



## Physical Therapy and Rehabilitation After Anterior Cruciate Ligament Reconstruction - Case Report

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**Received:** June 29, 2023

**Published:** June 03, 2025

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### Abstract

Anterior cruciate ligament (ACL) injuries commonly occur during sports requiring jumping and pivoting. Despite continued advancements in surgical techniques and rehabilitation, outcomes following ACLR may be less than desirable, with only 33% of athletes returning to sports within 1 year after surgery and 37% never returning to their prior levels of sports participation.

The aim of this paper is to present the effect and role of physical therapy and rehabilitation in a patient after reconstruction of the anterior cruciate ligament.

**Method:** Patient with anterior cruciate ligament injury treated arthroscopically. Postoperative rehabilitation conducted in the Clinic for Physical Medicine and Rehabilitation with kinesiotherapy, magnetic therapy, laser therapy, hydrokinesiotherapy. The evaluation of the results made with Womac score at the beginning and at the end of the rehabilitation, range of motions in the knee were made at two time points, at the beginning and at the end. The patient had two rehabilitation treatments. At the end of the rehabilitation, the patient goes without orthopedic aids. Manual muscle test performed on m. quadriceps.

**Results:** Improved Womac score and knee movements.

**Conclusion:** Rehabilitation, kinesiotherapy and physical modalities have an important role in rehabilitation after anterior cruciate ligament reconstruction.

**Keywords:** Rehabilitation; Anterior Cruciate Ligament; Laser Therapy

### Introduction

Acute anterior cruciate ligament rupture is a common and serious knee injury in the young active population [1]. It has been estimated that 200,000 are torn each year, and 100,000 anterior cruciate ligament reconstructions are done each year in the United States. The controversy for managing this injury now centers more on the choice of graft selection for reconstruction instead of whether surgery is necessary [2]. About half of all injuries to the anterior cruciate ligament occur along with damage to other structures in the knee, such as articular cartilage, meniscus, or other ligaments.

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The anterior cruciate ligament is composed of longitudinally oriented bundles of collagen tissue arranged in fascicular subunits within larger functional bands. It inserts on the tibial plateau, me-

dial to the insertion of the anterior horn of the lateral meniscus in the depressed area anterolateral to the anterior tibial spine. The ligament is 31 to 35 mm in length and 31.3 mm<sup>2</sup> in cross section. The primary blood supply is from the middle geniculate artery and additional supply comes from the retropatellar fat via the inferior medial and lateral geniculate arteries. The posterior articular nerve, a branch of the tibial nerve innervates the anterior cruciate ligament.

**Biomechanical** The anterior cruciate ligament is the primary restraint to anterior tibial displacement, accounting for approximately 85% of the resistance to the anterior drawer test when the knee is 90 degrees of flexion and neutral rotation. Selective sectioning of the anterior cruciate ligament has shown that the anteromedial band is tight in flexion, providing the primary restraint, whereas the posterolateral bulky portion of this ligament is tight in extension. Tension in this ligament is least at 30-40 degrees of the knee flexion. The anterior cruciate ligament also functions as a secondary restraint on tibial rotation and varus-valgus angulation at full extension.

**Mechanisms of injury-** Shearing of the ACL when a sudden shifting occurs between the tibia and the femur which is occur when a person is running and attempts to rapidly slow down and change the direction at the same time or attempts to turn quickly after the foot has been planted. Hyperextension of the knee causing failure of the ligament from excessive stretching which can be result of landing from a jump with the knee extended or by sustaining a blow to the front of an extended knee [3].

**Non-operative management** is a viable option for patient who is willing to make lifestyle changes and avoid the activities that cause recurrent instability. It include an aggressive rehabilitation program and counseling about activity level. Repair of the ACL (either isolated or with augmentation). Reconstruction with either autograft which is used most commonly or allograft tissues or synthetics. The most common current graft choices are bone-patellar tendon-bone graft and the quadrupled hamstring tendon graft. Autografts have the advantages of low risk of adverse inflammatory reaction and virtually no risk of disease transmission. Disadvantages of this soft tissue graft include the concern over tendon healing within the osseous tunnels and the lack of rigid bony fixation.

The goal in rehabilitation after ACL reconstruction is to restore normal joint motion and strength while protecting the ligament graft. Most important step is the early restoration of full extension. Knee immobilisation in a fully extended brace is started immediately after surgery to prevent flexion contracture. The early emphasis of strengthening is on the hamstrings which function in concert with the ACL to prevent anterior translation of the tibia. There are two types of strengthening: open and close-chain exercises.

