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From instability to functional independence: Physiotherapy outcomes after arthroscopic acl reconstruction with meniscus repair

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Abstract
Background: Anterior cruciate ligament injury is among the most common presentation amongst young adults, frequently associated with meniscal tears that also present with pain, instability, and functional loss of the knee. These are complex knee injuries consisting of the rupture of the ACL combined with medial and lateral meniscus tears. Surgical reconstruction should be followed by a structured physiotherapy rehabilitation to restore the knee's stability and function.
Aim: To assess the impact of a structured physiotherapy rehabilitation intervention on the following parameters: pain; range of motion; muscular strength; balance; gait; and overall function for a younger female with obesity following arthroscopic reconstruction of the ACL and repair of medial and lateral meniscus.
Case Presentation: A 19-year-old female complained of right knee pain/instability, which began during a twisting injury. MRI examination revealed a full-thickness ACL tear along with tears in the medial and lateral menisci. The right knee arthroscopic ACL reconstruction followed by arthroscopic surgery to treat the torn meniscus in the knee was carried out on the obese female. After surgery, the patient complained about the pain in the knee, generalized swelling, inability to extend her knee freely, quadriceps inhibition, reduced muscle strength in her lower limbs, impaired balance, and painful gait/weight-bearing movements.
Intervention: The patient underwent a structured, criterion-based postoperative physiotherapy rehabilitation program focusing on pain and edema management, gradual restoration of knee range of motion, and progressive strengthening of the quadriceps, hamstrings, and hip musculature. Recent physiotherapy advances, including neuromuscular electrical stimulation for early quadriceps activation, low-load progressive resistance training, blood flow restriction training, and neuromuscular and proprioceptive exercises, were incorporated in accordance with current evidence. Gait re-education and functional task progression were guided using patient-reported and performance-based outcome measures, as recommended in recent rehabilitation consensus and clinical trials.
Outcomes: After rehabilitation, the patient showed considerable improvement in IKDC Subjective Evaluation, KOOS Score, Lysholm Knee score, Tegner Activity Scale, Dynamic Gait Index, POMA, LEFS, NPRS, Single leg stance and timed up and go test in aspects such as reduction of pain, normal extension of the knee, improvement in knee flexion, improvement in muscle power, improvement in balancing skills, normalization of gait, and improvement in performance. There was marked improvement in aspects of patient-perceived outcome measures for knee function.
Results: The patient demonstrated significant improvement on all outcome measures with reductions in pain and improved levels of mobility and independence when engaged in daily activities.
Conclusion: This case highlights the effectiveness of structured, evidence-based physiotherapy rehabilitation following ACL reconstruction with medial and lateral meniscus repair. The integration of recent advances such as neuromuscular electrical stimulation, progressive strengthening, and neuromuscular training resulted in significant improvements in pain, mobility, muscle strength, and functional performance despite obesity-related challenges. These findings support the role of individualized, outcome-driven physiotherapy in optimizing recovery after complex knee surgery.

Keywords: Anterior cruciate ligament reconstruction, medial and lateral meniscus repair, physiotherapy rehabilitation, knee instability, postoperative functional outcomes

Introduction

One of the most common knee injuries in active populations, especially in young adults who participate in sports or physical activity, is an anterior cruciate ligament (ACL) injury. ACL injuries frequently cause severe functional deficits that impair knee stability and daily activities [1] People who have an ACL tear frequently experience pain, swelling, and episodes of giving way because the knee joint's mechanical stability is compromised, which can restrict their ability to engage in recreational, athletic, and occupational activities [1] Concomitant injuries, particularly to the medial and lateral menisci, are common and have been shown to worsen symptoms, increase joint instability, and contribute to progressive joint degeneration if untreated. An ACL tear rarely occurs in isolation [1, 2]

In order to restore anatomical alignment, maintain meniscal function, and maximize long-term knee biomechanics, surgical management usually entails both ACL reconstruction and meniscal repair when both meniscal and ACL structures are damaged [1, 2] Promoting tissue healing, minimizing pain and effusion, and regaining range of

motion, strength, and neuromuscular control all depend on prompt and efficient rehabilitation after surgery [3]

