

Relationship between lower limb muscle strength and kinesiophobia with functional stability and knee function in anterior cruciate ligament reconstruction patients: a literature review

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ABSTRACT

Background: One of the athletes' most prevalent knee injuries is a torn anterior cruciate ligament (ACL). ACL injuries may lead to various unpleasant symptoms, including joint instability, muscular atrophy, and soreness. ACL reconstruction is usually recommended to restore peace and function to the knee joint. After ACL reconstruction, knee muscle strength can remain compromised, leading to deficits in stability and functional limitations. ACL reconstruction also has psychological consequences, such as fear of moving due to injury or kinesiophobia.

Purpose: To determine the relationship between lower leg muscle strength and kinesiophobia with functional stability and knee function in patients with ACL reconstruction.

Methods: The research method used is a literature review using data from scientific articles in scientific journal databases related to muscle strength, kinesiophobia, functional stability, and knee function after ACL reconstruction. The literature search used the keywords "ACL," "Strength," "Function," and "Kinesiophobia" by combining the Boolean Operators "OR" and "AND."

Results: It was found that after ACL reconstruction, muscle strength and kinesiophobia will affect the functional stability and function of the knee. Decreased muscle strength will lead to lower knee stability and function. Kinesiophobia level is associated with poorer clinical outcomes after ACL reconstruction.

Results: Based on the review results, it can be concluded that there may be problems arising from ACL reconstruction. Decreased muscle strength and psychological consequences such as fear of moving due to injury or kinesiophobia can affect the knee's functional stability and function.

Keywords: anterior cruciate ligament, anterior cruciate ligament reconstruction, functional stability, kinesiophobia, knee function, muscle strength

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Introduction

One of the athletes' most prevalent knee injuries is a torn anterior cruciate ligament (ACL).^{1,2} In America, ACL ruptures occur in approximately 250,000 people each year. In the United States, total medical costs, including diagnosis, surgical reconstruction, and postoperative rehabilitation of ACL injuries, amount to \$3 billion annually.³ In Indonesia, the prevalence of knee joint ligament injuries in 2015 was recorded by the Rumah Sakit Olahraga Nasional (RSON) as around 47 out of 87 cases (54%).⁴ Injuries to ACL may occur due to contact or non-contact. Non-contact ACL injuries occur

due to rapid deceleration when suddenly changing the direction of the foot, such as landing from a jump, twisting, and turning. While contact ACL injuries occur due to hyperextension or sudden jerking directly on the knee's lateral side, producing a valgus force that can cause a tear in the ACL or dislocation of the knee.^{5,6,7} ACL injuries may lead to unpleasant symptoms, including joint instability, muscular atrophy, and soreness.⁸

Tissue grafting from the ACL is a standard surgical procedure used to repair a torn ACL and return a patient to their pre-injury activities while also warding off potential

knee osteoarthritis.^{8,9} In addition, after ACL reconstruction, the muscle strength of the knee can remain compromised and lead to deficits in stability.¹⁰ The functional stability of the knee depends on an intact ligament system and proper and efficient contraction of the supporting muscles. After ACL injury and reconstruction, lower extremity muscle weakness is common, especially in the quadriceps and hamstring muscles. The quadriceps muscle of the injured knee is significantly weakened after ACL reconstruction. This weakness can affect knee function.¹¹ In addition, decreased knee flexion strength in the hamstring muscles can also cause functional limitations, especially in daily activities or sports requiring increased knee flexion.¹² ACL damage directly causes a loss of plantar flexion strength in the gastrocnemius muscle linked to the knee joint.¹³ Weakness in the gluteus maximus increases the risk of ACL damage because the capacity to resist internal rotation of the tibia is compromised.¹⁴

In addition to disrupting muscle strength, ACL reconstruction has psychological consequences, such as fear of moving due to injury or kinesiophobia.¹⁵ The term kinesiophobia comes from the word kinesis which means movement. This condition is described as an excessive fear that results from feeling vulnerable to painful injuries or new injuries when doing physical activity.¹⁶ More severe kinesiophobia was associated with lower physical activity levels after ACL reconstruction and decreased daily functioning.¹⁷ These situations can hurt patient functioning, such as activity daily living (ADL) and sports or physical activity.¹⁶ Inadequate knee function following ACL repair might raise the likelihood of future knee discomfort and osteoarthritis via aberrant knee joint motion and loading patterns, particularly during intense activity.¹⁸

Based on the above background, the researcher aims to discover more about the relationship between lower leg muscle strength and kinesiophobia with functional stability and knee function in ACL reconstruction patients. This research is expected to be useful for students and physiotherapists to add insight and determine rehabilitation measures for patients after ACL reconstruction surgery.

