P-ISSN: 2394-1685
E-ISSN: 2394-1693
Impact Factor (RJIF): 5.93
IJPESH 2025; 12(5): 613-617

https://www.kheljournal.com
Received: 17-07-2025
Accepted: 22-08-2025

Dr. Aditi Dattatraya Lokhande
Student Researcher (MPT 1st Year), Musculoskeletal and Sports Physiotherapy Department, Rashtrasant Janardhan Swami College of Physiotherapy, Kopargaon, Ahmadnagar, Maharashtra, India.

Dr. Pankaj Jayswal
Professor & HOD, Musculoskeletal and Sports Physiotherapy Department, Rashtrasant Janardhan Swami College of Physiotherapy, Kopargaon, Ahmadnagar, Maharashtra, India.

Dr. Rohit Balasaheb Rahane
Assistant Professor, Musculoskeletal and Sports Physiotherapy Department, Rashtrasant Janardhan Swami College of Physiotherapy, Kopargaon, Ahmadnagar, Maharashtra, India.

Corresponding Author:
Dr. Rohit Balasaheb Rahane
Assistant Professor, Musculoskeletal and Sports Physiotherapy Department, Rashtrasant Janardhan Swami College of Physiotherapy, Kopargaon, Ahmadnagar, Maharashtra, India.

A multimodal approach to anterior cruciate ligament rehabilitation: "Combining blood flow restriction therapy and cognitive behavioural therapy with tailored physiotherapy protocol for muscle recovery and psychological well- being": Case report

Aditi Dattatraya Lokhande, Pankaj Jayswal and Rohit Balasaheb Rahane

DOI: https://www.doi.org/10.22271/kheljournal.2025.v12.i5i.4039

Abstract
Background: Anterior Cruciate Ligament (ACL) injuries pose significant physical and psychological challenges during postoperative recovery, particularly among active individuals. Standard rehabilitation often focuses on physical recovery, but psychological barriers like anxiety and fear of re-injury can impede progress. This case report presents a multimodal rehabilitation approach integrating blood flow restriction therapy, neuromuscular electrical stimulation (NMES), and Cognitive Behavioral Therapy (CBT) in a female following ACL reconstruction.
Case Presentation: A 42-year-old female presented with a chronic history of right knee instability culminating in a high-grade ACL tear and medial meniscus injury. Post-arthroscopic reconstruction, she reported severe pain (NPRS 8–9/10), limited knee mobility (active ROM 0–15°), quadriceps weakness (grade 2+), and moderate anxiety (BAI 25). Her rehabilitation included progressive exercise therapy based on Kisner & Colby framework, Blood Flow Restriction (BFR) therapy, NMES, and structured CBT to address psychological concerns.
Intervention & Outcome: Over six weeks, the patient demonstrated consistent improvements: NPRS reduced to 3/10, active knee flexion increased to 0–115°, quadriceps strength reached grade 3+, and BAI score dropped to 20. CBT techniques—including cognitive restructuring, graded exposure, and behavioural activation—effectively reduced anxiety and enhanced rehabilitation adherence. The patient successfully returned to dance-related activities.
Conclusion: A comprehensive, multimodal rehabilitation protocol combining physical and psychological interventions facilitated significant improvements in pain, strength, mobility, and anxiety. This approach supports the integration of mental health strategies within physical rehabilitation for optimal recovery after ACL reconstruction.

Keywords: ACL reconstruction, rehabilitation, blood flow restriction therapy, neuromuscular electrical stimulation, cognitive behavioural therapy

Introduction
Anterior cruciate ligament (ACL) injuries are common among physically active individuals, particularly athletes [1]. In India, the incidence of ACL injuries is estimated at 68.6 per 100,000 person-years, with a higher prevalence among males and individuals aged 20–30 years [1]. Road traffic accidents and sports activities are leading causes of these injuries. A study conducted at a tertiary care center in Pune reported that ACL reconstruction surgeries accounted for approximately 4.89% of major orthopedic procedures, with the highest incidence in the 21–30 age group [1]. Surgical reconstruction is often necessary to restore knee stability and function. In India, the success rate of ACL reconstruction surgeries exceeds 90%, with patients typically resuming normal activities or sports within 10–12 months post-surgery [3]. Physiotherapy treatment makes a huge difference for recovery to the patients after the surgical intervention.
While surgical advancements have improved clinical outcomes, the rehabilitation process

remains complex, challenged not only by physical impairments but also by psychological stressors, particularly anxiety. Kinesiophobia defined as the fear of movement due to pain or reinjury has also been identified as a significant psychological barrier that can compromise rehabilitation engagement and delay recovery [6]. Post-surgical anxiety manifesting as fear of re-injury, persistent pain, and uncertainty regarding return to prior activity levels can significantly hinder rehabilitation adherence and overall recovery [4]