The importance of structured physiotherapy that is started shortly after surgery is emphasized by modern rehabilitation protocols. These protocols focus on a phased progression of therapeutic exercises that are intended to target quadriceps and hamstring strength, restore full knee extension, and achieve controlled flexion within safe limits determined by surgical repair. In order to guide progression and return to activity criteria in patients undergoing meniscus repair with or without concurrent ACL reconstruction, the Formal EU-US Meniscus Rehabilitation 2024 Consensus highlights that postoperative rehabilitation should incorporate both patient-reported and performance-based outcomes [1] Studies show that integrating objective performance metrics with subjective evaluations, like patient-reported knee function scales, improves clinicians' capacity to track recovery paths and modify interventions [1] Therefore, quadriceps weakness with poor neuromuscular control have been well established as sequelae following ACL reconstruction and meniscal repair, hence necessitating intervention that entails isometric exercises, progressive strength training, as well as proprioceptive exercises to improve perfect quadriceps control [5, 6]. Furthermore, criterion-based rather than time-based exercises have also been advocated to improve strength prior to the initiation of more complex sport-specific exercises [1, 5, 6] However, as rehabilitation research advances to improve outcomes for patients undergoing ACL reconstruction or repair of the torn meniscus, new strategies are being investigated to improve patient outcomes through neuromuscular stimulation to improve patterns of muscular control during rehabilitation to improve outcomes by reducing reoccurrence, hence improving physiotherapeutic interventions for better outcomes [7] However, evidence indicates that rehabilitation is crucial as it reduces the occurrence of degenerative changes to the meniscal tissue as well as osteoarthritis of the knee by improving dynamic control of the knee [1, 5] This is a case report which describes the postoperative assessment and outcome of a physiotherapy session for a 19-year-old female patient after undergoing a right knee arthroscopic ACL reconstruction and repair of medial and lateral meniscus using a rehabilitation framework informed by best practices and principles in orthopedic rehabilitation.

Case Presentation

A 19-year-old female patient presented with complaints of right knee pain when walking and instability, along with difficulties that occurred after a twisting injury 2 months prior to presentation. Physical assessment of the patient identified an antalgic pattern of gait, tenderness along the joint line, positive anterior drawer, and positive Lachman's signs, indicating a deficiency of ACL integrity along with associated meniscus damage.

Range of motion of the knee joint found to be limited and painful, with flexion limited to 110 degrees, -10 degrees of lag at full extension, weakness of the quadriceps and hamstring, diminished proprioception, and decreased SLR on the affected limb during pre-operative physiotherapeutic evaluation, with confirmation through MRI depicting full-thickness ACL rupture along with associated meniscus tears on the medial and lateral sides. The patient subsequently underwent arthroscopic ACL reconstruction and arthroscopic repair of both menisci.

Post-operative physiotherapy assessment revealed mild effusion, pain (NPRS score 4/10 at rest and NPRS score 8/10 during movement), guarded knee movements with range of motion limited to 0-60° flexion in the early stages post-operative, quadriceps inhibition with an overall lag in knee extension, and relatively decreased muscle strength around the knee region. There was an antalgic gait with less time spent on the affected lower limb on the right side. Assistance was also needed for the gait. There was impaired balance, and the patient had impaired proprioception with less single-leg standing time. The patient was able to perform daily activities with difficulty and thereby required gait training and assistive devices for completing daily activities. The patient received physiotherapy intervention for pain and edema management, progressive exercise for restoring knee movements, strengthening exercises for hip and quadriceps and hamstring muscles, and overall improvement in knee movements with a subsequent goal of attaining knee stability, normal gait, and overall improvement in daily activities.

Fig 1 and 2: MRI of Right Knee Joint

Fig 3 and 4: Post op Physiotherapy Intervention

Materials and Methods

The patient/guardian has been provided with comprehensive information and consent has been obtained. The patient's identity has been suitably masked.

