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REVIEW

A Summary of the Evidence for Managing Exercise Phobia in Patients After Anterior Cruciate Ligament Reconstruction Surgery

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Background: In recent years, the incidence of anterior cruciate ligament (ACL) injuries has risen persistently. Notably, some patients develop movement fear after ACL reconstruction surgery. This psychological issue significantly reduces patients' exercise rehabilitation adherence and active participation willingness. It also exacerbates family caregiving pressures and healthcare systems' socioeconomic burden. Thus, it has become a critical factor affecting postoperative rehabilitation outcomes and public health resource allocation.

Methods: Using the "6S" evidence resource pyramid model, we systematically searched domestic and international guideline websites, professional society or association websites, and Chinese and English databases to obtain relevant literature on the management of exercise phobia after Anterior Cruciate Ligament Reconstruction (ACLR). The types of literature included clinical decision-making, evidence summaries, guidelines, etc. The search period was from the establishment of the database to June 30, 2025. Two researchers independently conducted literature screening and quality assessment, extracted, and integrated the evidence.

Results: A total of 18 documents were included, including one clinical decision, four guidelines, six meta-analyses, four systematic reviews, two evidence summaries, and one randomized controlled trial. These were summarized into 20 pieces of evidence and categorized into six aspects: management principles for patients with exercise phobia after ACLR, health education, pain management, rehabilitation exercises, intervention methods, and follow-up management.

Conclusion: This study summarized the best evidence for the management of exercise phobia in patients after ACLR. It is recommended that clinical healthcare providers select intervention strategies appropriately based on clinical practice and individual patient conditions to reduce the severity of exercise phobia in patients.

Keywords: anterior cruciate ligament reconstruction, exercise phobia, evidence summary, evidence-based nursing

Introduction

Anterior cruciate ligament (ACL) injuries are one of the most common knee injuries.[1] According to statistics, more than 400,000 people worldwide require treatment for ACL injuries each year.[2] In recent years, with the development of the national fitness movement, the incidence of ACL injuries has gradually increased.[3] Currently, anterior cruciate ligament reconstruction (ACLR) is the primary treatment for restoring knee stability after ACL injury.[4] Previous studies have shown that 90% of patients who undergo ACLR can recover knee function after surgery, but only 65% of patients can return to their pre-injury level of physical activity,[5] with fear of movement considered a key factor hindering and limiting patients' return to physical activity.[6]

ACL injuries are typically sudden, acute sports-related injuries. Patients often develop a stress response characterized by "fear of re-injury," leading those who undergo ACL reconstruction to frequently experience exercise

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phobia due to concerns about ligament re-injury or poor prognosis. The primary reasons for this psychological response are as follows: First, pain and restricted mobility are direct triggers of fear. ACL injuries are often accompanied by severe pain and limited knee joint movement. The physical suffering caused by this acute trauma creates a powerful sensory memory. Second, some patients experience anxiety after injury, manifesting as excessive sensitivity to uncertainties in the rehabilitation process. They tend to exaggerate the potential risks of movement, leading to cognitive biases.[7,8]

In 1983, Lethem et al[9] proposed the "fear-movement-avoidance" model. Subsequently, Kori[10] first defined "kinesiophobia" as an excessive and irrational fear of movement and behavior that arises when an individual experiences pain and fears that movement will cause secondary pain.Exercise phobia directly affects patients' compliance with exercise rehabilitation, promotes muscle atrophy, reduces cardiovascular health, and increases the economic burden on families and society.[11,12]

To date, most studies on exercise phobia have focused on knee replacement and chronic pain populations, while the management of exercise phobia after ACLR surgery remains in the exploratory stage. In clinical practice, the lack of targeted guidance often leads to inconsistent management strategies. This causes difficulties for medical staff and hinders the provision of effective guidance. In view of this, this study conducted a comprehensive review of the existing evidence on postoperative exercise phobia after ACLR both at home and abroad. By integrating relevant information, it aims to provide a reference basis for formulating a standardized management plan for postoperative exercise phobia after ACLR.

Data and Methods

Identifying the Problem

The evidence-based practice question was formulated using the PIPOST[13] evidence-based question development tool from Fudan University's Evidence-Based Nursing Center: (1) P (population): refers to the target population for the application of evidence, namely patients who have undergone ACLR surgery; (2) I (intervention): refers to intervention measures aimed at reducing the incidence and severity of exercise phobia in patients who have undergone ACLR surgery; (3) P (professional): refers to the personnel implementing the evidence application, including orthopedic surgeons, physical therapists, psychologists, nurses, ACLR postoperative patients, and caregivers; (4) O (outcome): refers to outcome measures, such as the severity of exercise phobia, pain scores, and knee joint function; (5) S (Setting): Refers to the location where the evidence is applied, including rehabilitation wards, orthopedic wards, and patients' homes; (6) T (Type of Evidence): Refers to the type of evidence, including guidelines, clinical decisions, expert consensus, systematic reviews, evidence summaries, and original research. This study has been registered at the Fudan University Center for Evidence-Based Nursing (registration number: ES20258383).

Literature Search

Following the "6S" evidence pyramid model, conduct the search from top to bottom: (1) Clinical decision support systems: BMJ (British Medical Journal) Best Practice, UpToDate, and the JBI (Joanna Briggs Institute) Evidence-Based Healthcare Center database; (2) Clinical practice guideline websites: the Registered Nurses' Association of Ontario (RNAO) website, the National Institute for Health and Clinical Excellence (NICE) guidelines website, the New Zealand Guidelines Group (NZGG), and the Guidelines International Network (GIN); (3) Professional association websites: American Academy of Orthopaedic Surgeons (AAOS), Osteoarthritis Research Society International (OARSI); (4) Comprehensive databases: PubMed, Embase, Web of Science, China National Knowledge Infrastructure (CNKI), Wanfang Database, and Chinese Biomedical Literature Database. Literature was retrieved using a combination of subject terms and free-text keywords, with the search scope set to include records up to June 30, 2025.The English search terms included "Anterior Cruciate Ligament," "Cruciate Ligament, Anterior," "Anterior Cruciate Ligaments," "Anterior Cranial Cruciate Ligament," "Kinesiophobia," "Fear of Movement," and "Pain Related Activity Avoidance." Figure 1 shows an example of a PubMed search strategy.

