The association between kinesiophobia and dynamic balance in patients with patellofemoral pain syndrome

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Abstract. – OBJECTIVE: The aim of the study was to examine the relationship between Kinesiophobia and dynamic balance in patients with patellofemoral pain syndrome (PFPS).

SUBJECTS AND METHODS: Forty subjects with PFPS [20 Low Kinesiophobia (LK), 20 High Kinesiophobia (HK)], and 20 pain-free subjects (control group) were enrolled in the study. All subjects performed a Y-balance test to measure the dynamic balance. Normalized reach distance and balance parameters were recorded.

RESULTS: Our findings indicated that patients with PFPS who have a greater Kinesiophobia showed a poorer dynamic balance. In addition, the HK group showed a significantly lower mean reach distance score in the anterior, posterolateral, and posteromedial directions compared to LK and healthy groups.

CONCLUSIONS: Addressing the psychological factors such as Kinesiophobia during examination and treatment of people with PFPS may be important to improve the dynamic balance.

Key Words:
Balance, Patellofemoral pain syndrome, Kinesiophobia, Y-balance test.

Introduction

Patellofemoral pain syndrome (PFPS) is one of the most widespread knee conditions of musculoskeletal origin with a prevalence of more than 20% in the general population[1]. PFPS is described or labeled all anterior knee pain since there is a large number of pathologies similarly manifested as PFPS[2]. The clinical features of PFPS are usually described as a pain behind or around the patella that is exacerbated by several movements or activities such as squatting, running, and stair ambulation[3]. However, it is still one of the most challenging muscle-skeletal disorders facing physiotherapists and sport medicine specialists[4] as the underlying pathological mechanisms require further investigations[5].

Kinesiophobia, also known as "fear of movement", can be defined as "an excessive, irrational, and debilitating fear to carry out a physical movement due to a feeling of vulnerability to a painful injury or re-injury"[6]. PFPS could be a result of a direct unpleasant experience (e.g., trauma and pain) or indirectly by social learning methods such as observation and instruction[7]. Previous studies have shown that pain, disability, and quality of life are associated with Kinesiophobia[8], and reported a prevalence of Kinesiophobia in chronic musculoskeletal pain ranging between 50% and 70%[9,10]. Studies[11] have further demonstrated that Kinesiophobia and severity of self-reported disability are positively correlated in patients with PFPS.

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Dynamic postural control dysfunction is also reported in patients with PFPS[12,13]. It is manifested as reduced in knee and hip flexion, increased hip adduction and internal rotation, and pelvic drop during the single leg squat[14,15]. While both dynamic postural control dysfunction and Kinesiophobia have been reported in PFPS, the relationship between Kinesiophobia and dynamic postural balance in patients with PFPS has not been investigated. We hypothesized that Kinesiophobia may affect dynamic balance in our patient's group. Therefore, the aim of this study was to investigate the relationship between Kinesiophobia and dynamic balance in patients with PFPS.

Subjects and Methods

Large effect sizes were reported in prior Y-balance test (YBT) studies in participants with knee and ankle disorders[16,17]. Using $\alpha = .05$, power = 0.80, a sample of 15 subjects was needed in each group. To account for attrition, a convenience sample of 20 subjects was chosen for each of the groups in the study. Therefore, a total sample size of 60 subjects were recruited for this study.

We included PFPS subjects with criteria: age 18-40 years; anterior knee pain in one leg for at least 8 weeks, tenderness on palpation of the patella and pain during isometric quadriceps contraction, pain provoked or increased by two or more of these positions and activities: (squatting, sitting, stair climbing, hopping, running); at the time of the study, we stopped all the rehabilitation program for our patients. Subjects in the high Kinesiophobia group should have >37 score on the Tampa Scale of Kinesiophobia[18]. Subjects with previous knee surgery, patellofemoral instability, knee joint effusion, ligamentous or other soft tissue injuries, vestibular or other balance disorders were excluded. Procedures and protocols of the study were approved by the Ethical Committee of the Hashemite University and patients signed written informed consents before participation in the study.

