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The impact of knee instability with and without buckling on balance confidence, fear of falling and physical function: the Multicenter Osteoarthritis Study

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SUMMARY

Objective: Knee buckling, in which a knee gives way during weight-bearing, is common in people with knee pain and knee osteoarthritis (OA), but little is known about the prevalence of sensations of knee instability, slipping or shifting in which the knee does not actually buckle, or of the psychosocial and physical consequences of these symptoms.

Design: We asked participants in the Multicenter Osteoarthritis Study (MOST) separately about episodes of knee buckling and sensations of knee instability without buckling in the past 3 months, and assessed fear of falling, poor balance confidence (Activities-specific Balance Confidence (ABC) Scale $\leq$ 67/100), activity limitation due to concern about buckling, and poor physical function (Western Ontario and McMaster Universities Arthritis Index (WOMAC) physical function $\geq$ 28/68). We used Poisson regression to estimate prevalence ratios (PRs) for cross-sectional associations of buckling and sensations of instability without buckling with these outcomes, adjusting for confounders.

Results: Of 2120 participants (60% female, 40% $\geq$ 65 years, mean Body mass index (BMI): 31 kg/m258), 18% reported buckling, 27% had sensations of knee instability without buckling, and 9% reported both symptoms. Buckling and sensations of instability without buckling were each significantly associated with fear of falling, poor balance confidence, activity limitations, and poor WOMAC physical function. Subjects who reported both buckling and instability without buckling and those with at least two buckling episodes (15%) had the strongest association with poor outcomes.

Conclusions: Knee buckling and especially sensations of knee instability without buckling were common and each was significantly associated with fear of falling, poor balance confidence, activity limitations, and poor physical function.

Introduction

Knee instability is a common symptom in persons with knee OA and knee pain[1,2]. Knee instability frequently manifests as buckling, defined as the sudden loss of postural support from 'giving way' of the knee due to mechanical failure during weight bearing activities[1]. While knee buckling is sometimes a complication of injuries to the anterior cruciate ligament or to the menisci, it is also common in people with knee pain who have had no history of such injuries[1,2]. People with knee buckling and other symptoms of knee instability are also more likely to have radiographic knee osteoarthritis (OA), quadriceps weakness, and limitations in physical function compared with people without knee buckling[1,3,4]. In a population-based study, 10% of all adults experienced knee buckling and four of five bucklers had knee pain[1,3].

Buckling has not been a major focus of OA research, although treatments may be available, including bracing, and risk factors for

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buckling are remediable, such as quadriceps weakness[5–7]. While knee buckling has been shown to adversely affect physical function[2,4], its impact on psychosocial outcomes such as fear of falling, loss of balance confidence and avoidance of certain activities, has not been examined. It is possible that people whose knees buckle may avoid physical activity because of reduced balance confidence or fear of falling, which may then lead to decreased physical function and deconditioning, resulting in a further increase in the risk of knee buckling.

In addition, while many people with knee OA may not experience mechanical failure of the knee resulting in loss of postural support (knee buckling or giving way), they may experience sensations of knee instability, slipping or shifting without the knee actually giving way. Such sensations of instability without the knee buckling may have a similar association as buckling with adverse health outcomes; however, the frequency of buckling and the instability symptoms that do not involve buckling and their association with health outcomes have not been studied[8,9].

The goals of this study were: 1) to examine the prevalence of knee buckling (giving way), and of sensations of knee instability, slipping or shifting without buckling, in a cohort of people with or at high risk of knee OA; 2) to examine the association of a) knee buckling and the frequency of buckling, b) sensations of knee instability, slipping or shifting without buckling, and c) the presence of either or both of these symptoms with functional health outcomes and concern about falls and poor balance.