This case study explores a multimodal rehabilitation approach following ACL reconstruction in a female dancer who sustained a complete ACL tear with a meniscal injury. Post-surgical challenges included knee motion restriction, pain, and remission -anxiety. Treatment integrated manual therapy, Blood Flow Restriction, neuromuscular electrical stimulation, and progressive exercises based on Kisner and Colby's therapeutic framework [6]. This integrated strategy addressed both physical deficits and psychological barriers, improving adherence and functional outcomes. The case supports the effectiveness of combining physical rehabilitation and anxiety management in optimizing recovery after ACL reconstruction.

History

A 42-year-old Indian female, professionally school trusty active, remained in good health until the end of the year 2022, when she got a twisting injury to her right knee after a fall while playing badminton. The injury was associated with immediate swelling and immense pain in the right knee joint. The next day She consulted a local physician directly & was prescribed the Non-steroid Anti-inflammatory drugs (NSAIDs) with antacids and advised for the rest. Condition remained unchanged after the rest. Therefore, the patient had consulted the orthopedic surgeon and found the ACL injury on physical assessment. She was put on the waiting period and given NSAIDS with supplement for the period of a month and instructed for rest and avoiding the stressful lower limb activities. After a month the pain intensity was reduced but having repeated episodes of the buckling. Feeling relatively better, she resumed her regular activities, including dancing, trekking, and playing badminton. However, she began experiencing recurrent knee discomfort and instability, especially after exertional activities. These symptoms would typically subside with rest, leading her to gradually avoid physical activities over time. This pattern continued for nearly two years until April 2023, However, a second fall in November 2024, this time while performing yoga, led to a significant aggravation of symptoms. She presented with severe pain, swelling, and marked instability of the right knee joint. MRI was done on urgent basis. Image 1 showing the MRI of the Rt side ACL tear with the medial meniscus Subsequent MRI findings revealed a bucket handle tear of the medial meniscus with a displaced fragment, a high-grade partial thickness ACL tear from the femoral attachment a Baker's cyst measuring 1.8 × 0.3 × 8.7 cm, and mild joint effusion. (Image2)

She underwent arthroscopic ACL reconstruction, partial medial meniscectomy, and hamstring tendon graft harvest with a graft diameter of 36TT 36, 8.0 mm. Post-surgical challenges included ongoing knee pain, instability, and anxiety regarding movement and reinjury, necessitating a comprehensive rehabilitation approach integrating physical therapy and psychological support.

During the initial rehabilitation assessment, she presented with moderate to severe pain, rated 8/10 on the Numeric Pain Rating Scale (NPRS) during activity. Active range of motion (ROM) of the right knee was limited to 0–10°, and passive ROM to 0–15°, with an empty end feel. Quadriceps muscle strength was recorded at grade 2+, and swelling was visibly present around the joint anteromedial. Her gait was antalgic and cautious, influenced by significant anxiety. Posture showed left hip hike, increased lumbar curve and increased thoracic curve with forward head. Patellar mobility was hypo mobile and painful on palpation, tenderness was present over the popliteal region and proprioception was impaired. Psychologically, she scored 25 on the Beck Anxiety Inventory (BAI), indicating moderate anxiety. She expressed fear of re-injury and held negative beliefs about recovery, stating concerns about returning to weight-bearing activities. These findings indicated the need for comprehensive rehabilitation After an ACL injury and surgery, many patients experience psychological barriers, such as: Fear of re-injury (kinesiophobia) of confidence in movement, anxiety about returning to sport Depression or frustration due to limited mobility Cognitive Behavioural Therapy (CBT) can be an effective tool to help patients manage these anxieties, rebuild confidence, and enhance recovery outcomes.