Physiotherapy Intervention

Phase I: Immediate Postoperative Phase (Day 0- 2weeks)

- Breathing exercises and patient education.
- Cryotherapy + compression (15–20 min, 3–4×/day)
- Limb elevation and ankle pump exercises.
- Retrograde massage.
- Static quadriceps, hamstrings, and gluteal sets (10 reps × 3 sets)
- NMES to quadriceps for activation.
- Heel slides (30 degrees)
- Patellar mobilization (Grade I–II)
- Partial weight bearing with walker.

Day 4–7

- Continue NMES + isometric exercises.
- Active-assisted knee ROM (focus on full extension)
- Standing gastro stretch and soleus stretch.
- Straight leg raises (with brace if needed)
- Hip abduction/adduction in supine
- Calf raises, quads set.
- Gait training emphasizing heel strike and knee control
- Blood flow restriction training.

Phase II: Early Rehabilitation Phase (Week 3–5)

Day-wise (Alternate days)

- Active ROM exercises (knee flexion progressed gradually)
- Gentle stretching to all muscle groups: Prone quads stretch, standing quad stretch, kneeling hip flexor stretch.
- Standing/ prone hamstring curls.
- MET for Knee Flexion.
- Closed-chain exercises: mini squats (0–30°), weight shifts
- Stationary cycling (low resistance)
- Core strengthening exercises.
- Step ups with march.
- Mini squats (0-60 degrees)
- Balance training: double-leg → supported single-leg stance.
- Progress to full weight bearing as tolerated.

Phase III: Strengthening & Neuromuscular Phase (Week 6-8)

Day-wise (5 days/week)

- Progressive resistance training (quadriceps, hamstrings, hip muscles)
- Squat to chair.
- Seated knee extension (90-45 degrees)
- Lateral lunges.
- Step-ups and controlled lunges.
- Perturbation and proprioceptive training (foam, wobble board)
- Dynamic balance exercises.
- Gait retraining with emphasis on symmetry.
- Cycling and low-impact aerobics training.

Phase IV: Advanced Functional Phase (Week 9-12)

Day-wise

- Higher-level strengthening (leg press, resisted squats)
- Dynamic Bosu squats.
- Gym-ball bridging.
- Single-leg balance with reach tasks.
- Agility ladder (linear movements)
- Stair climbing and controlled descent training
- Functional outcome testing (TUG, Y-Balance)
- Telerehabilitation support.

Phase V: Return To Activity Phase (Week 13 Onwards)

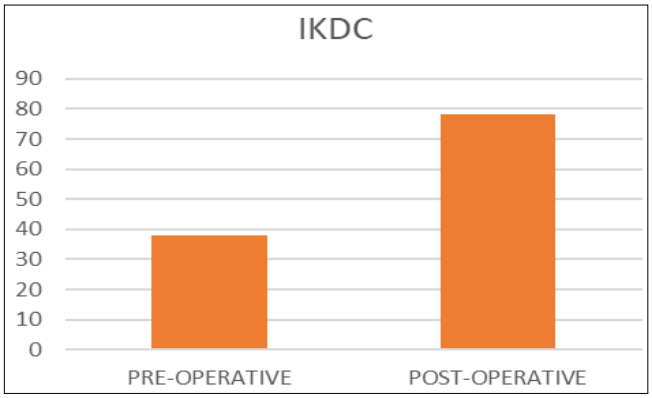
- Plyometric drills (after meeting strength criteria)
- Sport-/activity-specific drills (if applicable)
- Hop tests and limb symmetry assessment.
- Psychological readiness assessment (ACL-RSI)
- Home exercise program with periodic follow-up.