#1 "Anterior Cruciate Ligament"[Mesh]

#2 (Cruciate Ligament, Anterior) OR (Anterior Cruciate Ligaments) OR (Cruciate Ligaments, Anterior) OR (Ligament, Anterior Cruciate) OR (Ligaments, Anterior Cruciate) OR (Anterior Cranial Cruciate Ligament) OR (Cranial Cruciate Ligament) OR (Cranial Cruciate Ligaments) OR (Cruciate Ligament, Cranial) OR (Cruciate Ligaments, Cranial) OR (Ligament, Cranial Cruciate) OR (Ligaments, Cranial Cruciate) OR (ACL)

#3 #1 OR #2

#4 "Kinesiophobia"[Mesh]

#5 (Pain-Related Activity Avoidance) OR (Activity Avoidance, Pain-Related) OR (Avoidance, Pain-Related Activity) OR (Pain Related Activity Avoidance) OR (Movement Phobia) OR (Fear of Movement) OR (Movement Fear) OR (Kinesophobia) OR (Kinetophobia) OR (Phobia, Movement) OR (fear avoidance model)

#6 #4 OR #5

#7 #3 AND #6

Figure 1 PubMed search strategy. #1 represents the Medical Subject Headings (MeSH) term for anterior cruciate ligament. #2 includes free-text terms and synonyms related to anterior cruciate ligament. #3 represents the combined anterior cruciate ligament–related search terms (#1 OR #2). #4 represents the MeSH term for kinesiophobia. #5 includes free-text terms and related concepts of kinesiophobia, including fear of movement and fear-avoidance. #6 represents the combined kinesiophobia-related search terms (#4 OR #5). #7 represents the final search strategy combining anterior cruciate ligament–related terms and kinesiophobia-related terms (#3 AND #6).

Inclusion and Exclusion Criteria for Literature

Inclusion criteria for literature: (1) The study subjects were patients who had undergone ACLR surgery; (2) The content involved the management of exercise phobia after ACLR surgery; (3) The study type was a guideline, best practice, expert consensus, systematic review, or original study.Literature exclusion criteria: (1) Incomplete information or inability to obtain the full text; (2) Non-English or non-Chinese literature; (3) Literature with incomplete information or duplicate publications; (4) Systematic review proposals, reviews, or conference papers; (5) Literature that fails to meet quality evaluation standards (Grade C).

Evaluation of Literature Quality

Evaluation Criteria

Multiple literature quality evaluation criteria were used. (1) For evidence related to clinical decision-making, if it originated from an authoritative database, it was considered high-quality evidence and directly included. (2) The Appraisal of Guidelines for Research and Evaluation II (AGREE II) was used to evaluate the methodological quality of the guidelines.[14] (3) Evaluate systematic reviews, expert consensus statements, and randomized controlled trials using the corresponding methodological quality assessment tools from the 2016 edition of the Australian JBI Centre for Evidence-Based Healthcare.[15] (4) Summarize the evidence, trace the original literature sources, and select the appropriate quality assessment tools based on the type of original literature for quality evaluation.

Literature Quality Assessment Process

The quality assessment of guidelines was conducted independently by four researchers, while the quality assessment of other types of literature was conducted independently by two researchers. In cases of disagreement, a decision was made after discussion with a third researcher. All researchers had received training in evidence-based research.

Evidence Summary and Grading

Two researchers independently extracted and summarized the evidence. The principles for summarizing evidence were as follows: when evidence was identical or complementary, it was merged and summarized; when evidence was conflicting, high-quality evidence and the most recently published evidence were given priority. The 2014 version of the JBI

Evidence Pre-classification and Evidence Recommendation Level System developed by the JBI Centre for Evidence-Based Healthcare classifies evidence levels into grades 1a to 5c, with 1a being the highest and 5c the lowest.[16]

Results

Literature Screening results

The initial search yielded 1,165 documents, of which 789 remained after removing duplicates. After reading the titles and abstracts, 47 documents were selected, and after reading the full texts and re-screening, 18 documents were ultimately included. The literature screening flowchart is shown in Figure 2.

Basic Characteristics of the Included Literature

The final literature included in this study comprised one clinical decision,[17] four guidelines,[18–21] ten systematic reviews,[22–31] two evidence summaries,[32,33] and one randomized controlled trial.[34] The basic characteristics of the included literature are shown in Table 1.

Quality Evaluation Results of Included Literature

Quality Evaluation Results of Clinical Decision-Making

The one clinical decision-making study[17] included was from Up To Date, with a default evaluation of high-quality evidence, and was approved for inclusion.

Quality Evaluation Results of the Guidelines

A total of four guidelines were included, all of which were of good quality and were therefore included. See Table 2.

