including the measurement of center of pressure (COP), measurement of medial-to-lateral (M/L) or anterior-to-posterior (A/P) symmetry, assessment anatomic landmark positioning, and assessment of fall risk. However, no uniform protocols or outcomes were used to evaluate the quality of the WBB as a clinical assessment tool; therefore a wide range of sensitivities, specificities, accuracies, and validities were reported.
Conclusion: Currently it is not possible to make a universal generalization about the clinical utility of CAGS in the field of orthopaedics. However, there is evidence to support using the WBB and the Xbox Kinect as tools to obtain reliable and valid COP measurements. The Wii Fit Game may specifically provide reliable and valid measurements for predicting fall risk.

Contents

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Introduction

The Affordable Health Care Act emphasizes improvement in the quality and efficiency of health care, the development of innovative medical therapies, and the prevention of chronic disease [1]. As a result, the field of orthopaedics faces new socioeconomic pressures to develop and utilize evidence-based clinical tools that predict, monitor, and assess patient outcomes after musculoskeletal injuries. It is paramount that these clinical tools demonstrate clinical utility, cost-effectiveness, as well as high accuracy and reliability. As a result, the orthopaedic trauma community is now faced with the challenge to identify inexpensive, non-invasive, portable, clinician-friendly assessment tools that can be used to assess and predict clinical outcomes for orthopaedic patients.

In order to meet these quality and efficiency standards, identification of technology that is commercially available offers high potential for adopting tools that can objectively assess functional capabilities in orthopaedic patients. Commercially available gaming systems (CAGS) may serve as relatively inexpensive, clinician friendly tools to assess objective functional measures in patients and their functional outcomes. Many of these devices for example, the Nintendo Wii with Balance Board (WBB; Fig. 1) and the Microsoft Xbox with Kinect (Xbox Kinect; Fig. 2), incorporate several technological options such as integrated accelerometer technologies, infrared detection, and movement tracking into their consoles. The appeal of the WBB and Xbox Kinect, in particular, is that they are portable, user-friendly, and significantly cheaper than the research-grade technologies that incorporate similar features. They also include a number of options for balance and motion training programs that can be used to assess postural control and the general quality of motion while performing various movement tasks. These tools even offer the capability of providing affordable therapeutic training protocols that could be used by both patients and clinicians to track the progress of objective functional measures during rehabilitation stages.

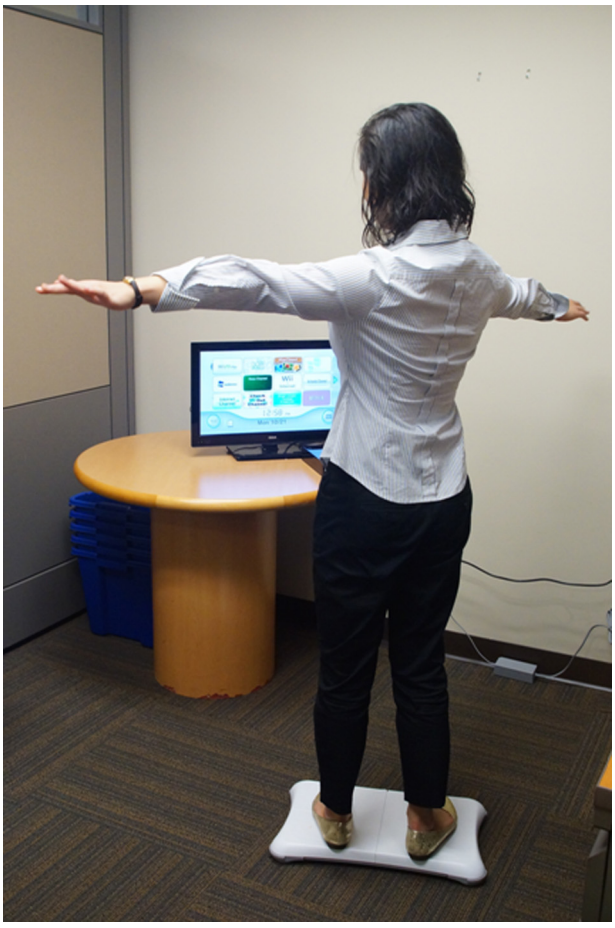

Fig. 1. Wii Balance Board in Use.

A number of studies in the literature utilize CAGS in various orthopaedic applications. However, there remains a lack of synthesis of the findings of these studies. Consequently, there is not a clear understanding of the measurement properties and clinical utility of these devices. The purpose of this systematic review was to answer the following question: "Are commercially available gaming systems valid and reliable instruments for use as clinical diagnostic and functional assessment tools in orthopaedic settings?" Specific objectives for this review were to provide a descriptive summary of relevant studies and to generate conclusions regarding the general validity and reliability of CAGS in the field of orthopaedics.

Materials and methods

The methodological approach for this systematic review was modelled after the methods outlined by Harris et al. [2] Systematic searches using PubMed MEDLINE (from 1966) and SCOPUS (from 1996) were performed July 2013. Systematic searches of the electronic databases were designed using keywords to capture all literature relevant to the use of CAGS in orthopaedics, rehabilitation, and various other clinical settings. The electronic database searches were performed with keyword terms including ""Wii," "kinect," "ebavir," "game console," "exergames," "Wiihabilitation," "computer assisted therapy," "postural sway," "therapy," "stability," "strength," "rehabilitation," "orthopaedic," "orthopaedic," "elderly [1]," "computer assisted rehabilitation." The relatively broad search criteria identified any published relevant studies to maximize the generalizability of this review. The search was supplemented with a review of the bibliographies of the retrieved articles, personal correspondence with authors of retrieved articles, and hand search of pertinent journals to identify any additional studies addressing this topic of interest.

The retrieved articles were screened and reviewed by two independent reviewers to identify articles that aligned with the following inclusion criteria: (1) a minimum of 5 subjects, (2) a full manuscript was provided in English or translated to English, and (3) the study incorporated an investigation of the measurement properties of CAGS that could be used for orthopaedic-related diagnostic and functional assessments. Exclusion criteria for articles included: (1) articles classified as review, systematic reviews, summary/clinical commentary, or case studies, (2) conference proceedings/presentations, (3) studies with cadaveric specimens, (4) studies focusing on non-reversible, non-orthopaedic-related musculoskeletal disease (i.e., stroke, Parkinson's disease, etc.), and (5)therapeutic studies that did not report comparative evaluation to already established functional assessment criteria.

All studies meeting inclusion and exclusion criteria were appraised for quality by two independent reviewers. Evidence levels (I–V) were assigned to each study based on the methodological criteria listed in the American Academy of Orthopedic Surgeons primer on evidence-based medicine. When there was a disagreement between the two independent reviewers, a third reviewer was utilized to reconcile these differences. Level I studies included high-quality randomized control trials (RCTs) for

[1] Elderly was used as an OR search term so as not to screen out articles.

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