Procedures

The demographic data including height, weight, age, and gender were taken by using self-report. The Visual analogue scale (VAS), Knee Injury and Osteoarthritis Outcome Score, and Patellofemoral questionnaire (KOOS-PF) were used to measure the pain and disability in Subjects with PFPS[19]. In addition, the Tampa Scale of Kinesiophobia (TSK) was used to measure the fear of movement in subjects with PFPS (Table I). Once subjects completed all the questionnaires, physiotherapist evaluated their dynamic balance using the YBT. All the outcome measures were evaluated by a blinded assessor.

Following completion of the preparatory procedures, subjects performed the Y-Balance Test using the Y-Balance Test Kit. The testing protocol followed recommendations made by Gribble et al[16].Verbal instructions and visual demonstration were given for all subjects on how to perform the Y-balance test. The performance of the Y-balance test was done by all subjects by standing barefoot on the center footplate with the involved side bearing their weight. The subjects were instructed to push the box as far as possible in the three directions were tested (the anterior (ANT), posterolateral (PL), and posteromedial (PM) directions) (Figure 1). In addition, every subject was asked to practice four trials before starting the actual trials to minimize the learning effect[29]. However, during the actual test, they performed three successful repetitions in each direction (Anterior, PL, and PM) with a 10-seconds rest following each trial[21]. The three testing directions were

Table I. RMean (SD) of baseline characteristics by study group (n = 60).

	High Kinesiophobia group (n 1=20)	Low Kinesiophobia group (n 2=20)	Control (n 3=20)	*p*-value
Male n (%)	9 (45%)	11 (55 %)	9 (47.4 %)	0.98
Age, year	29.5 (2.4)	28.95 (2.9)	28.16 (3)	0.11
BMI (kg/m^2)	25.3 (3.1)	24 (2.21)	24.3 (2.6)	0.22
Pain Level	3.9 (1.1)	3.3 (1.4)	-	0.11
KOOS-PF	33.4 (8.3)	29.8 (6.3)	-	0.42
TSK	42.7 (5.5)	27.8 (2.8)	-	0.001

SD, Standard Deviation; BMI, Body mass index; KOOS-PF: The Knee Injury and Osteoarthritis Outcome Score Patellofemoral; TSK, Tampa Scale for Kinesiophobia.

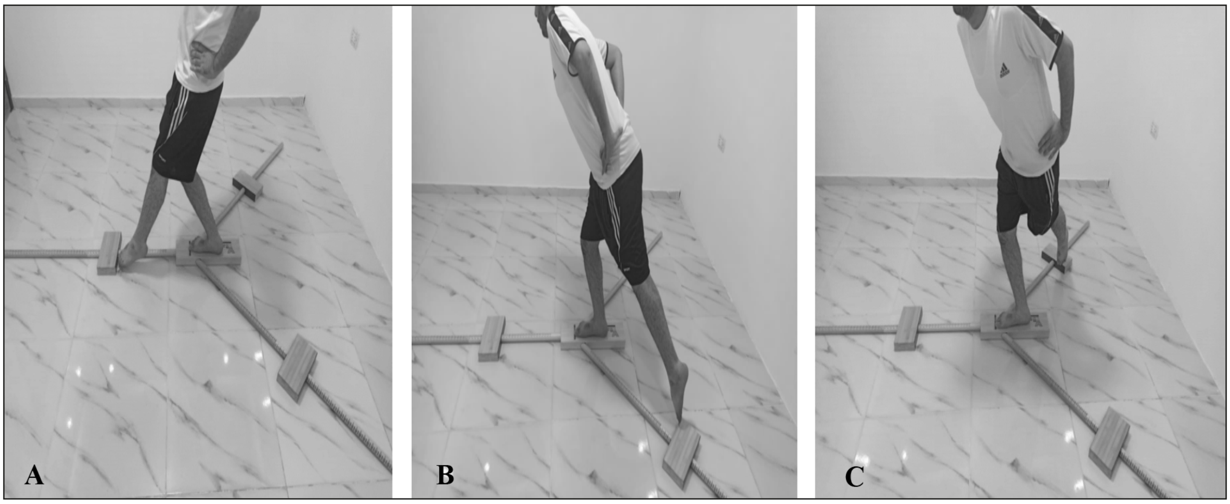

Figure 1. The Y-Balance Test. Subject reaches in the anterior (**A**), posteromedial (**B**), and posterolateral directions (**C**).

randomized to control the order effect. The trial was considered invalid if one of the following occurred: unable to maintain the reach foot contact with the reach indicator while in motion, the stance foot is lifted during reaching out, or lost their balance during reach out and return[21]. The limb length (from the anterior superior iliac spine to the medial malleolus) was used to normalize reach distance[22].