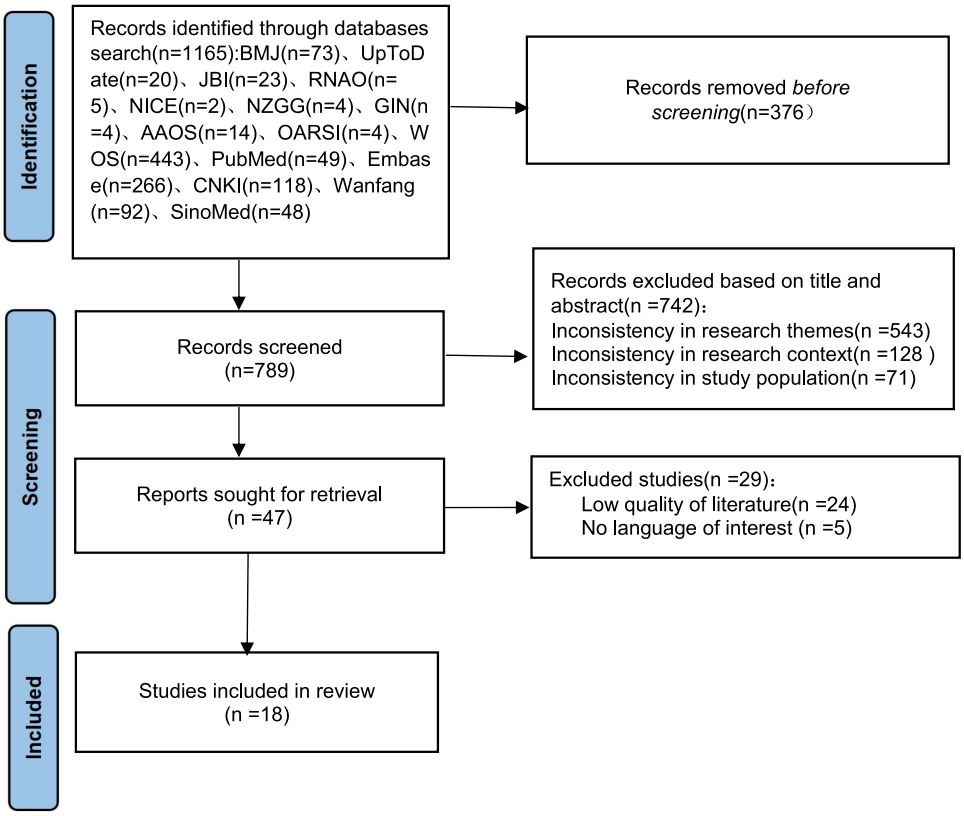

Figure 2 Literature screening flowchart.

Table 1 Basic Characteristics of Included Studies (n=18)

Included in the Literature	Year of Publication	Source of Literature	Type of Literature	Subject of Literature
Friedberg[17]	2023	Up To Date	Clinical decision-making	ACL injury
Kotsifaki et al[18]	2023	PubMed	Guide	Clinical Practice Guidelines for Rehabilitation Following ACLR Surgery
Van Melick et al[19]	2016	PubMed	Guide	ACLR Practice Guidelines
AAOS[20]	2022	AAOS	Expert consensus	Evidence-based clinical practice for the treatment of ACL injuries
Bai Lunhao et al[21]	2022	Wanfang	Guide	Clinical Practice Guidelines for the Diagnosis and Treatment of ACL Injuries
Wang Juan et al[22]	2025	CNKI	Systematic review	The effect of exercise therapy on rehabilitation outcomes after ACL reconstruction
Carl[23]	2019	Up To Date	Systematic review	The Effect of Exposure Therapy on Agoraphobia
Wang et al[24]	2022	PubMed	Systematic review	The Effectiveness of Virtual Reality Technology in Treating Patients with Motion Sickness
Naderi[25]	2023	PubMed	Systematic review	Psychosocial interventions can alleviate phobia after ACLR surgery.
Li Shunchang et al[26]	2019	CNKI	Systematic review	The effect of exercise therapy on the functional recovery of the ACL knee joint
Zhang Xiaoyu et al[27]	2022	CNKI	Systematic review	Analysis of the efficacy of early rehabilitation training after ACLR surgery
Chen Yu et al[28]	2018	CNKI	Systematic review	Rehabilitation effects of open-chain and closed-chain exercises
Glattke et al[29]	2022	PubMed	Systematic review	Recovery and rehabilitation after ACLR surgery
Mir et al[30]	2023	PubMed	Systematic review	Fear of re-injury after initial ACLR surgery
Isaji et al[31]	2024	PubMed	Systematic review	The effectiveness of psychological intervention following ACLR surgery
Liu Jingwen[32]	2025	CNKI	Evidence Summary	Summary of evidence on rehabilitation interventions following arthroscopic ACLR surgery
Li Yiji et al[33]	2023	CNKI	Evidence Summary	Evidence summary on exercise management for patients after ACLR surgery
Wang Fang et al[34]	2022	CNKI	Randomized controlled trials	Application of a collaborative nursing model to patients with post-operative phobia following ACLR surgery

Table 2 Results of Guideline Quality Evaluation

Included Literature	Percentage of Standardization by Domain						≥ 60% of the Number of Fields	≥ 30% of the Number of Fields	Rec- om- mend- ed Level
	Scope and Purpose	Participants	Rigor of Formulation	Clarity of Presentation	Useful- ness of the Guide	Editorial independence			
Kotsifaki[18]	97.22	79.17	76.04	93.06	64.59	95.84	6	6	A
Van Melick[19]	76.39	61.11	62.09	63.89	64.58	83.33	6	6	A
AAOS[20]	86.11	83.33	90.63	79.17	68.75	87.50	6	6	A
Bai Lunhao[21]	86.11	76.39	62.50	75.00	42.71	72.92	6	5	B

Quality Assessment Results of Systematic Reviews

This study included ten systematic reviews with relatively complete research designs and good quality. See Table 3.

Quality Assessment Results of Evidence Summaries

Two evidence summaries were included, and the extracted evidence was derived from the literature included in this study, namely one guideline[19] and three systematic reviews.[26,28,30] The overall quality was high, and they were included.

