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ORIGINAL ARTICLE

Postural Stability in Patients With Knee Osteoarthritis: Comparison With Controls and Evaluation of Relationships Between Postural Stability Scores and *International Classification of Functioning, Disability and Health* Components

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Abstract

Objectives: To assess the differences in postural stability between patients with knee osteoarthritis and controls without knee osteoarthritis, and to evaluate possible relations between postural stability scores and *International Classification of Functioning, Disability and Health* (ICF) components.

Design: An age-matched, case-controlled trial with a cross-sectional design.

Setting: A teaching hospital.

Participants: Patients with knee osteoarthritis (n=73) and age-matched controls (n=60).

Interventions: Data on patients' postural stability and additional health-related variables were collected using various instruments. These included the Hospital Anxiety and Depression Scale, the Multidimensional Fatigue Inventory, the World Health Organization Quality of Life Brief Version, the physical function test (chair-rising time), the Chinese version of the Western Ontario and McMaster Universities Osteoarthritis Index, the Chinese version of the Knee Injury and Osteoarthritis Outcome Score, and the Biodex Stability System.

Main Outcome Measures: A comparison of postural stability in patients with knee osteoarthritis versus that of controls was performed. The relation between postural stability scores for patients with knee osteoarthritis and ICF components was evaluated. Pearson correlation tests were used to determine the variables that correlated with postural stability among these patients.

Results: Patients with knee osteoarthritis displayed lower overall postural stability than controls (scores of 0.7 vs. 0.5, $P=.006$) and scored lower on the environmental domain of the World Health Organization Quality of Life Brief Version (62.2 vs 66.8, $P=.014$). For patients with knee osteoarthritis, postural stability was weakly associated with the ICF components of body functions and structures, including pain ($r=.33-.34$, $P=.004$), physical fatigue ($r=.28$, $P=.016$), and reduced motivation ($r=.30$, $P=.011$). Weak to moderate associations between postural stability and the ICF components of activities and participation were found; the relevant ICF variables included reduced activity ($r=.38$, $P=.001$), physical domain and function ($r=.34-.48$, $P=.001$ to $P<.004$), activities of daily living ($r=.51$, $P<.001$), and sports and recreation ($r=.35$, $P=.003$). A moderate association between postural stability and the ICF components of personal and environmental factors was observed, including age ($r=.52$, $P<.001$) and quality of life ($r=0.4$, $P=.001$).

Conclusions: Patients with knee osteoarthritis displayed lower postural stability and achieved lower scores in the environmental domain of quality-of-life measures than did controls. The postural stability of patients with knee osteoarthritis was weakly to moderately associated with the following ICF components: body functions and structures, activities and participation, and personal and environmental factors.

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Postural stability can be defined as control over the body's position in space for the purpose of orientation and balance.[1] It is a complex process that requires a person to combine multiple neurologic sensory components (visual, vestibular, proprioceptive, and somatosensory), motor components, and central integration to

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maintain the body's balance and keep it upright.[2,3] Postural control declines with age.[4] Postural instability compromises a person's ability to maintain his or her balance during the normal activities of daily living and walking.[4] The deterioration in postural stability is a contributing factor to falls in older adults and thus constitutes a significant public health problem.[4]

Thirty percent of people aged 70 years and older experience knee pain.[5] Previous studies have described patients with knee osteoarthritis as displaying poorer postural stability than controls.[6,7] Numerous activities of normal daily life require good postural stability for the shifting and transfer of weight, such as transitioning between sitting and standing, leaning, reaching, bending forward, and locomotion. In patients with knee osteoarthritis, decreased postural stability causes difficulties in performing activities of daily living or recreation, and these difficulties affect the patient's quality of life. Furthermore, reduced postural control is correlated with an increased risk of falling.[8] One study reported that one third of adults older than 65 years experience a fall each year.[8] Falls can have serious consequences, such as soft tissue injury, joint dislocation, fracture, loss of independence, and even mortality.[9] In an aging population, improving the postural stability of older adults with knee osteoarthritis has become an important challenge.