Methods

The research method used is a literature review study compiled using secondary data from scientific journal databases on the internet related to the relationship of lower limb muscle strength and kinesiophobia with functional stability and knee function in ACL reconstruction patients. Literature articles are obtained through searches on PubMed and google scholar using the keywords "ACL," "Strength," "Function," and "Kinesiophobia" by combining the Boolean Operator "OR" and "AND." The selection of literature was based on criteria of inclusion and exclusion. The inclusion criteria for this literature study are as follows: 1) Published literature from credible institutions, 2) The reviewed literature is published from the last ten years, 3) Contains two or more variables such as ACL reconstruction, muscle strength, functional stability, knee function, and

kinesiophobia. The exclusion criteria in this literature review were: 1) The sample had bilateral ACL reconstruction. The literature used in the literature review has met the requirements set by the author.

Results

Four studies found eligibility criteria: two prospective cohort studies, one pilot study, and one cross-sectional design study regarding lower limb muscle strength, kinesiophobia, functional stability, and knee function in ACL reconstruction patients. According to research published in four publications published in the past ten years and has the following relevant data and information.

In prospective cohort research, Yong-Hao Pua (2017) examined quadriceps strength and hopped performance in 70 ACL improvement samples, a dynamometer tested isometric quadriceps strength six weeks post-ACL surgery. The patient underwent a single-leg hop for distance test 6 months after ACL repair to evaluate hop performance. This study found a correlation between quadriceps strength and single-leg hop distance ($P < 0.001$).¹⁹

Another Yong-Hao Pua (2017) study used a prospective cohort study with 106 unilateral ACL reconstruction samples. This study assessed self-reported knee function using the Lysholm Knee Score, and work and exercise activity levels were evaluated using the Tegner Activity Score. Patients perform a single-leg hop for distance test after six months post-ACLR. Three months after the patient had ACLR, isokinetic and isotonic quadriceps and hamstring strength were assessed using dynamometers and a weight machine. After controlling for age, gender, body mass index, Lysholm score before ACL repair, and Tegner score before the injury, this research found that isotonic and isokinetic quadriceps strength LSI (Lower Symmetry Index) were correlated with hop distance ($P \leq 0.01$), Lysholm ($P \leq 0.03$), and Tegner scores ($P \leq 0.02$). Isotonic and isokinetic strength hamstring LSI was also associated with Lysholm scores ($P \leq 0.03$). However, the hamstring's isotonic strength ($P = 0.01$) significantly correlates with the LSI hop distance.²⁰

Ana Tichonova (2016) studied 41 samples, 22 after ACL reconstruction and 19 after meniscectomies, from rehabilitation patients at the Hospital of Lithuanian University of Health Sciences. This research evaluated kinesiophobia with the Tampa Kinesiophobia Scale (TSK-11) and knee function with the Knee Injury and Osteoarthritis Outcome Score (KOOS) before and after 14 sessions of rehabilitation. Before and after ACL reconstructive rehabilitation surgery, the TSK-11 score and the KOOS function in daily life subscale score had a moderate negative correlation ($P < 0.05$). Increased degrees of kinesiophobia are correlated with higher challenges in doing everyday tasks.²¹

Grant E. Norte (2019) conducted a cross-sectional study on kinesiophobia and clinical outcomes following ACL repair in 77 individuals aged 13–47. TSK-17 measures kinesiophobia in this research. Four single-leg hops evaluate hop performance (single, triple, crossover, 6-m timed). KOOS for knee function. All post-ACLR patients had a negative

association with triple hop distance $r=-0.323$ and crossover hop distance $r=0.331$. In low-physical activity patients, TSK-17 was negatively correlated with KOOSsymptoms, KOOSADL, and KOOSQOL ($r=-0.434$, -0.443 , and -0.375). TSK-17 had a negative association and moderate correlation with crossover hop distance, single hop symmetry, and triple hop symmetry in high-activity individuals ($r=-0.541$, -0.506 , and -0.530).²²