Results of the Quality Assessment of Randomized Controlled Trials

In the randomized controlled trial,[34] except for item 2, "Was allocation concealed?", which was rated as "unclear", and items 4, "Were the study subjects blinded?" and 5, "Were the interventionists blinded?", which were rated as "no", all other items were rated as "yes", indicating good quality, and the trial was included.

Evidence Description and Summary

Through systematic retrieval, evaluation, analysis, extraction, and integration, 20 best evidence statements were summarized from six aspects: management principles, health education, pain management, rehabilitation exercises, intervention methods, and follow-up management for patients with post-ACLR phobia. See Table 4.

Table 3 Quality Assessment Results of Systematic Reviews

Literature Review Items were included	Wang Juan et al[22]	Carl[23]	Wang et al[24]	Naderi[25]	Li Shunchang et al[26]	Zhang Xiaoyu et al[27]	Chen Yu et al[28]	Glattke et al[29]	Mir et al[30]	Isaji et al[31]	
(1) Whether the evidence-based questions raised are clear and unambiguous	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
(2) Whether the literature inclusion criteria were appropriate for the evidence-based question	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
(3) Whether the search strategy is appropriate	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
(4) Whether the database or resources of the searched literature are sufficient	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
(5) Whether the quality evaluation criteria adopted are appropriate	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
(6) Whether the quality evaluation of the literature was completed independently by two or more reviewers	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
(7) Whether certain measures are taken to reduce errors when extract- ing data	Unclear	Yes	Yes	Unclear	Unclear	Yes	Yes	Yes	Yes	Yes	Yes
(8) Whether the methods of pooling studies are appropriate	Yes	Yes	Yes	Yes	Yes	Unclear	Unclear	Yes	Yes	Yes	Unclear
(9) Whether the likelihood of publication bias was assessed	Yes	Yes	Yes	Yes	Yes	Yes	Unclear	No	Unclear	Unclear	Yes
(10) Whether the recommendations made for policy or practice are based on the results of the systematic review	Yes	Yes	Yes	Yes	Yes	Unclear	Unclear	Yes	Yes	Yes	Unclear
(11) Whether the proposed direction for further research is appropriate	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Unclear	Unclear

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Table 4 Summary of the Best Evidence for the Management of Patients with Phobia After ACLR Surgery

Category	Evidence Content	Level of Evidence
Management principles	1. Postoperative anxiety disorder following primary ACLR is a key factor affecting postoperative outcomes. Screening should be conducted postoperatively to enable potential treatment during rehabilitation.[30]	1b
	2. Psychologists, rehabilitation physicians, rehabilitation nurses, and rehabilitation therapists conducted joint research and discussions on ACL rehabilitation-related issues and factors affecting postoperative movement phobia after ACLR surgery, collaborating to alleviate postoperative movement phobia in patients.[32,34]	1b
	3. In identifying patients with kinesiophobia, assessing the effectiveness of management, and determining the appropriateness of returning to exercise, the use of the TSK-17, TSK-11, or ACL-RSI is supported for evaluating the severity of kinesiophobia in patients following ACLR.[18,19,29,30,32]	2a
Health education	4. Health education using plain language and providing verbal, written, and visual reminders helps reduce anxiety.[23]	1a
	5. Develop an immersive health education model to divert patients' attention, alleviate preoperative anxiety, and effectively improve patients' anxiety, depression, and fear of movement.[23,24]	1a
	6. Strengthen education on patient safety and ice pack usage to prevent injury.[18]	5a
	7. Healthcare providers should screen for pain 30 minutes before activities that cause pain and provide anticipatory analgesia to reduce the severity of motion sickness.[23]	1a
	8. Observation of the effects of different analgesic methods during surgery on postoperative pain scores and muscle function in patients.[29]	1a
	9. Injections around the joints can significantly improve pain scores.[29]	1a
	10. Cryotherapy has the advantages of low cost, ease of use, high patient satisfaction, and few adverse reactions. Cryotherapy can effectively reduce pain perception both before and after surgery, and its use before surgery can also reduce the dosage of analgesics. Compression cryotherapy may be more effective than simple cryotherapy. Cryotherapy can ultimately be applied up to one week after surgery.[18–20,29,33]	1b
Rehabilitation exercises	11. The duration of ACLR postoperative rehabilitation varies among individuals. It is recommended to continue for 9–12 months, with adjustments made based on the patient's ultimate goal of returning to work or resuming recreational activities. Accelerated rehabilitation programs may be implemented provided that the graft is adequately protected and the minimum healing time requirements are met.[19]	5a
	12. Immobilization does not alleviate pain and may lead to muscle atrophy, slowing down functional recovery. Postoperative active knee joint exercises should be initiated immediately, with gradual adjustments to exercise intensity, duration, and frequency to achieve gradual exposure and desensitization, which is beneficial for alleviating kinesiophobia.[18,21,23]	2a
	13. Early weight-bearing should be initiated during the first week postoperatively in a gradual, stepwise manner that is tolerable for the patient (following specific surgical instructions), while isometric quadriceps exercises are performed to achieve pain-free reactivation of the quadriceps.[19,33]	5a
	14. Starting from the fourth week postoperatively, perform open-range motion exercises within a limited range of motion (knee flexion 90°–45°) without compromising knee stability.[16,19,26,31]	5a
	15.6 months or more of neuromuscular training has a clear advantage in promoting functional recovery after ACLR surgery.[19,22,26,33]	1a
Intervention methods	16. Virtual reality technology has the potential to reduce the severity of motion sickness, and when combined with exercise, it is more effective in reducing motion sickness than virtual reality intervention alone. At the same time, psychological education activities that use immersive virtual reality to divert patients' attention can also alleviate postoperative anxiety, depression, and fear.[23,24]	1a
	17. It is recommended that cognitive behavioral therapy techniques such as imagery, mindfulness, guided relaxation, and breathing techniques, as well as psychosocial interventions such as guided imagery, positive self-talk, muscle relaxation, body exposure therapy, and modeling videos, be combined with rehabilitation exercises to effectively reduce phobia after ACLR.[25,30–32]	1a
Follow-up management	18. In the early stages of rehabilitation, explicit motor learning should be the primary focus, while in the later stages, implicit motor learning strategies should be used more frequently, as they produce more stable results under conditions of stress, anxiety, and fatigue.[19,32]	5b
	19. Postoperative exercise programs should be provided in accordance with the patient's wishes, with clear expected goals. Patients should be advised to develop exercise plans and record their progress. In appropriate cases, accelerated schedules should be adopted, and exercise should be conducted according to specific standards.[18,27,32]	1a
	20. Supervised rehabilitation interventions may be more effective than unsupervised exercise, but it is not necessary to monitor the performance of all exercises in the rehabilitation program throughout the entire process. It is recommended to conduct follow-up visits at least once every two weeks to ensure the smooth progress of rehabilitation.[17,29,33]	5a

