J. Phys. Ther. Sci. 35: 128–132, 2023

The Journal of Physical Therapy Science

Original Article

Association between knee function and kinesiophobia 6 months after anterior cruciate ligament reconstruction

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Abstract. [Purpose] Kinesiophobia after anterior cruciate ligament reconstruction has been identified as an inhibitor of return to sports. This study aimed to clarify the relationship between kinesiophobia and knee function 6 months after anterior cruciate ligament reconstruction when the patient intends to return to sports. [Participants and Methods] A total of 66 patients who underwent primary anterior cruciate ligament reconstruction (mean age 17.3 ± 2.6 years, 17 males and 49 females, Tegner activity score ≥7) were included in the study. The 11-item version of Tampa scale of kinesiophobia was used to evaluate kinesiophobia 6 months postoperatively. Knee function was evaluated with knee extension muscle strength, tibial anterior displacement, heel buttock distance, heel height difference, anterior knee pain score, and single-leg hop test. The relationship between Tampa scale of kinesiophobia, patient characteristics, and knee function was investigated. [Results] A low Anterior knee pain score and low single-leg hop test, male gender, and age were significant factors associated with kinesiophobia. [Conclusion] Kinesiophobia was associated with a low anterior knee pain score and low single-leg hop test 6 months after anterior cruciate ligament reconstruction. Patients with a low single-leg hop test score or severe pain may need rehabilitation to reduce kinesiophobia.

Key words: Anterior cruciate ligament reconstruction, Kinesiophobia, Knee function

(This article was submitted Oct. 6, 2022, and was accepted Nov. 9, 2022)

INTRODUCTION

Anterior cruciate ligament reconstruction (ACLR) is performed to return athletes to sports (RTS). However, problems of a limited range of motion (ROM)[1)], pain, and muscle weakness after ACLR can occur[2, 3)]. Physical therapy focusing on functional improvement is necessary in the early postoperative period. The Single-Leg Hop Test (SLHT) and knee joint extension muscle strength have been reported as indicators of RTS after ACLR[4, 5)].

Psychological factors also greatly influence the RTS after ACLR[6)]. The Tampa scale for kinesiophobia (TSK) has been useful to evaluate kinesiophobia, pain, and re-injury[7)]. Previous studies reported the association between kinesiophobia and early postoperative subjective knee function and pain at 1, 2, and 3 months, and at 6 months after ACLR[8, 9)]. Muscle strength and the SLHT were lower in patients with strong kinesiophobia than those with weak kinesiophobia in patients who RTS; however, timing of evaluation of return to sports was not consistent[10)]. In a previous study, only patients who had RTS were

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evaluated, and the timing of the evaluation was not consistent. In this study, the evaluation period was fixed at six months. In addition, knee function and performance at six months post-ACLR were reported as a predictor of whether a patient will be able to return to the same activity level as pre-injury at 12 to 24 months post-ACLR[11]. We believe it is important to have good knee function and psychological status six months after ACLR surgery to RTS.

We hypothesized that kinesiophobia might be related to knee joint function and pain after ACLR; therefore, this study determined the relationship between knee function, pain, and kinesiophobia six months after ACLR.

PARTICIPANTS AND METHODS

This cross-sectional study included 66 patients who underwent anatomical single-bundle ACLR (semitendinosus and gracilis tendons [STG] and bone-patellar tendon-bone [BTB] grafts) between June 2015 and January 2016. These patients underwent initial ACLR. The inclusion criteria were (i) patients undergoing anterior cruciate ligament reconstruction, (ii) patients with no serious complications, and (iii) patients who understand and respond to the questionnaires. The exclusion criteria were (i) patients with a history of ACLR, (ii) patients who underwent ACLR and complex ligament reconstruction at the same time, and (iii) patients with a limited knee extension range of motion. The Anshin Hospital ethics committee approved all procedures before the study (approval protocol number 110). The study was conducted according to the Declaration of Helsinki, and all participants provided written informed consent before participating. The postoperative rehabilitation protocol was the same for all patients. Patients were discharged from the floor on the same day after surgery and started using a walker. They were rehabilitated twice a day, using cold therapy to reduce inflammation, range of motion training, muscle strength training, and daily life activities such as walking, and stage Rise and Fall. No range of motion or load limits were set. After discharge from the hospital, the patient continued weekly outpatient rehabilitation and home exercises until returning to sports, intending to acquire independent walking in 1 month, start running and athletic rehabilitation in 3 months, start dashing in 4 months, gradually return to practice in 5 months, and returning to practice and games in 6 months or later. Physical therapy including icing and inflammation management of the affected area was used for 6 months during hospitalization. Split squats and lunges, airplane, and one-legged squats, jump training, hopping and cutting movements, and movements of each exercise category were performed in the first, second, third, fourth, and fifth postoperative months, respectively. Moreover, competition practice was resumed in the fifth postoperative month. Hip and trunk training, such as one-legged hip lifts and clamshells, were performed in muscles that were weak in the early postoperative period.