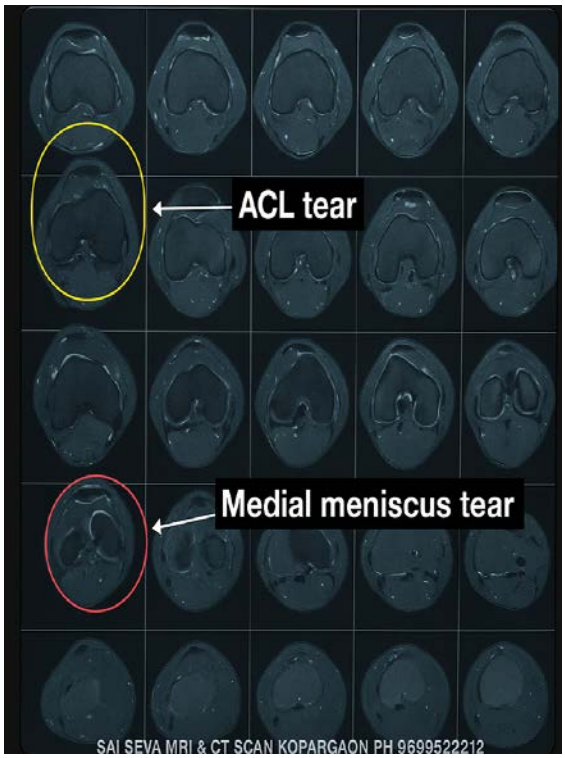

Fig 1: Showing Rt ACL & MCL tear

SAI SEVA
CT SCAN & MRI CENTRE
"A Step Towards Accurate Diagnosis"
Near Ram Mandir, Kopargaon, Dist. Ahmednagar. Cont. No. 02423-222336, 9699522212

Patient ID:	[redacted]	Patient Name:	[redacted]
Age:	42 Years	Sex:	FEMALE
Study Date:	22-Nov-2024	Referring Physician:	DR YOGESH KOTHARI SIR

MRI RIGHT KNEE

Protocol:
Multiplanar MRI of the right knee joint was performed in the sagittal, coronal & transverse planes using T1 & T2 weighted spin echo, turbo STIR & T2 weighted gradient echo sequences.

Observations:
Bucket handle tear of medial meniscus is seen with torn fragment lying anterior to posterior cruciate ligament.
Partial thickness high grade tear of anterior cruciate ligament is seen from its femoral attachment.
Rest of the menisci exhibits normal morphology, smooth outline & preserved signal intensity.
The posterior cruciate & collateral ligaments are uniform in the outline & do not display any focal signal abnormality.
Articular cartilage is preserved in thickness & does not reveal any focal area of altered signal intensity.
Articular margins & subarticular marrow are normal.
Periarticular soft tissue structures reveal 1.8x0.3x8.7cm sized backer's cyst with multiple superficial verbosities along posterior aspect of joint.
Patella & its cartilage are normal. Patellar tendon is normal in the thickness & signal intensity.
Mild joint effusion is seen.

Conclusion:
- **Bucket handle tear of medial meniscus with torn fragment lying anterior to posterior cruciate ligament.**
- **Partial thickness high grade tear of anterior cruciate ligament from its femoral attachment.**
- **1.8x0.3x8.7cm sized backer's cyst with multiple superficial verbosities along posterior aspect of joint.**
- **Mild joint effusion.**

Dr. Shirish Mulay
Consultant Radiologist.

Fig 2: Shows the MRI report of the subject

Intervention

Table 1.1: Phase 1 post-operative ACL Rehabilitation Protocol, 0-2 weeks

Exercise	How to Perform	Reps & Sets	Purpose	Goals
Quadriceps Sets	Sit with legs extended. - Tighten the quadriceps to push the back of the knee down. - Hold for 5-10 seconds, then relax.	3 sets of 15 rep	Prevents quadriceps atrophy and maintains muscle activation.	Improve quad strength from 2+ to 3
Straight Leg Raise (SLR)	Lie flat with the knee straight. - Tighten the quad and lift the leg to 45°. - Lower slowly without bending the knee.	3 sets of 10-15 reps	Strengthens quadriceps without knee movement.	Enhance quadriceps control while protecting knee
Seated Knee Extensions (Mini-Range, 0-30°)	Sit on a chair with feet flat. - Extend the knee slightly (only 0-30° flexion). - Lower slowly.	3 sets of 12 reps	improves early quadriceps function with minimal joint stress	Initiate gentle ROM and quad reactivation
Ankle Pumps	- Move the foot up and down, like pressing a gas pedal.	3 sets of 30 reps	Promotes circulation and reduces swelling	Reduce edema and maintain blood flow
Heel Slides	- Lie on your back. - Slowly slide the heel toward the glutes while keeping control. - Avoid forcing the knee.	3 sets of 10 reps	Restores knee flexion ROM within tolerance.	Achieve 0–30° active ROM by week 2
Passive Knee Extension Stretch	- Sit with the leg propped on a rolled towel under the heel. - Let the knee extend fully without force. - Hold for 30-60 sec.	3 rounds of 30-60 sec holds	Encourages full knee extension to prevent contractures.	Restore full passive extension (0°)
Glute Squeezes (Isometric)	- Lie on your back, squeeze the glutes together, hold, then relax.	3 sets of 12 reps	Maintains glute activation for hip and knee stability.	Preserve proximal stability during recovery
Hamstring Sets (Isometric)	- Lie on your back, push the heel into the bed without moving the knee. - Hold for 5-10 seconds.	3 sets of 12 reps	Prevents hamstring atrophy and supports knee stability.	Maintain hamstring tone and prevent disuse
Patellar Mobilization	- Gently move the patella side to side using your fingers. - Perform slowly and gently.	3 rounds of 30 sec	Prevents scar tissue formation and stiffness.	Avoid patellar adhesions, maintain mobility