Discussion

Early Identification and Multidisciplinary Collaboration Lay the Foundation for the Management of Tremor Disorders

Evidence 1–3 summarizes the evidence related to the management principles of post-ACLR phobia, which is derived from guidelines, systematic reviews, and evidence summaries, and is of high quality.Postoperative akinesia following ACL

reconstruction is influenced by multiple physiological, psychological, and social factors. Early identification of high-risk patients is a prerequisite for individualized intervention. Several high-quality studies have recommended the routine use of scales such as the TSK-17, TSK-11, or ACL-RSI for assessment in clinical practice, along with dynamic monitoring throughout the rehabilitation process to accurately assess patients' akinesia status.[18,19,29,30,32] Among these, the TSK-17 was developed by Miller et al[35] in 1995 and validated by Huang et al[36] in 222 patients with ACL injuries, showing a Cronbach's α coefficient of 0.79 and a test-retest reliability of 0.90, demonstrating good reliability and validity.Woby et al[37] first adapted the Anxiety Disorder Inventory into the revised version TSK-11 in 2005. This scale has significant advantages due to its broad applicability, strong universality, and specific item descriptions; The Anterior Cruciate Ligament Return to Sport Inventory (ACL-RSI) is another validated measurement tool,[38] where psychological factor scores directly influence patients' post-surgical recovery levels — higher scores indicate better psychological preparedness.The ACL-RSI better reflects the severity of anxiety disorder than the TSK-11.[39] In the post-training assessment of anxiety disorder, the ACL-RSI distinguished between high (≥64) and low (<64) score groups, while the TSK-11 could not distinguish between high (≥19) and low TSK (<18) score groups.[39] TSK-11 scoring emphasizes akathisia only in pre-training assessments and cannot distinguish individual fear-inducing factors.[39] Both scales assess akathisia, and multidisciplinary team collaboration is the core support for optimizing akathisia management based on identifying patient status.A multidisciplinary team comprising orthopedic surgeons, rehabilitation therapists, psychologists, and nursing staff can share information and complement each other's professional strengths to develop more precise intervention strategies, thereby improving patient compliance with rehabilitation and confidence in returning to sports.[32,34] Research by Wen Yating et al[39] also confirmed that multidisciplinary team rehabilitation interventions centered on specialist nurses can effectively improve knee function and rehabilitation exercise compliance in patients in the early stages after ACLR surgery. However, compared with mature models abroad, ACLR rehabilitation in China is still dominated by rehabilitation therapists and clinicians, with multidisciplinary collaboration still in its infancy and no unified standards for team member configuration.Therefore, it is recommended that medical institutions combine patient conditions with their own medical resources, reasonably allocate team personnel, establish standardized multidisciplinary collaboration processes, and provide institutional guarantees for the systematic management of motion sickness.

Pain Management and Health Education to Reduce Avoidance of Physical Activity

Evidence summaries 4–10 summarize the relevant evidence on health education and pain management for post-ACLR phobia. Pain and misperceptions are the two key factors contributing to the occurrence of post-ACLR phobia and avoidance of exercise.In terms of cognitive correction and health education, multimodal educational materials that are easy to understand, visual, and can be reviewed and referenced repeatedly should be provided to people of different educational backgrounds. The focus should be on clarifying the scientific understanding that "pain does not equal tissue damage or worsening of the condition" and reducing the avoidance tendencies that result from this misconception.[23] Given that educational attainment is closely related to cognitive proficiency and can influence anxiety levels, it is essential to strengthen foundational knowledge education and contextualized explanations for individuals with lower educational attainment. When necessary, innovative approaches such as immersive or virtual reality technologies should be employed to enhance attention engagement and active participation, thereby alleviating anxiety, depression, and fear. This approach aims to mitigate the "catastrophizing" mindset associated with pain from its root cause.[23,24] At the same time, key points directly related to rehabilitation safety should be included in education, such as the proper use and timing of ice packs, to avoid secondary injuries caused by improper use.[18] On this basis, integrating health education with gradual exposure, desensitization, and functional training in an organic manner is more conducive to reducing exercise avoidance from a cognitive perspective.Secondly, in terms of pain management, clinical studies have shown that the severity of postoperative pain is positively correlated with the manifestation of fear of movement. The higher the pain score, the more pronounced the tendency toward fear of movement,[40] which is consistent with the conclusions of previous studies.[41] For patients with a low pain threshold, excessive focus on pain is more likely to trigger "pain catastrophizing," further hindering early rehabilitation progress. Evidence-based evidence supports the inclusion of pain assessment in process management: conduct pain screening approximately 30 minutes before activities that may induce pain and implement anticipatory analgesia to reduce the upcoming peak of pain and related fear;[23] During and after surgery, focus on the effects of different pain relief strategies on pain scores and muscle strength recovery. If necessary,

