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ORIGINAL ARTICLE

Preliminary Prediction Model for Fear-Induced Activity Limitation After Total Knee Arthroplasty in People 60 Years and Older: Prospective Cohort Study

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Abstract

Objectives: To assess the presence of fear-induced activity limitation (FIAL) in a sample of patients 1 year after total knee arthroplasty (TKA), and to develop a preliminary prediction model to predict the risk of FIAL.

Design: Prospective cohort study.

Setting: A tertiary teaching hospital.

Participants: Patients (N=72; mean age, 70±6y) undergoing primary, unilateral TKA participated.

Interventions: Not applicable.

Main Outcome Measures: Preoperative candidate predictors were age, sex, body mass index, previous falls history, number of comorbidities, self-report physical function, gait speed, knee range of motion, knee pain, and standing balance. Outcome measure at 1-year follow-up was the level of FIAL, measured by the Survey of Activities and Fear of Falling in the Elderly.

Results: Thirty-one patients (41%; 95% confidence interval, .31−.55) had FIAL, of whom 15 had moderate to severe FIAL. Multivariable predictors of FIAL included preoperative habitual gait speed and velocity of postural sway in the anterior-posterior axis. A 2-variable nomogram-based prediction model was constructed, and this model showed moderately good discrimination (optimism-corrected *c*-index, .76) and adequate calibration.

Conclusions: In our sample of patients with TKA, FIAL is common, and early identification of patients at risk of FIAL would bring them into appropriate modes of preventive care. Our prediction model shows some promise in identifying patients with FIAL, but prospective validation studies are needed.

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Fear-induced activity limitation (FIAL) is the avoidance or curtailment of daily activities because of a fear of falling.[1] To be sure, in older adults, some level of fear of falling is rational, and when the fear of falling does not interfere with daily activities, it may even be helpful in preventing falls.[2-4] The situation, however, becomes problematic when the fear of falling induces older adults to avoid or restrict their daily activities.[1-4] Specifically, FIAL contributes to a vicious cycle of physical deconditioning and frailty that, in turn, perpetuates or increases the fear of falling, the risk for falls, and the severity of FIAL.[1-4] Furthermore, because older adults with FIAL may become socially isolated because of a reduction in social interaction, FIAL can negatively affect their mental well-being.[2-4] Clearly, early recognition and prediction of FIAL are vital so that interventions can be initiated to prevent these negative outcomes.

To date, several studies[1,4,5] have evaluated FIAL in community-living older adults and in patients with rheumatoid arthritis.[6] To our knowledge, however, no studies have focused on older adults who have undergone a total knee arthroplasty (TKA).

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And yet, understanding FIAL and its predictors may be particularly important in this patient population for 2 reasons. First, although a TKA can relieve knee pain and restore self-report function in patients with advanced stages of knee osteoarthritis (OA), falls[7,8] and fear of falling[8,9]—both of which are strong risk factors for FIAL[1,4]—continue to be considerable problems in these patients. Second, compared with age-matched, knee-healthy controls, patients with TKA have greater physical impairments and functional limitations even 1 year after surgery,[10] and it is plausible, at least in a subgroup of patients, for FIAL to contribute to or perpetuate these persistent impairments and limitations.

Given the aforementioned considerations, the objectives of this study were to (1) assess the presence of FIAL in our sample of patients 1 year after TKA, and (2) develop a preliminary prediction model to predict the risk of FIAL. When developing the model, we deliberately focused on preoperative variables with the rationale that if the health care professional could identify, at the preoperative level, patients who are at risk of having FIAL 1 year postsurgery, it would prompt the recommendations of early and targeted "prehabilitation"—a treatment concept with accumulating recent evidence for its therapeutic potential.[11-13]