Rehabilitation following Anterior Cruciate Ligament Reconstruction (ACLR) is an essential part of a full recovery. This protocol is intended to provide the user with instruction, direction, rehabilitative guidelines and functional goals. The physiotherapist must exercise their best professional judgment to determine how to integrate this protocol into an appropriate treatment plan. Some exercises may be adapted depending on the equipment availability at each facility. As an individual's progress is variable and each will possess various pre-operative deficiencies, this protocol must be individualized for optimal return to activity.

The aim of this paper is to present the effect and role of physical therapy and rehabilitation in a patient after reconstruction of the anterior cruciate ligament.

**Method:** Patient with anterior cruciate ligament injury treated arthroscopically. Postoperative rehabilitation conducted in the Clinic for Physical Medicine and Rehabilitation with kinesiotherapy, magnetic therapy, laser therapy, hydrokinesiotherapy. The evaluation of the results made with Womac score at the beginning and at the end of the rehabilitation, rang of motions in the knee were made at two time points, at the beginning and at the end. The patient had two rehabilitation treatments. At the end of the rehabilitation, the patient goes without orthopedic aids. Manual muscle test performed on m. quadriceps.

A 49-year-old female patient, a former handball player, has no other comorbidities. She has injured her knee several times, the last time when she fell on a flat, in April 2021. After clinical and radiological examinations, as well as magnetic resonance, she was first treated conservatively. After a few months, an indication was set for an operation with arthroscopy treatment. The patient was operated with spinal anesthesia. Operative and postoperative course

orderly. After a few weeks, the patient came to physical therapy, she was still wearing an orthosis with limitation of knee flexion and she was walking with two crutches.

Was applied physical treatment with kinesiotherapy, electrotherapy, magnetic therapy, laser therapy and hydro kinesiotherapy.

Our protocol for rehabilitation of ACL reconstruction:

- 1-7 days - exercises for maintaining range of motion in the early phase, - achieving full extension, - exercises for strengthening the knee musculature, - exercises for walking with crutches.
- 8-10 days - physical procedures (laser, DD), - maintenance of full extension, - exercises to strengthen the hamstrings,
- 21 day- physical procedures (laser, DD, IF), - maintenance of full extension, - reaching a flexion of 90°, - exercises to strengthen the knee musculature, - getting rid of crutches.
- 3- 4 weeks after surgery - physical procedures, - achieving flexion of 100° - 110° - release from immobilizer, - strengthening through exercise (static wheel, stepper, swimming), - starting fitness exercises to maintain general fitness
- 4-6 week - achieving flexion from 110° - 125° to maximum flexion, - continuous fitness exercises - introduction of proprioception exercises.
- 6-12 week - flexion of 135°. - continuous strengthening of the thigh muscles - walking freely on a flat surface, riding a bicycle on a flat surface
- 12-20 week - continuous strengthening of the muscles - introduction of jogging and light running - start of training specific to the sport
- 24 week - return to usual training and exercise activities.

The evaluation of the results of the physical therapy and rehabilitation were made with:

- Womac score at the beginning and at the end of the rehabilitation, rang of motions in the knee were made at two time points, at the beginning and at the end.
- The patient had two rehabilitation treatments.
- At the end of the rehabilitation, the patient goes without orthopedic aids. Manual muscle test performed on m. quadriceps and hamstrings.

- Womac score is one of the most widely used instruments in patients with knee or hip osteoarthritis and has proven psychometric properties. The WOMAC consists of three subscales: pain (five questions), stiffness (two questions), and physical function (17 questions) [4].
- Higher scores on the WOMAC indicate worse pain, stiffness, and functional limitation
- Womac score at the beginning of the first treatment was 65points, at the end was 45points
- Second treatment at the beginning was 45 points, at the end was 35points or VERY GOOD physical function.
- Rang of motions or knee movements was relatively all right: Flexion ....60°/65°.....70°/95°, Extension ...-10/-5.....0/0
- Manual muscle test performed on m. quadriceps and hamstrings. The result at the beginning was 3, at the end of second treatment was 5, which means that the patient has a full strength of the muscules and she can practice resistance exercises.