Methods

Population

The Multicenter Osteoarthritis Study (MOST) is a longitudinal study of people either with or at high risk of knee OA. Details of MOST have been published previously[10]. In brief, MOST included participants between 50 and 79 years of age at baseline who were community-dwelling in Birmingham, Alabama, or Iowa City, Iowa. Definition of being at high risk for OA included older age, female sex, previous knee injury or surgery, and high body weight[11]. Baseline exams occurred between April 2003 and April 2005 and participants were followed at the 15, 30 and 60 months visits. We utilized cross-sectional data from the 60-month visit, since that was the examination at which subjects were first asked about knee buckling and instability. The MOST study protocol was approved by the Institutional Review Boards at the University of Alabama at Birmingham, the University of Iowa, the University of California, San Francisco, and Boston University Medical Center.

Exposures of interest

Knee buckling and sensations of knee instability, slipping or shifting without buckling

To assess episodes of knee buckling or giving way (we use these two terms interchangeably), participants were asked "In the past 3 months, has either of your knees buckled or given way at least once?" We defined knee buckling as those who answered 'yes' to this question on knee buckling in the past 3 months. We further classified those who buckled into people who had one buckling episode, and those who had two or more buckling episodes in the previous 3 months. The same question on buckling was also asked in terms of the past 12 months.

In order to assess whether participants experienced a sensation of knee instability, slipping or shifting that did not involve the knee actually buckling, just after the question about knee buckling, we asked all participants "In the past 3 months, has either knee felt like it was shifting, slipping, or going to give way but didn't actually do so?" We defined sensations of knee instability without buckling as present in those who answered 'yes' to this question.

We also classified participants for combinations of knee buckling and sensations of knee instability without buckling in the past 3 months, as follows: Group 1) experienced no episodes of knee buckling and no episodes with sensations of knee instability without buckling; Group 2) experienced sensations of knee instability without buckling but did not experience any separate episodes of knee buckling; Group 3) experienced knee buckling but did not report any separate episodes of sensations of knee instability without buckling; and Group 4) experienced both knee buckling and sensations of knee instability without buckling.

Falls and falling during a buckling episode

We asked all participants "During the past 12 months, have you fallen and landed on the floor, ground, or stairs?" In addition, among people with knee buckling in the past 3 months, we asked "As a result of knee buckling or giving way, did you fall and land on the floor or ground?"

Outcomes of interest

Psychosocial outcomes included fear of falling, balance confidence, and limiting activities out of concerns about knee buckling or giving way. We assessed fear of falling using a single-item question directly asking "Are you ever afraid of falling?" with fear of falling coded as yes; no if otherwise[12]. Although assessing fear of falling can be done easily in a clinic setting, the prevalence of fear of falling is reported to range as high as 85% in especially high-risk elderly, such that fear of falling can be a non-specific psychosocial outcome measure[13]. Therefore, we also included a more specific measure of assessing degrees of balance confidence that was ascertained using the validated Activities-specific Balance Confidence (ABC) Scale, which assesses self-reported confidence in performing 16 daily activities without becoming unsteady or falling[14–17]. The summary ABC score ranges from 0 to 100 (the higher the score, the higher the confidence). Poor balance confidence[18] has been defined as having an ABC score of $\leq$67.

We also asked all participants "Because of concern about buckling or giving way in your knees, have you changed or limited your usual activities in any way?"

We assessed physical function with the WOMAC physical function subscale. The WOMAC physical function subscale consists of a 17-item questionnaire asking participants about difficulty performing specific physical tasks. The range is from 0 to 68 (the higher the score, the worse the function). We defined poor physical functioning as scores of at least 28/68 on the WOMAC physical function scale[19], consistent with a previous definition of poor functional outcome for people with knee OA[20,21].

Covariates

Knee pain was measured as the mean pain in the past 30 days on a Visual Analogue Scale (VAS) ranging from 0 to 100[22]. Co-morbidities were assessed using the Charlson co-morbidity index[23,24]. Body mass index (BMI) was calculated from measures of height and weight as the ratio of measured weight (kg) divided by height (m^2). Radiographic knee OA was defined as present when at least one knee showed a Kellgren and Lawrence score of two or greater, as previously described[10,25]. Quadriceps strength was determined from the maximum of four isokinetic knee extensor torque repetitions at 60 degrees/second, scaled by body weight, and was categorized into sex-specific deciles as previously described[26,27]. For about 10% of the participants, quadriceps strength data were taken from the baseline visit owing to missing