Outcome Measures

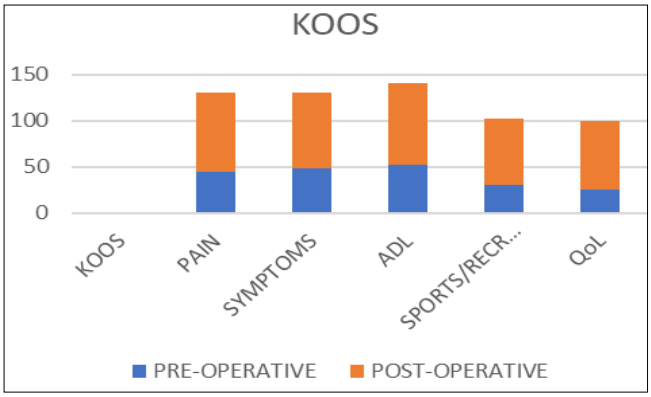
Sr no	Outcome measures	Pre-operative	Post-operative
1.	IKDC Subjective Knee Evaluation	38/100	78/100
2.	KOOS (Knee Injury and Osteoarthritis Outcome Score)	I Pain-45 II Symptoms-48 III ADL-52 IV Sport/recreation-30 V QoL-25	85 82 88 72 75
3.	Lysholm Knee Score	42/100 (Poor)	88/100 (Good)
4.	Tegner Activity Scale	Level 2 (Walking on uneven ground)	Level 6 ((Recreational sports)
5.	Dynamic Gait Index (DGI)	1 (Greater Risk of Fall)	23 (Lower Risk of fall)
6.	POMA (Tinetti Performance Oriented Mobility Assessment)	10 (High Fall risk)	26 (low fall risk)
7.	Lower Extremity Functional scale (LEFS)	3.75 (Severe Difficulty)	82.5 (Full functional level)
8.	Numeric Pain Rating Scale (NPRS)	4/10- Rest 8/10- Activity	2/10- Rest 2/10- Activity
9.	Single Leg Stance	8 seconds	35 seconds
10.	Timed up and go scale	14 seconds	8 seconds

Range Of Motion					
		Pre-operative		Post-operative	
A	**Hip Joint**	**Right (Affected)**	**Left**	**Right (Affected)**	**Left**
	Flexion	0-100	0-110	0-115	0-100
	Extension	10	10	0-20	0-5
	Abduction	0-30	0-40	0-40	0-40
	Adduction	20-0	40-0	30-0	40-0
	Internal Rotation	0-25	0-30	0-35	0-30
	External Rotation	0-30	0-30	0-40	0-30
B	Knee Joint				
	Flexion	0-110	0-100	0-125	0-110
	Extension	-10	0	0	0
C	Ankle Joint				
	Dorsiflexion	0-20	0-20	0-20	0-20
	Plantarflexion	0-40	0-40	0-40	0-40
	Inversion	0-30	0-30	0-30	0-30
	Eversion	0-10	0-10	0-10	0-10
Mmt Grading According To Mrc					
A	Hip Joint	Right (Affected)	Left	Right (Affected)	Left
	Flexors	Grade 3	Grade 4	Grade 4	Grade 5
	Extensors	Grade 3	Grade 4	Grade 4	Grade 5
	Abductors	Grade 3	Grade 4	Grade 4	Grade 5
	Adductors	Grade 3	Grade 4	Grade 4	Grade 5
	Internal Rotators	Grade 3	Grade 4	Grade 4	Grade 5
	External Rotators	Grade 3	Grade 4	Grade 4	Grade 5
B	Knee Joint				
	Flexors	Grade 3	Grade 4	Grade 5	Grade 5
	Extensors	Grade 3	Grade 4	Grade 5	Grade 5
C	Ankle Joint				
	Dorsi-flexors	Grade 4	Grade 4	Grade 5	Grade 5
	Plantar-flexors	Grade 4	Grade 4	Grade 5	Grade 5
	Invertors	Grade 4	Grade 4	Grade 5	Grade 5
	Evertors	Grade 4	Grade 4	Grade 5	Grade 5