Statistical Analysis

(mean ± SD) were calculated for quantitative variables and counts (%) for qualitative variables. Data were tested for normality of continuous variables using Shapiro-Wilk's test and Box- plots. Chi-square was used to test the frequency distribution of gender by study groups. Independent samples one-way analyses of variance (ANVAs) or independent *t*-test were used to determine any differences in means for quantitative variables.

Three independent samples of one-way ANOVAs were performed to examine significant differences in reach distance among the three groups. Tukey's post-hoc tests were used to identify the significant differences within each analysis. The level of significance was set at $\alpha = .05$. All statistical analysis was performed using SPSS Software, version 24 (IBM Corp., Armonk, NY, USA).

Results

Demographic data is shown in Table I. However, no significant differences existed in the subjects' characteristics among the three groups ($p > .05$).

Reach Distance

Anterior reach distance was a significantly differed in mean reach distance between the high Kinesiophobia (HK) group and low Kinesiophobia (LK) group (51.9 ± 3.5 *vs.* 60.2 ± 6.3, $p<0.001$). In addition, reach distances were significantly reduced in the HK group compared to the healthy group (51.9 ± 3.5 *vs.* 62.9 ± 3.7, $p<0.001$), but no significant difference was found between LK group and healthy. However, in the PL reach direction, a significant difference was found between HK and LK (69.9±5.4 *vs.* 78.5±6.8, $p<0.001$), HK and healthy (69.9±5.4 *vs.* 90.9±5.4, $p<0.001$). LK and healthy (78.5±6.8 *vs.* 90.9±5.4, $p<0.001$). Similar results were found in the PM direction, a significant difference was found between HK and LK (74.4 ±4.3 *vs.* 82.9±12, $p=0.03$), HK and healthy (74.4 ±4.3 *vs.* 93.6±4.4, $p=0.001$), LK and healthy (82.9±12 *vs.* 93.6±4.4, $p=0.01$) (Figure 2).

Discussion

This study examined the differences in the dynamic balance – Y-balance test scores – among two subgroups of PFPS compared with healthy subjects. Our findings indicated that patients with PFPS who have a greater Kinesiophobia showed a poorer dynamic balance. Our results showed that the mean reach distance was significantly lower in HK group compared to LK and pain-free control groups in all directions of YBT. Furthermore, LK group showed lower reach distance in both PL and PM directions compared to the pain-free control group.

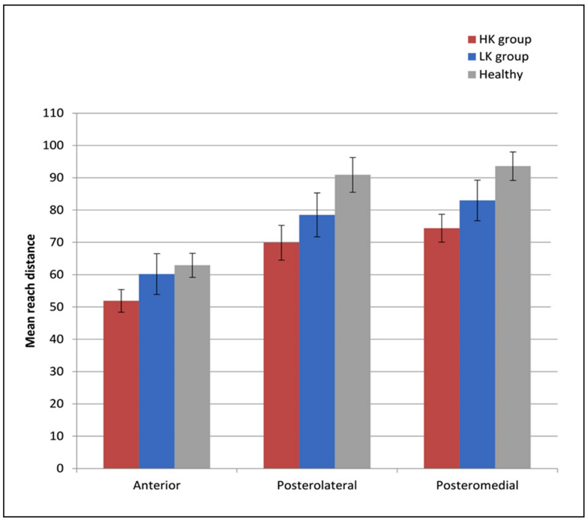

Figure 2. Reach distance (cm) by study group (N=60). HK: High Kinesiophobia group, LK: Low Kinesiophobia group.