## Discussion

Rehabilitation should commence prior to surgery. After an ACL injury, deficits occur in strength, proprioception, muscle timing and gait patterns. In fact, strength and proprioceptive alterations occur in both the injured and uninjured limb. The primary impairment with an ACL deficient knee is instability. This is manifested by episodes of 'giving way', which can lead to further joint damage and ultimately, long term degenerative changes. Research has demonstrated that physiotherapy provided pre-operatively is effective in increasing strength and balance which may limit the number the episodes of 'giving way' and decrease the incidence of re-injury in the ACL deficient knee. The main goals of a 'pre-habilitative' program prior to surgery include: full range of motion equal to the opposite knee, minimal joint swelling, adequate strength and neuromuscular control, and a positive state of mind. All of these factors facilitate optimal post-operative recovery. It is important to maintain the highest level of strength and function possible in the unaffected leg as it will be used for comparison to assess the progress of the reconstructed knee, in the later stages of rehabilitation [5].

Recovery following ACL surgery is a lengthy process that requires prolonged rehabilitation. Initial efforts are to decrease swelling and improve mobility following surgery. Over time, strengthening and balance become more important and ultimately sport-specific activities are performed to get athletes back on the field.

Despite continued advancements in surgical techniques and rehabilitation, outcomes following ACLR may be less than desirable, with only 33% of athletes returning to sports within 1 year after surgery and 37% never returning to their prior levels of sports participation.

Rigorous rehabilitation after anterior cruciate ligament (ACL) reconstruction is necessary for a successful surgical outcome. A large number of clinical trials continue to assess aspects of this rehabilitation process. Prior systematic reviews evaluated fifty-four Level-I and II clinical trials published through 2005. Bracing following ACL reconstruction remains neither necessary nor beneficial and adds to the cost of the procedure. Early return to sports needs further research. Home-based rehabilitation can be successful. Although neuromuscular interventions are not likely to be harmful to patients, they are also not likely to yield large improvements in outcomes or help patients return to sports faster. Thus, they should not be performed to the exclusion of strengthening and range-of-motion exercises. Several new modalities for rehabilitation after ACL reconstruction may be helpful but should not be performed to the exclusion of range-of-motion, strengthening, and functional exercises. Accelerated rehabilitation does not appear to be harmful but further investigation of rehabilitation timing is warranted [6].

After ACLR it is important to restore and maintain full range of motion (ROM) in the knee. Quadriceps re-training has been found to improve ROM in the early stages [6]. Attaining full knee extension as early as possible is not deleterious to the graft or to joint stability and may prevent patellofemoral pain and compensatory gait pathologies. A stretching program is incorporated to maintain lower extremity flexibility. Research recommends that a 30 second stretch is sufficient to increase ROM in most healthy people. It is likely that longer periods of time, or more repetitions, are required for those individuals with injuries or with larger muscles [7].

Proprioception plays an important role in knee movements. Since there are controversies surrounding the overall recovery time of proprioception following surgery, it is necessary to define the factors affecting proprioceptive recovery after anterior cruciate ligament (ACL) reconstruction and to investigate the relationship between proprioception and muscle strength [8].

Currently, clinical doctors often prescribe a progressive protocol after ACL reconstruction and suggest their patients returning to sporting activities 6 months after surgery [9]. Since controversies exist surrounding the overall time taken for proprioception to recover, investigation of proprioception 6 months after surgery is needed. It has been confirmed that proprioception is affected by many factors, such as age, trauma, arthritis, effusion, pain, and exercise training [10].

Various balance exercises is use to help improve and recover the proprioception. These exercises also help to regain strength. In subsequent phases when jumping, cutting and pivoting are emphasized, it is essential that the body is in correct alignment. The systematic review of Cooper, *et al.* investigated the effect of proprioceptive and balance exercise on outcomes following injury and surgical reconstruction of the anterior cruciate ligament (ACL). Five studies of high quality that offered empirical evidence by comparing one rehabilitation program to another were included in the review. There is some evidence that proprioceptive and balance exercise improves outcomes in individuals with ACL-deficient knees. Improvements in joint position sense, muscle strength, perceived knee joint function, and hop testing were reported following proprioceptive and balance exercise. Only one included study investigated proprioceptive exercise following ACL reconstruction. Benefits were noted in the proprioceptive group for measures of strength and proprioception; however, no benefits were noted for any measures of activity [11].

Moisala, *et al.* analyzed the quadriceps and hamstring muscle strengths of 16 patients operated using a bone-patellar tendon-bone (BTB) autograft and 32 patients operated using a quadruple hamstring autograft for an arthroscopic anterior cruciate ligament (ACL) reconstruction for 4- to 7-years postoperatively. The findings showed no significant strength deficits between the patients in the BTB, and Hamstring groups and the deficits were, in general, small. The quadriceps and hamstring muscle strengths were better in patients with a longer than shorter follow-up and stable knees had less knee flexion torque deficit than unstable knees. The findings of this study showed that the muscle strengths of the operated limb had a positive association with the functional outcome of the knee in the long-term and support the use of active rehabilitation after ACL reconstruction [12].