Methods

Participants

Our study sample comprised patients 60 years and older undergoing unilateral TKA for primary knee OA at 1 hospital from June 2010 to January 2011. Patients were recruited within a month before their surgery as part of a randomized trial investigating the effects of postoperative electrical muscle stimulation. Patients were excluded if they (1) had secondary knee OA resulting from trauma, inflammatory or metabolic rheumatic diseases; (2) had previous lower extremity surgery in the past year; (3) had significant back, hip, or foot pain; (4) were unable to walk 10m independently without an assistive device; or (5) had any medical conditions that would compromise physical function or affect their abilities to complete testing. A total of 104 eligible patients participated in our original clinical study. So that our results were more comparable with those from the geriatric literature, we excluded 16 patients who were younger than 60 years. A further 16 patients were excluded from the final analysis because of the following reasons: (1) underwent unicompartmental knee arthroplasty instead of TKA (n=2); (2) found to be unfit for the operation (n=6); (3) declined to continue participation (n=5); and (4) developed postoperative medical complications that adversely affected the outcomes (n=3). Thus, the final sample comprised the remaining 72 patients. Ethical approval was obtained for this study.

List of abbreviations:

AP	anteroposterior
CI	confidence interval
COP	center of pressure
FIAL	fear-induced activity limitation
ML	mediolateral
OA	osteoarthritis
OR	odds ratio
ROM	range of motion
SAFFE	Survey of Activities and Fear of Falling in the Elderly
SF-36	Medical Outcomes Study 36-Item Short-Form Health Survey
TKA	total knee arthroplasty

Sociodemographic characteristics

Patients attended a test session at the outpatient physiotherapy department after providing written informed consent. For our analysis, besides treatment assignment, we focused on age,[1,3,4,14] sex,[3,14,15] body mass index,[15] history of fall occurrence in the past year,[3,4,14] number of comorbidities,[3] self-report physical function,[1,2] gait speed,[1,3] knee impairments,[16] and standing balance[4,16]—variables that are routinely or easily obtained in a preadmission setting and have been correlated elsewhere with FIAL, falls, or activity limitations. The number of comorbidities was obtained using a checklist modeled after the Self-Administered Comorbidity Questionnaire.[17] Self-report physical function and bodily pain were assessed using the physical function and bodily pain subscales of the Medical Outcomes Study 36-Item Short-Form Health Survey (SF-36).[18]

Habitual gait speed

To assess gait speed, patients were timed using a stopwatch as they walked 10m at their usual pace. Patients stood directly behind the start line and were clocked from the time the first foot crossed the start line until the lead foot crossed the finish line. Patients were instructed to finish at least 2m past the finish line to eliminate the deceleration effects from stopping the walk. Each patient performed 2 valid trials, and the faster trial was recorded.

Knee range of motion

A Lafayette Gollehon extendable goniometer[a] was used to measure passive knee range of motion (ROM). Knee extension ROM was measured with the patients in supine position with the heel elevated on a firm wedge. Knee flexion ROM was measured with the patients in long sitting position. Two sets of measurements were taken, and the higher measurement was recorded.

Standing balance

Standing balance was assessed using the Wii Balance Board[b] in a protocol previously validated against a laboratory forceplate.[19] To perform the test, patients stood barefooted on the Wii Balance Board in their usual comfortable stance, and they were instructed to stand quietly. Two 30-second trials were performed, and the mean of 2 trials was used. The Wii Balance Board was interfaced with a laptop computer using custom-written software,[c] and anteroposterior (AP) and mediolateral (ML) center-of-pressure (COP) coordinates were recorded at 40Hz and low-pass filtered at 6.25Hz. A priori, we focused on 4 measures: COP range and COP velocity along both AP and ML axes. COP range represents the distance between the most positive and negative COP trajectory positions in the respective axes; COP velocity represents the distance covered by the COP in the respective axes (path length) divided by the sampling duration. Conventionally, greater postural sway and velocity indicate poorer balance control.

Outcome measure

Trained personnel, blinded to both the study hypothesis and the patients' baseline performance, interviewed the patients by telephone 1 year after their TKA. In our study, FIAL was quantified by the Survey of Activities and Fear of Falling in the Elderly