Comparing our findings with different chronic pain conditions, we found that our results agree with Bränström and Fahlström[23] study, which compared the differences in Kinesiophobia in patients with chronic musculoskeletal pain and found that 56% of patients had high Kinesiophobia scores (TSK, >37). In addition, another study showed that TSK score could be higher in presence of different disorders including musculoskeletal, cardiovascular disease, or mental disorders compared with the absence of the aforementioned disorders[24].

Our findings are in the same line with the Priore et al[25] study, which found significant differences in modified Star Excursion Balance Test (mSEBT) between women with PFPS compared to a pain-free control group, as well as that individuals with PFPS have poorer performance in dynamic balance test, which are consistent with previous research[26] reporting that individuals with PFPS demonstrated poorer performance in Star Excursion Balance Test (SEBT) compared to healthy individuals. The limited reach distance in the Y-balance test in both PFPS subgroups compared to the healthy subjects could be explained by many reasons. First, maintaining postural control is a complex skill that requires interaction between vestibular, visual, and somatosensory systems. Furthermore, if any of these systems are impaired, the body tries to compensate by increasing the demands on the other systems. However, failure of this compensation could lead to loss of dynamic balance[27]. Therefore, during anterior reach trials in YBT, the visual system compensates for any deficits in the somatosensory system in people with PFPS because they were able to visualize the movement throughout the activity; however, visualizing the movement is not possible during reaching in the posterior trials because the movement out of the line of sight[30]. Second, the Y-balance test requires knee flexion to maximize the reaching distance, and people with PFPS may reduce knee flexion to reduce Patellofemoral joint stress and consequently reduce pain[28]. In addition, this adoption of compensatory movement strategies could be higher in HK subgroup[29]. Third, reaching in the anterior directions in the YBT is more challenging to HK group subjects compared to LK and healthy groups. Reaching in the anterior directions could elicit a high level of quadriceps muscle activation and this muscle is commonly deficient in people with PFPS[30], therefore, subjects with HK may anticipate increasing pain during the performance of this task, consequently, they may avoid performing the task vigorously which is resulting in poor performance.

Our findings indicated that HK group had a significantly higher scores Tampa Scale for Kinesiophobia compared to LK group. However, no significant difference was found in pain and disability scores between HK group and LK among individuals with PFPS. Higher Kinesiophobia among people with PFPS is consistent with recent findings reported by Machlachlan et al[11] which have reported that Kinesiophobia seems to stand as an important factor in the experience of PFPS. Based on previous studies[29,31,32], people who experience fear of movement tend to avoid any movement and physical activities that may increase the risk of pain exacerbation.

Our study findings provide a great addition for future interventions and studies. The study of Koho et al[33] concluded that multidisciplinary rehabilitation team may create favorable results in terms of pain and physical activity level among high Kinesiophobia patients, while Vlaeyen et al[34] study showed that people with chronic pain can successfully adapt the movements or activities that might normally avoid due to Kinesiophobia. Lüning Bergsten et al[35] suggest that including treatment of Kinesiophobia among individuals with chronic pain might be useful to prevent patients with high Kinesiophobia from preserving high activity limitations.

Study Limitations

The current study has several limitations that should be acknowledged. Our study did not investigate the relationship between psychological impairments and movement patterns as well as PFPS prognosis. The cross-sectional design of our study limits the chance to measure the relationship between Kinesiophobia, pain, and functional performance over time. In addition, we did not measure muscle activation or lower limb kinematics during the performance of Y-balance test. This information could provide more insights about the movement strategy and biomechanical changes in this target population.

Conclusions

Our findings suggest that individuals with PFPS have greater Kinesiophobia and poorer dynamic balance compared to healthy subjects. Further research warrants the understanding of the effects of physical and psychological factors on balance performance and daily function among individuals with PFPS. Further research is needed to identify effective intervention approaches for people with PFPS who have a high level of Kinesiophobia.

Conflict of Interest

The Authors declare that they have no conflict of interests.

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Ethics Approval

The present study was approved by the Ethical Committee of The Hashemite University, Jordan (No.: 4/9/2021/2022), and it was performed according to the principles of the Declaration of Helsinki.

Informed Consent

All participants signed a written informed consent before the examination. Instructions, objectives, and steps of the procedure were explained for each participant.

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