Table 1.2: Phase 2 ACL rehabilitation protocol, 3-4 WEEKS

Exercise	How to Perform	Reps & Sets	Blood Flow Restriction Application	Neuro Muscular Electrical Stimulation Application	Purpose	Goals
Quadriceps Sets	- Sit with legs extended. - Contract quadriceps to push the back of the knee down. - Hold for 5 seconds, then relax.	3 sets of 15 reps	BFR on (40-80% AOP)	Yes (Electrodes on VMO & rectus femoris, stim during contraction)	Reactivates quadriceps muscles to counteract inhibition (AMIs) and improve knee extension control.	Regain volitional quad control and promote early muscle firing
Straight Leg Raise (SLR)	- Lie flat with the knee straight. - Tighten the quad and lift the leg to 45°. - Lower slowly without bending the knee.	3 sets of 15 reps	BFR on (40-80% AOP)	Yes (Stim during quad contraction phase)	Prevents quadriceps atrophy and improves hip flexor strength, essential for knee stability.	Build quad endurance and pelvic stability
Seated Knee	- Sit on a chair with feet flat. -	3 sets of	BFR on (40-80%	Yes (NMES	Strengthens the quadriceps in a	Improve strength

Extensions (Mini-Range)	Extend the knee to 30-45° (not full extension). - Lower slowly.	15 reps	AOP)	synchronized with knee extension)	controlled range without excessive joint stress.	without joint stress
Heel Slides	- Lie on your back. - Slide the heel toward the glutes while maintaining control. - Extend back to the starting position.	3 sets of 12 reps	No BFR (full circulation needed)	Optional (If weak quad activation)	Improves knee flexion ROM while avoiding compensatory movements.	Restore functional ROM without compensation
Partial Wall Squats	- Stand against a wall, feet shoulder-width apart. - Lower into a 30-45° squat (not too deep). - Hold briefly and return up.	3 sets of 15 reps	BFR on (40-80% AOP)	No NMES	Develops early quadriceps and glute activation while controlling weight-bearing load.	Control early closed-chain quad load
Step-Ups (Low Step)	- Step up onto a low platform (~6 inches). - Push through the heel and control the descent.	3 sets of 12 reps (each leg)	BFR on (40-80% AOP)	No NMES	Improves single-leg strength and balance, key for walking and stair climbing.	Achieve controlled weight transfer during step activities
Calf Raises	- Stand tall and lift heels off the ground. - Hold briefly at the top, then lower slowly.	3 sets of 15 reps	BFR on (40-80% AOP)	No NMES	Restores calf muscle function and prevents muscle imbalances.	Regain push-off strength for gait
Glute Bridges	- Lie on your back, knees bent. - Push through the heels and lift hips. - Lower slowly with control.	3 sets of 12 reps	No BFR (for optimal glute activation)	No NMES	Activates the posterior chain, which helps offload stress from the knee.	Activate glutes to reduce anterior knee stress