use periarticular injections to achieve more ideal pain control.[29] Cryotherapy is routinely used preoperatively and postoperatively. When conditions permit, compression cryotherapy is preferred to achieve better pain relief and satisfaction. Preoperative use also helps reduce the amount of analgesics required. This strategy can usually be continued for up to one week postoperatively.[18–20,29,33] The aforementioned pain relief measures create a low-pain environment for rehabilitation training, which, together with the cognitive correction of health education mentioned earlier, forms a synergistic effect between physiology and psychology, thereby more effectively reducing exercise avoidance behavior.[23,29,33]

Functional Training Combined with Psychological Intervention Promotes Synchronized Physical and Mental Rehabilitation

Evidence summaries 11–17 summarize the relevant evidence on functional training and intervention for post-ACLR kinesiophobia. Functional training after ACLR is the foundation of rehabilitation, as it can both prevent complications and accelerate functional recovery.Early active exercise and progressive weight-bearing training are safe and effective, reducing muscle atrophy and promoting joint mobility.[18,21,23] If knee joint mobility is restricted after surgery, it can easily lead to complications such as deep vein thrombosis and infection, so functional exercise is particularly important.[18] Neuromuscular training (≥6 months) has demonstrated long-term functional advantages in multiple meta-analyses;[19,22,26,33] moderate-intensity clinical evidence suggests that comprehensive training is most effective in improving muscle strength and joint function, followed by eccentric training, plyometric training, etc.[22] At the same time, psychological interventions have unique advantages in reducing fear of movement. Multiple studies and reviews have consistently concluded that psychosocial interventions such as cognitive behavioral therapy and guided imagery can enhance self-efficacy and reduce fear of re-injury.[25,30–32] Ardern et al[42] found that psychosocial interventions were more effective than non-psychosocial control groups in reducing postoperative dyskinesia, consistent with the results of related reviews. This highlights the benefits of psychosocial factors centered on building self-confidence in rehabilitation and motor recovery. Other systematic reviews have also confirmed their effectiveness in promoting the recovery of musculoskeletal injuries and reducing postoperative pain and anxiety.[43,44] At the same time, psychological intervention may enhance motivation to participate in physical therapy and help reduce fear of movement.[45] In addition, combining psychological intervention with functional training, such as incorporating goal adjustment and realistic expectation setting into the rehabilitation process, as well as using virtual reality technology to enhance the training experience, can promote rehabilitation on both the physical and mental levels.[23,24] Therefore, the integration of functional training and psychological intervention provides a comprehensive strategy that addresses both physiological and psychological aspects in the management of post-ACLR phobia.

Personalized Follow-Up and Self-Management to Sustain the Effects of Intervention

Evidence 18–20 focuses on the follow-up management of dyskinesia after ACLR surgery. From the perspective of the rehabilitation process, dynamic adjustment of the motor learning approach is key. In the early stages, explicit learning methods, such as clear guidance on movement techniques, help patients establish foundational movement patterns. In later stages, shifting to implicit learning (eg, repetitive practice to develop automated responses) can enhance movement stability under stress or fatigue, aligning with the characteristic of akathisia patients being prone to relapse in complex situations.[19,32] Developing personalized goals based on the patient's preferences and documenting training details (eg, exercise logs) can enhance their sense of active participation. Regular follow-ups at least once every two weeks can help promptly correct deviations, adjust the plan, and prevent the exacerbation of fear caused by inadequate self-management.[18,27,32,33] In addition, supervised rehabilitation interventions are superior to unsupervised exercise. Timely intervention by professionals not only ensures training safety but also enhances patient confidence through feedback, further consolidating the effects of the intervention and laying the foundation for long-term rehabilitation.[17,46,47] In the future, remote monitoring technology can be used to track training data in real time, strengthen patient self-management skills training, and combine follow-up data with scales such as TSK-17 and ACL-RSI to construct risk warning models,

thereby achieving a shift from passive response to active prevention and providing more comprehensive protection for long-term physical and mental rehabilitation.

Summary

This study summarizes the best evidence for managing exercise phobia in patients after ACLR, covering six aspects: management principles, health education, pain management, rehabilitation exercises, intervention methods, and follow-up management, providing scientific guidance for medical staff to carry out targeted management.It is recommended that healthcare professionals combine clinical practice with individual patient circumstances to appropriately utilize multi-disciplinary collaboration, pain management, functional training combined with psychological intervention, and other strategies to accurately assess and dynamically monitor patients' fear of movement. Simultaneously enhance specialized training, standardize rehabilitation processes and follow-up management, and optimize personalized intervention plans to effectively reduce patients' fear of movement, improve their rehabilitation compliance, and increase the success rate of returning to physical activity, thereby providing robust support for the physical and mental rehabilitation of patients following ACLR surgery.

Data Sharing Statement

Data may be obtained from the first author upon reasonable request.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors have no conflicts of interest to declare for this work.