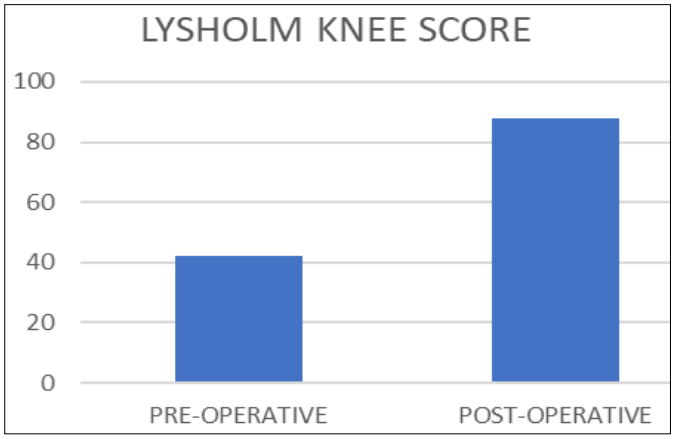
Results



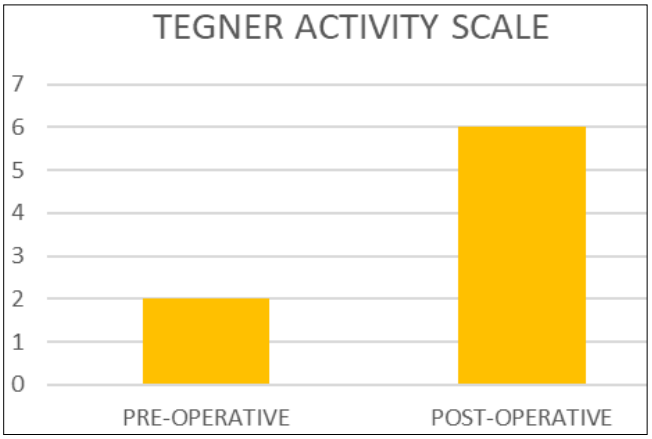
Graph 1: Pre-post op IKDC Score



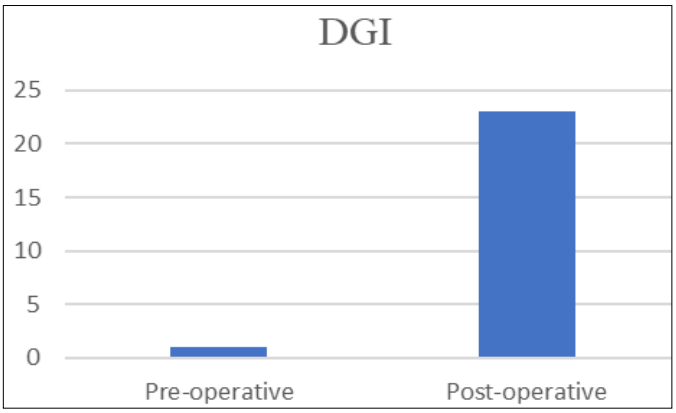
Graph 2: Pre-post op KOOS Scor



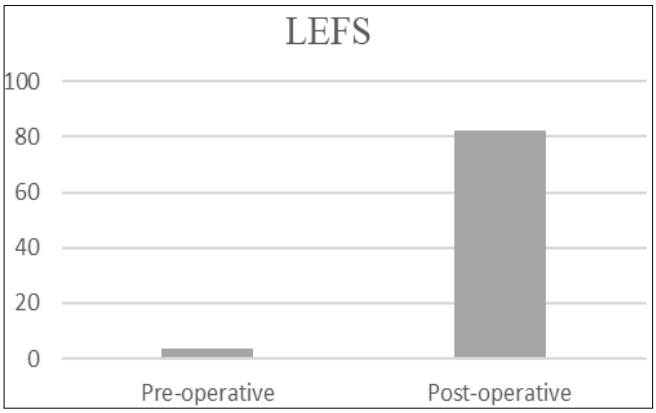
Graph 3: Pre-post op LKS



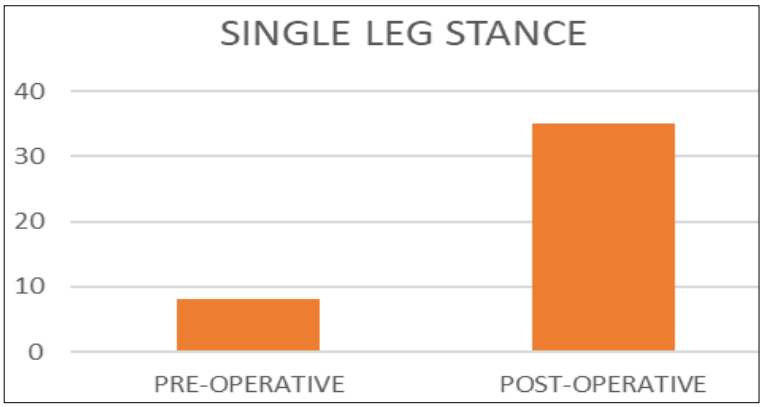
Graph 4: Pre-post op Tegner Scale



Graph 5: Pre-post op DGI Score Graph 6: Pre-post op POMA



Graph 7: Pre-post op LEFS Score



Graph 8: Pre-post op Single leg Stance

Discussion

Combined anterior cruciate ligament injuries with simultaneous medial and lateral meniscal tears present a complex condition and require a rehabilitation process to be conducted in an elaborate and progressive manner. Contemporary literature highlights that merely reconstructing an anterior cruciate ligament is not sufficient to recover optimal function for a knee joint and physiotherapy rehabilitation is crucial for joint recovery and health [8, 9]. The deficits experienced post-surgery, such as discomfort, effusion, range-of-motion loss, quadriceps inhibition, weakness, and balance abnormalities, have been consistent in physiotherapy rehabilitation literature for anterior cruciate ligament and meniscal tears injuries [10].

Recent consensus statements and systematic reviews from 2024 to 2025 strongly recommend early restoration of full knee extension, gradual progression of flexion, and a focus on quadriceps strengthening to prevent arthrogenic muscle inhibition and functional instability [8, 11]. NMES, in early rehabilitation as an adjunct, has been documented to significantly improve quadriceps activation and strength recovery following ACL reconstruction-especially when voluntary contraction is compromised [12]. Furthermore, BFRT has emerged as another recent valuable advance that enables strength and hypertrophy at low loads, therefore reduces mechanical stress on the healing grafts and repaired menisci.