Table 1.3: Phase 3 ACL Rehabilitation Protocol, 4-6 WEEKS

Exercise	How to Perform	Reps & Sets	Purpose
Seated Knee Extensions (Full ROM)	- Sit on a chair, extend the knee fully, hold, then lower.	3 sets of 15 reps	Improves quadriceps strength and knee control.
Leg Press (Partial to Full ROM, 0-90°)	- Perform controlled leg presses in a progressive ROM (starting with 0-60°, then increasing to 90° as tolerated).	3 sets of 12 reps	Enhances quadriceps, hamstring, and glute strength while minimizing joint stress.
Step-Ups (Higher Step, Slow Eccentric)	- Step up onto a higher platform (~12 inches). - Control the descent slowly.	3 sets of 12 reps (each leg)	Develops single-leg strength, control, and balance.
Swiss Ball Hamstring Curls	- Lie on your back, feet on a Swiss ball. - Lift hips and curl the ball toward glutes. - Extend back slowly.	3 sets of 12 reps	Strengthens hamstrings, glutes, and core for knee stability.
Swiss Ball Wall Squats	- Stand with a Swiss ball behind your back against a wall. - Squat down to 45-60° knee flexion.	3 sets of 15 reps	Improves quadriceps and glute activation while providing trunk support.
Single-Leg Balance on Swiss Ball	- Stand on an unstable surface or use a Swiss ball for support. - Hold for 30 seconds. - Progress with eyes closed.	3 rounds of 30 sec holds	Enhances proprioception, knee stability, and neuromuscular control.
Lunges (Forward & Lateral)	- Step forward or sideways, lower into a controlled lunge. - Push back to starting position.	3 sets of 12 reps (each leg)	Develops strength, dynamic stability, and coordination.
Swiss Ball Plank Hold	- Rest forearms on a Swiss ball in a plank position. - Hold for 30-45 seconds.	3 rounds of 30-45 sec holds	Engages core for postural control and trunk stability.
Swiss Ball Bridges	- Lie on your back with feet on a Swiss ball. - Lift hips and hold, then lower with control.	3 sets of 12 reps	Strengthens glutes, hamstrings, and core, reducing stress on the knee.

Table 2: Treatment protocol of Cognitive Behavioural Therapy (CBT)

CBT Technique	Goal	Example Strategy
1. Cognitive Restructuring	Challenge irrational fears about movement and re-injury	Replace: if I put too much weight on my knee, it will tear again. With: my knee is structurally sound and I am following a safe rehab plan.
2.Exposure Therapy	Reduce fear-avoidance behavior by gradual exposure to movement	Start with mental imagery,followed by shadow practice,small hops,controlled jump landings
3.Mindfulness & Relaxation	Minimize catastrophic thinking and enhance focus	Use 4-7-8 breathing, guided imagery, and Progressive Muscle relaxation before challenging exercises
4.Goal Setting & Reinforcement	Shift focus from fear to progress through small, attainable goals	Replace "I need to be back in 6 months" with micro-goals like: I will focus on knee bending more for this 1 month followed by walking in next month
5.Behavioral Activation	Prevent disengagement and low mood by staying active in meaningful tasks	Maintain involvement in exercise, social life, and hobbies

Results

Table 3: Progression of Outcome Measures Following Postoperative Rehabilitation

Outcome Measure	Assessment Day after surgery	Postoperative treatment weeks			
		Day 1-2 Weeks	3-4 Week	5-6Week	Return to dance
Numeric Pain Rating Scale (NPRS)	9/10	7/10	6/10	5/10	3/10
Active Knee Flexion (°)	Not allow to assess due to pain	0–15°	0–60	0–90°	0-115
Passive Knee Flexion (°)	Not allow to assess due to pain	0–20° (empty end feel)	0–65	0-90	0-120
Quadriceps Strength	Not allow to assess due to pain	2+	3	3	3+
Bai Score	--	25/30	24	20	—

Discussion

This case study serves as a compelling example of the positive impact of a multimodal physiotherapeutic approach to postoperative ACL rehabilitation. Importantly, it emphasizes the psychological component as a vital consideration alongside physical recovery. The significant drop in pain, from an NPRS score of 9 to 3 over the 8-week rehabilitation period, reflects not only the physiological

healing process but also the role of daily controlled physiotherapy, judicious use of immobilization, and psychological support. Notably, despite the absence of electrotherapeutic pain-relieving modalities, the observed pain relief underscores the effectiveness of manual therapy and active interventions alone.

Mazhar *et ali*. (2023) emphasized that early-stage interventions, including neuromuscular training and controlled loading, enhanced joint stability and reduced postoperative complications. Their study also found that consistent pain monitoring using the NPRS helps tailor individual rehabilitation strategies [7]

Daily supervised physiotherapy exercises in this case contributed to muscle strengthening, improved joint control, and enhanced circulation to the surgically traumatized area—thereby promoting faster healing by ensuring oxygen and nutrient delivery. Improvements in active knee flexion were notable, progressing from a restricted 0–15° by the end of week two to 0–115° by the return-to-dance stage, indicating a substantial regain of voluntary joint mobility. Passive knee flexion followed a similar trajectory, advancing from 0–20° with an empty end feel to 0–120°, as shown in Table/Fig 3. This marks a 67% improvement in ROM, reflecting restored joint integrity and reduced pain inhibition.