Many questionnaires and scores are used to evaluate the results of treatment and rehabilitation of the knee after anterior cruciate ligament reconstruction. All those functional tests have revisions that improve the tests so they can give more objective results.

Bley, *et al.* 2022, examine the psychometric properties of the SPORTS score and a modified score within the first year after anterior cruciate ligament reconstruction (ACLR). The modified version replaced “same sport” with “any sport” in the answer choices. It was hypothesized that both versions of the SPORTS score would have acceptable floor and ceiling effects and internal responsiveness, moderate convergent validity, and excellent test-retest reliability. Patients were recruited preoperatively from 2 academic medical centers. The authors collected responses to the 1-item SPORTS scores at 6 and 12 months after ACLR and the Tegner activity scale, Lysholm knee score, Knee injury and Osteoarthritis Outcome Score (KOOS)-sport/recreation subscale, and Marx activity rating scale preoperatively and 6 and 12 months after ACLR. Cross-tabulation of the SPORTS scores showed that 64% to 66% of patients reported a change in their score from 6 to 12 months, with significant differences noted between the proportions that improved versus worsened for return to any sport. They **conclusions that** the SPORTS score appears to be a reliable, responsive, and valid 1-item scale that can be used during the first year after ACLR. No differences in psychometric properties were found between the SPORTS score and the modified version [13].

Several studies have examined changes in patient-reported outcome measures (PROMs) after anterior cruciate ligament (ACL) injury, but no studies to date have prospectively evaluated changes from preinjury baseline through injury and follow-up among ACL-injured patients compared to the baseline and follow-up changes of uninjured patients. The purpose of Antosh study (Antosh, 2018) was to examine changes in PROMs over time from preinjury baseline to at least 2 years after ACL reconstruction and to compare these changes with those of an uninjured control group having similar physical activity requirements. Consenting participants completed a baseline questionnaire that included the KOOS (Knee injury and Osteoarthritis Outcome Score), WOMAC (Western Ontario and McMaster Universities Osteoarthritis Index), and MARS (Marx Activity Rating Scale). Participants who sustained a subsequent ACL injury completed assessments at the time of surgery and at 6, 12, and 24 months after surgery. Patients with ACL in-

juries reported significant deficits on PROMs at least 2 years after surgical reconstruction in relation to preinjury baseline scores and an uninjured control group [14].

Therapeutic education aims to help patients acquire skills and knowledge, and to improve psychosocial aspects to manage chronic disease. After anterior cruciate ligament reconstruction (ACLR), only 35 to 60% of the patients can go back to their previous sport. Return to sport depends on the motivation of the patient. No therapeutic education has already been proposed. We aimed to evaluate the effect of therapeutic education sessions on knowledge improvement during inpatient rehabilitation after ACLR, compared to patients operated with the same surgical technic, but who had no therapeutic education because of outpatient rehabilitation [15].

Therapeutic patient education performed during hospitalization for rehabilitation enables patients to have a better knowledge of the stages from rehabilitation to return to sport and the risks of complication after anterior cruciate ligament reconstruction. Questionnaire administration and therapeutic education could have a positive impact on patients during the course of the rehabilitation to avoid psychological issues about their knee and the risks regarding return to sport. This could also lead to a better knowledge of the possible knee complications and allow earlier management if necessary. This early therapeutic approach seems important to manage the return to sports at risk. Therefore, further studies are necessary to know if this increase in knowledge allows a better return to sport or a reduction in the occurrence of complications after surgery [16].

## Conclusion

- Rehabilitation, kinesiotherapy and physical modalities have an important role in rehabilitation after anterior cruciate ligament reconstruction
- Despite the properly implemented rehabilitation, it is necessary to implement measures for the prevention of long-term complications, the first of which is loss of bone mass in the operated segment, rapid arthrosis changes of the knee and possible re-injury of the reconstructed ligament.
- Prevention is aimed at stabilizing muscles, correcting deficits, promoting proprioception and balance. All this indicates that rehabilitation after ACL reconstruction is a long-term continuous process.



## Conflict of Interest Statement

Statement of financial disclosures and conflict of interest.

I affirm that I have no financial affiliation (including research funding) or involvement with any commercial organization that has a direct financial interest in any matter included in this manuscript.

The authors declare no conflict of interest.

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