



# A Mini-Review on the Rehabilitation of Anterior Cruciate Ligament Injury



**Caner Kararti and Öznur Büyükturan\***

*School of Physical Therapy and Rehabilitation, Ahi Evran University, Turkey*

**\*Corresponding author:** Öznur Büyükturan, PT, PhD, Ahi Evran University, School of Physical Therapy and Rehabilitation, Kırşehir, Turkey

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## Introduction

The anterior cruciate ligament (ACL) is attached medially to the anterior inter-condylar area of the tibia partly blending with the anterior of the lateral meniscus; it ascends posterolaterally, twisting on itself and fanning out to attach to the posteromedial aspect of the lateral femoral condyle [1]. ACL is the main static stabilizer against anterior translation of the tibia on the femur. Because of oblique anatomy of ACL, it is efficient for limiting excessive anterior tibial translation as well as axial tibial and valgus with knee rotations [2]. Besides its mechanical function related to knee stabilization, there is also neuromuscular function of the ACL due to mechanoreceptors [3]. If there is an ACL deficiency, deafferentation zones can be seen. These zones alter spinal and supra-spinal motor control [4]. The changes in motor control strategy can reveal changes in proprioception, postural control, muscle strength, movement and recruitment patterns [3]. Therefore, an ACL injury is not only a musculoskeletal injury, but also a neurophysiological dysfunction.

ACL injuries are reported to be the most common knee ligament injury. It has been estimated that injury rate of 1 per 3,000 in general population [5]. A rehabilitation programme, which promotes the muscular strength and re-establishing the knee joint functional stability, is an essential and integral part of treatment after ACL injury [6]. If exercises are not compatible with normal arthrokinematics of knee, normal stresses, such as overloading, occur on the tibio femoral joint articulating surfaces and other joint structures [6]. Intrinsic and extrinsic factors related to ACL determine both rehabilitation protocol and return to sports and recruitment activities [7]. Intrinsic factors are genetics/biological characteristics, type of lesion, anatomical features, and compliance with the rehabilitation protocol, motivation, and psychological attitude. As for extrinsic factors, they are type of graft, surgical technique, rehabilitation phases, and biological support [7]. Because of existence of a number of factors, rehabilitation protocol should be patient-tailored.

Some factors and functional capacity of the patient in the preoperative period affect the success of the ACL rehabilitation. Preoperative extension deficit, preoperative deficit in quadriceps

strength of >20%, lack of preoperative rehabilitation are important factors to predict the outcome of treatment [8,9]. Functional recovery of the patient may be worse if mentioned predictive factors are present. Therefore, treatment programme modifications may be needed to achieve the best functional level. Cornerstone of rehabilitation is time of programme and whether the program is supervised rehabilitation or home-based rehabilitation. A minimally supervised rehabilitation programme may result in successful rehabilitation in specific groups of patients that are highly motivated and live far from a physical therapist [10]. Duration of the treatment in either program can be selected to be 19 or 32 weeks. When comparing a 19-week with a 32-week rehabilitation programme, there are no differences in terms of laxity, range of motion, self-reported knee function, single-leg hop test for distance or isokinetic concentric quadriceps and hamstring muscle strength [3]. The rehabilitation program for ACL should include the following headings: open kinetic chain (OKC) and closed kinetic chain (CKC) exercises, strength training and neuromuscular training, electrostimulation and electromyographic feedback, and cryotherapy.

Andersson et al. [11] have determined that CKC quadriceps exercises are effective on less pain, less risk of increased laxity and better self-reported knee function compared to OKC quadriceps exercises. Although it has been known that CKC is more beneficial, OKC can also be used. Fukuda et al. [12] described that OKC quadriceps exercises can be started from week 4 after ACL reconstruction with hamstring autograft, but in a limited ROM between 45° and 90°. An early start to OKC exercises result in more laxity after a follow-up period of 7 months [13-15]. Therefore, it is important for the clinician to train ACL with CKC exercises in early phases of rehabilitation. Although isometric quadriceps exercises are safe from the first postoperative week, starting eccentric quadriceps training (in CKC) from 3 weeks after ACL reconstruction is safe and contributes to a bigger improvement in quadriceps strength than concentric training [3]. Neuromuscular training and electro-stimulation/electromyographic feedback in combination with conventional rehabilitation should be added to

strength training in early phases to optimise self-reported outcome measurements. Regardless of early or late phase of rehabilitation, an important problem that clinicians should eliminate in individuals with ACL lesion is the pain and edema. Cryotherapy is effective in decreasing pain and edema immediately after application upto 1 week ACL post surgery in addition to electrical stimulation applications based on "Gate Control" theory [16].

Return to sports and recruitment activities after ACL lesion is a critical situation which should be correctly timed against possible risk of re-injury. It has been reported that rate of ACL re-injury is 23% in young individuals [17]. First criteria of return to sports, it has been considered that 6 months as a cut-off value for allowing sport resumption, without major differences emerging between grafts [7]. As regards muscle strength, the cut-off value of >90% isokinetic strength compared to the contra lateral side is important criterion most used, followed by lower values of the same parameter (>85%, >80%) or different parameters, such as a quadriceps index>90% and weighted leg extension>90% [7]. Self-report knee scoring (Modified Noyes system  $\geq 90$ , International Knee Documentation Committee subjective knee form >70) is frequently used for returning to sports [18,19]. In addition to these clinical criteria's, if patient is an athlete, the sport branch of the athlete should also be considered for their turn to the sports [20].

## Conclusion

The decision to allow a patient to return to sport and recruitment activities is a challenge for the clinician. Because there are criteria's both clinic-based and performance-based. It is not possible to form standardised criteria for each patient indiscriminately. It would be preferable to apply patient-tailored rehabilitation protocols and return-to-sport and recruitment activities criteria, based on individual characteristics.

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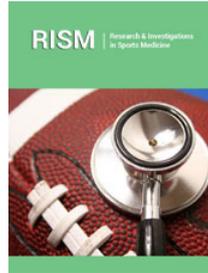
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