Hasan *et ali*. (2024) demonstrated that a combination of isometric strengthening and mobility drills leads to quicker gains in ROM post-ACL reconstruction, supporting early use of dynamic flexibility techniques [8]. The progression from open-chain isometric to closed-chain isotonic exercises in this case, including the integration of Swiss ball-based training, further illustrates a strategic escalation in functional rehabilitation that supports range restoration and muscle reactivation.

Quadriceps strength, initially untestable due to pain, improved steadily from grade 2+ at two weeks to grade 3+ by six weeks (see Table/Fig 3), reflecting effective neuromuscular reactivation. Such gains are critical for restoring gait and lower limb function.

Addressing psychological factors, the patient's Beck Anxiety Inventory (BAI) score decreased from 25 at two weeks post-op to 20 by week six, indicating reduced anxiety. This reduction likely resulted from cognitive reassurance, structured therapy progression, and gradual exposure to movement. Self-Reported Symptoms *et ali*. (2022) found that anxiety and fear of reinjury are strong predictors of poor rehabilitation adherence. Their findings highlight the importance of early psychological screening and targeted mental health support during physical recovery [9].

These results align with the findings of Prodromidis *et al*. (2024), who emphasized that psychological readiness significantly influences return-to-sport outcomes. Their research supports integrating mental resilience training into standard rehabilitation protocols [10]

Moreover, functional and patient-reported outcomes demonstrated consistent improvements, reinforcing the importance of using standardized tools such as NPRS, BAI, and goniometric ROM assessments. Arundale *et al*. (2018) reported that athletes who followed criteria-based rehabilitation with regular outcome tracking showed higher return-to-sport success and reduced reinjury rates. They noted that objective measures ensure more reliable phase-wise progression during rehabilitation [11]

While these results are promising, it is important to interpret them with caution given the single-case study design. Larger controlled studies are required to validate the efficacy of this integrated, multimodal approach.

Conclusion

A multimodal rehab approach combining blood flow restriction therapy, NMES, and progressive exercise improved pain, mobility, strength, and anxiety post-ACL surgery, highlighting its effectiveness in addressing both physical and psychological recovery.

References

1. Sharma MK, Aggarwal A, Mehta N. Epidemiology and pattern of anterior cruciate ligament injuries in India: a review. J Orthop Allied Sci. 2021;9(2):75-80.
2. Patil S, Shetye SS, Pawar A. Clinical audit of orthopedic surgeries: a tertiary center analysis. Int J Orthop Sci. 2020;6(4):635-639.
3. Yadav S, Sinha AG, Singh AK. Outcome of ACL reconstruction surgeries: an Indian cohort study. Indian J Orthop. 2022;56(1):89-95.
4. Beck AT, Steer RA, Brown GK. Manual for the Beck Anxiety Inventory. San Antonio, TX: Psychological Corporation; 1996.
5. Kisner C, Colby LA. Therapeutic Exercise: Foundations and Techniques. 6th ed. Philadelphia: F.A. Davis Company; 2012.
6. Kori SH, Miller RP, Todd DD. Kinesiophobia: a new view of chronic pain behavior. Pain Manag. 1990;3(1):35-43.
7. Mazhar H, Kaleem M, Raza H, Hussain S, Aslam S. Early neuromuscular training improves functional outcomes after ACL reconstruction: a randomized controlled trial. J Orthop Sports Phys Ther. 2023;53(2):90-96.
8. Hasan Z, Qureshi AR, Rehman S, Ali A. Effects of dynamic flexibility and progressive resistance training on knee range of motion and pain in ACL rehabilitation: a clinical study. Phys Ther Rehabil J. 2024;8(1):42-49.
9. Self-Reported Symptoms Group. The impact of psychological distress on adherence and outcomes in postoperative ACL rehabilitation. Clin Sports Med. 2022;41(3):511-520.
10. Prodromidis AD, Panagiotopoulos E, Kotsifaki A. Psychological readiness influences return-to-sport outcomes after ACL reconstruction: a longitudinal cohort study. Am J Sports Med. 2024;52(1):88-96.
11. Arundale AJH, Bizzini M, Giordano A, Hewett TE. Criteria-based progression and outcome tracking improve ACL return-to-sport outcomes and reduce reinjury risk. Br J Sports Med. 2018;52(23):1432-1438.