The *International Classification of Functioning, Disability and Health* (ICF) describes functional health conditions from a combined biopsychosocial perspective.[10] The ICF contains 2 main parts, each comprising 2 components. Part 1 pertains to functioning and disability and includes the following components: (1) body functions and structures and (2) activities and participation. Part 2 addresses contextual factors and includes the following components: (1) personal factors and (2) environmental factors. A person's functional health is viewed as a dynamic interaction among the various ICF components.[10]

Numerous treatments have been developed to improve the postural stability of patients with knee osteoarthritis. Treatment generally focuses on lessening the patient's impairment and increasing his or her ability to participate in daily activities. Determining the relation between a patient's postural stability, on the one hand, and measures of impairment, limitations in activities, and restrictions on daily participation, on the other hand, is an important task. Previous studies comparing the postural stability of patients with knee osteoarthritis versus that of controls have generally used a swaymeter or foot plate to measure postural stability.[6,7] Prior to our research, no study had compared the performance of patients under dynamic stress, and the use of the ICF model to evaluate postural stability in patients with knee osteoarthritis had not been assessed. Thus, our study was primarily exploratory. Its aims were (1) to compare the postural stability of patients with knee osteoarthritis under dynamic stress with that of controls and (2) to explore the relation between postural stability and ICF components. We hypothesized that the postural stability of patients with knee osteoarthritis under dynamic stress would be poorer than that of controls and that postural stability would correlate with the measures of ICF components.

List of abbreviations:

ICF	***International Classification of Functioning, Disability and Health***
KOOS	**Knee Injury and Osteoarthritis Outcome Score**
WHOQOL-BREF	**World Health Organization Quality of Life Brief Version**
WOMAC	**Western Ontario and McMaster Universities Osteoarthritis Index**

Methods

Participants

Sixty-three women and 10 men (n=73) with confirmed diagnoses of knee osteoarthritis were recruited from the clinic of the Department of Physical Medicine and Rehabilitation of Shin-Kong Wu Ho-Su Memorial Hospital in Taiwan. The participants' mean age was 60.3±10.4 years. All participants fulfilled the combined clinical and radiographic criteria for a diagnosis of knee osteoarthritis, as established by the American College of Rheumatology.[11] A second group was enlisted to provide an age-matched control group, with 38 women and 22 men (n=60) in this group. Some control participants were selected after responding to an advertisement for the study. Additional control participants were recruited from the families of patients who visited the clinic during the study period. Control participants reported no current or past knee pain, and the findings of a physical examination of both knees were normal. Participants with a self-reported history of vertigo, stroke, or other conditions that might impair balance were excluded.

Ethics

The study protocol was approved by the Institutional Review Board for the Protection of Human Subjects at the Shin-Kong Wu Ho-Su Memorial Hospital. Informed consent was obtained from each participant.

Evaluation of participants

The recruited participants, those with knee osteoarthritis and controls, were evaluated for postural stability. The data described their performance under dynamic stress. Potentially related variables were obtained from various sources and were then evaluated according to ICF-related components (eg, body functions and structures, activities and participation, and personal and environmental factors).

Body functions and structures

This category included psychological function, anxiety, depression, fatigue, and motivation, as well as postural stability.

Psychological distress was evaluated using the Hospital Anxiety and Depression Scale.[12-14] The Hospital Anxiety and Depression Scale consists of 14 items, grouped into anxiety and depression subscales. A score above 7 indicates the presence of anxiety and/or depression. The Multidimensional Fatigue Inventory was used to assess fatigue.[15,16] It contains 20 visual statements with a 5-point Likert scale, relating to various aspects of fatigue (eg, general fatigue, physical fatigue, reduced activity, reduced motivation, mental fatigue). The score in each dimension ranges from 4 to 20, with a higher score indicating greater fatigue.

The Biodex Stability System[a] was used to measure postural stability.[17-21] This device consists of an unstable platform to measure a patient's postural stability under dynamic stress; it also shows the degree of tilt of the platform along the anterior-posterior and medial-lateral axes. The Biodex Stability System thus provides