References

1. Kaeding CC, Léger-St-Jean B, Magnussen RA. Epidemiology and diagnosis of anterior cruciate ligament injuries. *Clin Sports Med*. 2017;36(1):1–8. doi:10.1016/j.csm.2016.08.001
2. Mengsteab PY, Nair LS, Laurencin CT. The past, present and future of ligament regenerative engineering. *Regener Med*. 2016;11(8):871–881. doi:10.2217/rme-2016-0125
3. Shi ZL, Li YL, Yu Y, et al. Progress in evaluation of return to sports after anterior cruciate ligament reconstruction. *Chin J Reparat Reconstr Surg*. 2023;37(4):495–501.
4. Shea KG, Carey JL. Management of anterior cruciate ligament injuries: evidence-based guideline. *J Am Acad Orthop Surg*. 2015;23(5):e1–e5. doi:10.5435/JAAOS-D-15-00094
5. Ardern CL, Taylor NF, Feller JA, et al. Fifty-Five per cent return to competitive sport following anterior cruciate ligament reconstruction surgery: an updated systematic review and meta-analysis including aspects of physical functioning and contextual factors. *Br J Sports Med*. 2014;48 (21):1543–1552. doi:10.1136/bjsports-2013-093398
6. Everhart JS, Best TM, Flanigan DC. Psychological predictors of anterior cruciate ligament reconstruction outcomes: a systematic review. *Knee Surg Sports Traumatol Arthrosc*. 2015;23(3):752–762. doi:10.1007/s00167-013-2699-1
7. Abuljadail S, Albotuaiba AO, Almarri AS, Alhamam AK, Almulhim AK. Return to sport following anterior cruciate ligament reconstruction: a cross-sectional study in Saudi Arabia. *Cureus*. 2025;17(4):e82965. doi:10.7759/cureus.82965
8. Vutescu ES, Orman S, Garcia-Lopez E, Lau J, Gage A, Cruz AI. Psychological and social components of recovery following anterior cruciate ligament reconstruction in young athletes: a narrative review. *Int J Environ Res Public Health*. 2021;18(17):9267. doi:10.3390/ijerph18179267