Discussion

Reconstruction is a suggested ACL tissue transplant procedure to restore knee joint stability and function, allowing patients to return to their prior activity level. After ACL reconstruction, several problems will occur as poor functional stability and decreased knee function. Several factors, such as muscle strength, pain, and kinesiophobia, can influence these. Lower extremity muscle weakness often occurs after injury or ACL reconstruction, impacting knee stability or function. In addition, kinesiophobia is one factor that prevents patients from returning to the level of physical activity before the injury and negatively impacts knee function.⁹

Muscle strength is one factor affecting functional stability in ACL reconstruction patients. Single-leg hop distance is correlated with quadriceps strength after ACL surgery. Functional stability of the lower extremities following ACL repair is sometimes evaluated using the hop test. A more significant decrease in quadriceps muscle strength is associated with lower functional performance. In particular, quadriceps muscle weakness has become one of the considerable disturbances after ACL reconstruction, and increasing quadriceps strength is necessary to improve functional stability. Jumping and other complex activities like running require the quadriceps to be able to generate torque quickly.^{19,23}

Lower extremity muscular strength significantly affects knee function in individuals after ACL reconstruction. ACL reconstruction is accompanied by reduced muscle function and abnormal functional movement patterns that can persist long after surgery. Poor muscle function, such as reduced quadriceps strength, predicts poor knee function after ACL surgery.²⁴ There is also a decrease in knee flexion muscle strength, which can cause functional limitations, especially in daily activities and sports that demand an increase in knee flexion muscle contraction.¹² In post-ACL reconstruction patients, quadriceps strength LSI correlates more strongly with future knee function and activity levels than hamstring strength LSI. Isotonic and isokinetic hamstring power LSI is also highly related to the Lysholm score, which evaluates knee function.²⁰

In addition to muscular strength, high levels of kinesiophobia were substantially associated with more significant difficulties in performing everyday tasks due to poorer knee function before and after rehabilitation. An overly adverse psychological reaction to repeated painful stimuli will cause the patient to avoid vigorous activity for fear of pain or harm (kinesiophobia). Avoiding physical exercise for lengthy periods may decrease knee function in everyday

activities and severely impact rehabilitation results. Because patients avoid movement and action to prevent discomfort, they don't undertake necessary exercises and activities throughout rehabilitation.²¹

Kinesiophobia negatively correlates with single-leg hop performance (single, triple, crossover), suggesting that ACLR patients with more fear have worse clinical results. Less active people with fatigable hamstrings have increased knee joint instability during regular activities, which increases worry. Inactive patients' sense of knee joint impairment affects their fear. In more active patients, anxiety was highly linked with single-leg hop performance. Even when the patient is more involved but has worse hop performance, he will feel more worried.²²

The limitations of this study were not explained regarding the surgical technique and the type of graft used, so there is a possibility of bias, and it cannot be generalized to all patients with ACL reconstruction. Future studies can explain the specifics of the surgical technique and type of graft in patients with ACL reconstruction and their relationship between lower leg muscle strength and kinesiophobia with functional stability and knee function.

Conclusion

The study's results above show possible problems arising from ACL reconstruction, such as decreased muscle strength and mental effects such as dread of movement due to injury or kinesiophobia that can affect functional stability and knee function. Higher kinesiophobia and weak muscle strength post-ACL reconstruction significantly affect knee function and poor stability. Therefore, a possible relationship exists between lower limb muscle strength and kinesiophobia with functional stability and knee function in ACL reconstruction patients.

Conflict of interest

This research is devoid of any conflicts of interest.

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Ethical consideration

This literature review used publicly accessible documents as evidence and did not require institutional ethics approval.

Author's contribution

GWPW conducted a literature search and prepared and edited the paper; IPGSA conceptualized the research design, conducted a literature search, and prepared and edited the report; and AAGAPN also conducted a literature search and reviewed the text.

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