Patient characteristics were evaluated including gender, age, BMI, injury origin (contact or noncontact), and Tegner activity score.

We used the TSK-11[8], an abbreviated version of the Tampa scale for kinesiophobia[7]. TSK-11 is a self-administered questionnaire that assesses fear-avoidance thoughts that limit exercise and behavior due to pain, anxiety, and fear[12]. The TSK-11 has been widely used to measure kinesiophobia in post-ACL reconstruction patients. There were 11 questions asked, each with a minimum score of 1 and a maximum score of 4. The lowest score was 11, and the highest score was 44. Pain was assessed using the anterior knee pain scale (AKPS)[13], a self-administered questionnaire for anterior knee pain. The five items of “Sports, heavy labor”, “Stairs”, “Kneeling”, “Daily life”, and “After sitting for a long time” are evaluated with 0 to 20 points for each item with 100 points in total. A higher score indicates less anterior knee pain during exercise.The SLHT was measured based on previous research[14]. Participants stood on one leg behind a line representing the starting point, hopped as far as possible, and landed on the same leg. The test was considered successful if the landing was stable. The limb symmetry index (LSI) of the SLHT was calculated as the difference between the means of two attempts. The forward travel distance of a single-legged jump was assessed and used as a performance test[15]. Knee extension strength was measured using a hand-held dynamometer μTas F-1 (Anima Corporation, Tokyo, Japan). The procedure was performed as in a previous study[16]. Measurements were made while the participants were seated. The upper limb was placed on the bed in the sitting position and supported the body to prevent a fall. The validity of the hand-held dynamometer has been reported[17]. The LSI of extension strength was calculated as the mean of two attempts. Tibial anterior displacement (TAD) was measured using the KS measure (Nihon Sigmax Co., Ltd., Tokyo, Japan)[18]. The patient was placed in a supine position and the knee joint was flexed with the knee rest placed over the popliteal fossa. The examiner performed the measurement twice and recorded the maximum value. The LSI of TAD was calculated as the difference between the operated side and the unoperated side. The Heel Height Difference was used to evaluate the range of motion of knee joint extension[19]. The healthy lateral difference of both calcaneal heights is measured in 0.5 cm increments with the patient supine and the patella at the edge of the bed. Heel Buttock Distance (HBD) was performed in the supine position with the knee joint on the measurement side flexed, and the distance between the heel and the hallux was measured just before the hallux was lifted off the bed. If pain occurred, measurements were taken at an angle at which the pain occurred. The reason for using HBD as an evaluation index of knee joint flexion range of motion was that it provides a more detailed measurement of range of motion in 0.5 cm increments, whereas the orthopedic rehabilitation society’s method of measuring range of motion is in 5° increments. Continuous variables are expressed as the median and interquartile range (IQR). Ordinal and categorical variables are expressed as numbers and percentages (%). Statistical analyses were performed with the Shapiro–Wilk test for normality for all assessments of the correlation coefficients between TSK-11. Multiple regression analysis (stepwise method) was performed with patient characteristics and knee function as dependent variables and TSK-11 as an independent variable. The significance level was 5%.

RESULTS

We confirmed the measured baseline characteristics and physical function of our remaining participants. The patient's demographic characteristics are shown in Table 1. The BMI was normal. No normal distribution was found for other values. The results of the multiple regression analysis are presented in Table 2. SLHT and AKPS and Male and Age were extracted as factors that correlate with TSK-11 at 6 months postoperatively (AKPS: $\beta=-0.34$, $p<0.01$, SLHT: $\beta=-0.36$, $p<0.01$, males: $\beta=-0.48$, $p<0.01$, Age: $\beta=-0.28$, $p=0.01$).