9. Lethem J, Slade PD, Troup JD, Bentley G. Outline of a fear-avoidance Model of exaggerated pain perception–I. *Behav Res Ther*. 1983;21(4):401–408. doi:10.1016/0005-7967(83)90009-8
10. SH K. Kinesiophobia: a new view of chronic pain behavior. *Pain Manage*. 1990;3:35–43.
11. Karabağ Y, Çağdaş M, Rencuzoğullari I, et al. Relationship between C-reactive protein/Albumin ratio and coronary artery disease severity in patients with stable angina pectoris. *J Clin Lab Anal*. 2018;32(7):e22457. doi:10.1002/jcla.22457
12. Taylor RS, Dalal HM, Mcdonagh STJ. The role of cardiac rehabilitation in improving cardiovascular outcomes. *Nat Rev Cardiol*. 2022;19(3):180–194. doi:10.1038/s41569-021-00611-7
13. Zhu Z, Hu Y, Zhou YF, et al. Promoting the transformation of evidence to clinical practice: research topic selection and problem construction. *J Nurses Train*. 2020;35(09):796–799.
14. Fen Z, Yu FH, Xue C. Supplementary explanation and reflection on the guideline research and evaluation tool agree II and the score of each field. *J Nurs Train*. 2018;25(18):56–58.
15. Hu Y, Zhou YF. *Theory and Practice of Clinical Transformation of Evidence-Based Nursing*. Shanghai: Fudan University Press; 2021.
16. Wang QQ, Hu Y. JBI evidence pre-classification and evidence recommendation level system (2014 Edition). *J Nurs Train*. 2015;30(11):964–967.
17. Friedberg RP, d'Hemecourt PA. Anterior cruciate ligament injury. *UpToDate, Waltham, MA*. 2015.
18. Kotsifaki R, Korakakis V, King E, et al. Aspetar clinical practice guideline on rehabilitation after anterior cruciate ligament reconstruction. *Br J Sports Med*. 2023;57(9):500–514. doi:10.1136/bjsports-2022-106158
19. Van Melick N, van Cingel REH, Brooijmans F, et al. Evidence-based clinical practice update: practice guidelines for anterior cruciate ligament rehabilitation based on a systematic review and multidisciplinary consensus. *Br J Sports Med*. 2016;50(24):1506–1515. doi:10.1136/bjsports-2015-095898
20. Carey JL, Shea KG. AAOS clinical practice guideline: management of anterior cruciate ligament injuries: evidence-based guideline. *J Am Acad Orthop Surg*. 2015;23(5):e6–8. doi:10.5435/JAAOS-D-15-00095
21. Bai LH, Chen JW, Chen J, et al. Clinical evidence-based guideline for the diagnosis and treatment of anterior cruciate ligament injury (2022 version). *Chin J Traumatol*. 2022;38(6):492–503.
22. Wang J, Wang GL, Zuo HW. Efficacy of exercise therapy in the treatment of anterior cruciate ligament reconstruction patients: a network meta-analysis. *Chin J Tissue Eng Res*. 2025;29(08):1714–1726.
23. Carl E, Stein AT, Levihn-Coon A, et al. Virtual reality exposure therapy for anxiety and related disorders: a meta-analysis of randomized controlled trials. *J Anxiety Disord*. 2019;61:27–36. doi:10.1016/j.janxdis.2018.08.003
24. Wang S, Sun J, Yin X, et al. Effect of virtual reality technology as intervention for people with kinesiophobia: a meta-analysis of randomised controlled. *Trials J Clin Nurs*. 2023;32(13–14):3074–3086. doi:10.1111/jocn.16397
25. Naderi A, Falla Mohammadi M, Dehghan A, et al. Psychosocial interventions seem redact kinesiophobia after anterior cruciate ligament reconstruction but higher level of evidence is needed: a systematic review and meta-analysis. *Knee Surg Sports Traumatol Arthrosc*. 2023;31(12):5848–5855. doi:10.1007/s00167-023-07630-6
26. Li SC, Fu L, Guo XC, et al. Efficacy of exercise therapy on recovery of moto function after anterior cruciate ligament reconstruction: a meta-analysis. *Chin J Evid Based Med*. 2019;19(9):1086–1092.
27. Zhang XY, Zhang JT, Wang P, et al. Effects of early aggressive rehabilitation on outcomes after anterior cruciate ligament reconstruction: a meta-analysis. *Chin J Integr Trad West Med Surg*. 2022;28(6):824–829.
28. Chen Y, Luo CM, Wang J, et al. Effects of closed and open kinetic chain exercises following anterior cruciate ligament reconstruction: a systematic review. *J Nurs*. 2018;25(17):25–30.
29. Glattke KE, Tummala SV, Chhabra A. Anterior cruciate ligament reconstruction recovery and rehabilitation: a systematic review. *J Bone Joint Surg Am*. 2022;104(8):739–754. doi:10.2106/JBJS.21.00688
30. Mir B, Vivekanantha P, Dhillon S, et al. Fear of reinjury following primary anterior cruciate ligament reconstruction: a systematic review. *Knee Surg Sports Traumatol Arthrosc*. 2023;31(6):2299–2314. doi:10.1007/s00167-022-07296-6
31. Isaji Y, Uchino S, Inada R, et al. Effectiveness of psychological intervention following anterior cruciate ligament reconstruction: a systematic review and meta-analysis. *Phys Ther Sport*. 2024;69:40–50. doi:10.1016/j.ptsp.2024.07.003
32. Liu JW, Yang XJ, Li Y, et al. A summary of the best evidence for rehabilitation interventions following arthroscopic anterior cruciate ligament reconstruction surgery. *Chin J Rehabil Med*. 2025;40(04):604–610.
33. Li YZ, Ma XL, Lin XZ, et al. Evidence summary for exercise management inpatients after anterior cruciate ligament reconstruction. *Chin Evid Based Nurs*. 2023;9(24):4377–4382.
34. Wang F, Li Y, Tang D, et al. Application of a collaborative nursing model in patients with phobia after anterior cruciate ligament reconstruction surgery. *Chin J Convalescent Med*. 2022;31(06):610–613.
35. Miller RP, Kori SH, Todd DD. The Tampa Scale: a measure of kinisophobia. *Clin J Pain*. 1991;7(1):51. doi:10.1097/00002508-199103000-00053
36. Huang H, Nagao M, Arita H, et al. Reproducibility, responsiveness and validation of the tampa scale for kinesiophobia in patients with Acl injuries. *Health Qual Life Outcomes*. 2019;17(1):150. doi:10.1186/s12955-019-1217-7
37. Woby SR, Roach K, Urmaton M, et al. Psychometric properties of the Tsk-11:a shortened version of the Tampa scale for kinesiophobia. *Pain*. 2005;117(1/2):137–144. doi:10.1016/j.pain.2005.05.029
38. Jia ZY, Cui J, Wang W, et al. Translation and validation of the simplified chinese version of the anterior cruciate ligament-return to sport after injury (Acl-Rsi). *Knee Surg Sports Traumatol Arthrosc*. 2018;26(10):2997–3003. doi:10.1007/s00167-018-4850-5
39. Vlaeyen JWS, Kole-Snijders AMJ, Boeren RGB, et al. Fear of movement/(re) injury in chronic low back pain and its relation to behavioral performance. *Pain*. 1995;62(3):363–372. doi:10.1016/0304-3959(94)00279-N
40. Li Y, Yang QQ, Dang CP, et al. Kinesiophobia and its influencing factors in patients after anterior cruciate ligament reconstruction. *J Nurs Sci*. 2024;18:16–19.
41. Es TWW, Vandersteen MC, Liu WY, et al. Timing of anterior cruciate ligament reconstruction and preoperative painare important predictors forpostoperative kinesiophobia. *Knee Surg Sports Traumatol Arthrosc*. 2020;28(8):2502–2510. doi:10.1007/s00167-019-05838-z
42. Ardern CL, Kvist J. What is the evidence to support a psychological component to rehabilitation programs after anterior cruciate ligament reconstruction? *Curr Orthop Pract*. 2016;27(3):263–268. doi:10.1097/BCO.0000000000000371

43. Powell R, Scott NW, Manyande A, et al. Psychological preparation and postoperative outcomes for adults undergoing surgery under general anaesthesia. *Cochrane Database Syst Rev*. 2016;2016(5). doi:10.1002/14651858.CD008646.pub2
44. Szeverenyi C, Kekecs Z, Johnson A, et al. The use of adjunct psychosocial interventions can decrease postoperative pain and improve the quality of clinical care in orthopedic surgery: a systematic review and meta-analysis of randomized controlled trials. *J Pain*. 2018;19(11):1231–1252. doi:10.1016/j.jpain.2018.05.006
45. Brewer BW, Van Raalte JL, E CA. An interactive cognitive-behavioural multimedia program favourably affects pain and kinesiophobia during rehabilitation after anterior cruciate ligament surgery: an effectiveness trial. *Int J Sport Exerc Psychol*. 2022;20(4):1133–1155. doi:10.1080/1612197X.2021.1934712
46. Rzybylak K, Sibinski M, Domzalski M, et al. Supervised physiotherapy leads to a better return to physical activity after anterior cruciate ligament reconstruction. *J Sports Med Phys Fitness*. 2019;59(9):1551–1557. doi:10.23736/S0022-4707.18.08692-9
47. Nyland J, Greene J, Carter S, et al. Return to sports bridge program improves outcomes, decreases ipsilateral knee re-injury and contralateral knee injury rates Post-Acl reconstruction. *Knee Surg Sports Traumatol Arthrosc*. 2020;28(11):3676–3685. doi:10.1007/s00167-020-06162-7