On the other hand, proprioceptive and neuromuscular conditioning, and balance and perturbation procedures have demonstrated their potential in enhancing functional balance and stability, thus ensuring a reduction in the incidence of re-injuries and a better rehabilitation outcome for returning

to activity [14]. It is also recommended to use criterion-based rehabilitation instead of time-based rehabilitation and to monitor the recovery process through patient-related and performance-related outcome measurements [8, 15]. Finally, it is a pleasure to incorporate and recommend recent research and technological developments to integrate tele-rehabilitation and wearables to ensure a better outcome for physical therapy rehabilitation and to monitor gait and activity performance objectively [9].

In conclusion, the functional benefits observed in the above-mentioned case scenario can be related to the existing evidence on individualized evidence-based physiotherapy practices, including the use of recent advances.

Conclusion

This case demonstrates that structured, criterion-based physiotherapy rehabilitation is essential for optimal recovery following ACL reconstruction with concomitant medial and lateral meniscus repair. The incorporation of recent advances such as neuromuscular electrical stimulation and blood flow restriction training effectively addressed postoperative quadriceps inhibition and strength deficits. Progressive neuromuscular and proprioceptive training contributed to improved knee stability, balance, and functional performance, consistent with recent evidence. Despite obesity-related challenges, individualized rehabilitation led to significant improvements in pain, range of motion, muscle strength, and gait. These findings reinforce current literature supporting evidence-based, outcome-driven physiotherapy to achieve favorable postoperative outcomes in complex knee injuries.

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