DISCUSSION

AKPS, SLHT, males and Age at six months after ACLR were associated with kinesiophobia. This study is the first to show this association at 6 months after ACLR.

The fear-avoidance thought model of musculoskeletal pain is considered a factor in developing chronic pain syndromes, and a strong sense of kinesiophobia contributes to pain and escape behaviors and delays functional recovery[20]. The high AKPS is an important postoperative problem in ACLR[21]. According to George et al., kinesiophobia and pain in the late postoperative period after ACLR are related[8]. We examined the relationship between AKPS and kinesiophobia, and our results support these findings.

Table 1. Patients' demograhic data

Variable	Average value
BMI, kg/m^2*	22.0 ± 2.0
Age, years*	17.3 ± 2.6
Gender	
Male	17
Female	49
Graft types	
STG	43
BTB	23
Tegner activity score	7.1 ± 0.3
BHD, cm	3.3 ± 3.8
HHD, cm	1.3 ± 1.4
Muscle strength, %	90 ± 13.7
TAD, mm	1.0 ± 1.9
SLHT, %	90 ± 1.0
AKPS[1], points	93.8 ± 6.5
TSK-11[2] points	16.9 ± 5.3

*Average Value or n.
STG: semitendinosus, and gracilis tendons; BTB: bone-patellar tendon-bone; HHD: Heel Height Difference; TAD: Tibial Anterior Displacement; SLHT: Single-Leg Hop; Test; AKPS: Anterior Knee Pain Score; TSK-11: 11-item version of the Tampa Scale of Kinesiophobia.
[1]Anterior knee pain score from 0 to 100 points, a lower score indicating greater anterior knee pain.
[2]TSK-11 scores range from 11 to 44 points, a higher score indicating greater fear of movement/reinjury.

Table 2. Multiple regression analysis to determine the association between Kinesiophobia and knee function

Variable	β
SLHT**	−0.34
AKPS**	−0.36
Male**	−0.48
Age*	−0.28

SLHT: Single-Leg Hop Test; AKPS: Anterior Knee Pain Score.
*The mean difference is significant at $p<0.05$.
** The mean difference is significant at $p<0.01$.
R^2: 0.44.

We also found an association between SLHT and kinesiophobia. A previous study reported an association between SLHT and the Fear-Avoidance Beliefs Questionnaire (FABQ), a physical activity scale of Fear-Avoidance Beliefs 2 to 3 years after surgery[22]. Although we assessed kinesiophobia with the TSK-11 in ACL patients six months after surgery, our results coincide with this study. Kinesiophobia is about movement and pain and thoughts of avoiding movements that may cause fear of re-injury[7]. The SLHT includes the one-legged landing movement[23], a common injury mechanism in ACL that may be related to the fear of reinjury.

Since patient education[9] and cognitive-behavioral therapy[24] have been reported to improve fear of movement, psychological factors must be considered in physical therapy to improve knee function after ACLR. If the SLHT value is low or the AKPS is strong, it is necessary to improve knee joint function and evaluate kinesiophobia at each stage and proceed with physical therapy while understanding the degree of kinesiophobia.

Next, we found that kinesiophobia was associated with the male gender and age. Previous studies have reported that males are more kinesiophobia than females[25] and that young adults are more likely to have psychological problems than their elders[26]. The results of the present study supported the previous study.

There were some limitations in this study. First, we could not describe causal relationships because this study was cross-sectional. It is necessary to conduct a longitudinal study to examine the causal relationship. Second, it did not consider the effect of the surgical technique. It has been reported that BTB is more likely to cause AKPS[27]. The difference in kinesiophobia depending on the type of surgery could have been examined if the study had been conducted with either surgery. Both BTB and STG were included in the procedure due to the small sample size. Third, we did not examine the relationship between the Q-angle and AKPS. A study reported an association between Q-angle and AKPS[28], which could have been discussed from a broader perspective if we had examined the alignment in the present study. Finally, this study has a small sample size. If the sample size had been larger, we could have examined the relationship with other knee functions such as flexion, range of motion, muscle strength, and other psychological aspects, such as those of the Pain Catastrophizing Scale.

This study showed that AKPS and SLHT six months after ACLR were associated with kinesiophobia. It is necessary to consider kinesiophobia during rehabilitation after ACLR to RTS.

Funding and Conflicts of interest

The authors declare no conflicts of interest to disclose.

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