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## **Physiotherapeutic treatment after break and reconstruction of ACL**

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## **Abstract**

Injuries of the knee joint are amongst the most common diseases that affect the human body. It is estimated that they affect about 15-30% of all body injuries. Beside the lateral ligaments the most the structure exposed for the any kind of damage is ACL. Concerning the cruciate ligaments, as much as 90% of the injuries are related to ACL [52]. Most often the damage to this structure occurs when practicing sports, both contact (for example basketball, football, martial arts) and non-contact like skiing.

## **Aim of the work**

The main purpose of the paper was to present the methods of reconstruction of the anterior cruciate ligament and to show the physiotherapeutic treatment associated with this injury where the main element of rehabilitation is proprioceptive training.

**Keywords:** ACL, anterior crucial ligament, reconstruction, physiotherapy, proprioceptive training

## **Introduction**

The knee joint is a very complex structure that often succumbs to all types of injuries. One of the most frequently damaged elements of this joint is the anterior crucial ligament (ACL). Depending on the profession or sport discipline practiced the doctor must decide on how to treat the given injury. Surgery treatment is definitely the most common one. The reconstruction of the anterior cruciate treatment is proceeded with the use of the patellar tendon, semi-sinew and semi-membranous muscle tendon or the tibialis anterior muscle. Proper reconstruction is the basis of ACL recovery but the physiotherapeutic treatment which consists of physiotherapy and kinesiotherapy plays a key role.

## **The role of ACL**

The anterior cruciate ligament is one of the internal ligaments of the knee joint. Its average length is 38mm, width 11mm and thickness 5mm. During the flexion movement in the knee joint ACL is able to extend by 10 to 25%. The tensile strength of the anterior ligament oscillates around 1641N [3]. Research has shown that depending on the race, sex, age, type of the body structure, the shape of tibial bone base and position all have the influence on the ligament strength. Therefore in women, it is 9 times more likely to be damaged. The anterior cruciate

ligament consists of three clusters: anterior – medial, posterior – lateral, and intermediate. During the flexion movement of the knee joint, the anterior - medial cluster is tightened while the posterior - lateral cluster during the extension, protecting the joint against excessive extension. [5,6]. In the case of anterior – medial cluster being damaged, the from drawer test will give positive results while Lachman test will be negative. If the anterior – lateral cluster is broken, the test will give reversed results. ACL is a multifunctional structure. One of its main functions is to protect against excessive joint mobility in the anterior, sagittal and transverse plane. [1,6,7]. This is related to the limitation of tibial bone displacement to the front in relation to the femur. It also controls sliding and rotation in the active and passive movements, takes care about the movement being smooth, protects against excessive distortion and deformation of the knee and protects the joint cartilage [1,4,7]. The anterior cruciate ligament control the last 10% of the tibial rotation during the extension. During the transition between flexion and extension, the ACL tension gradually decreases, reaching the maximum relaxation at 35 to 40 degrees of flexion.

### **Damage of the anterior cruciate ligament**

The anterior cruciate ligament is one of the structures (next to the knee lateral ligaments) which is the most often damaged. Of the all cruciate ligaments injuries, ACL is the one damaged the most (90%). The most typical disciplines in which ACL is exposed he most are: basketball, football, martial arts and skiing. [8,9]

The most common mechanism that causes ACL damage in contact sports is injury by clamping between articular surfaces. It is closely related to the external rotation of the femur to the tibia and too much valgus. In this situation, the medial - lateral ligament and the medial meniscus are very endangered. The second way to break ACL is hyperextension in the knee joint. In 30% of these situations meniscus is broken. This type of trauma can most often be found in basketball players who also suffer ACL damage by a sudden stop with the strained quadriceps femoris. Due to strong muscle contraction, the anterior part of the tibia is overloaded which leads to rupture. Another situation in which the anterior cruciate ligament can be damaged is a direct impact, when the bent knee is hit, for example, by surface of the pitch, which causes a probable break of the ACL. In this situation, the risk of PCL breaking increases. The last mechanism that leads to ACL injury is excessive malocclusion in the knee joint which leads to damage to the ligament along the course of the fibers. The damage also includes knee ligaments from the posterior - lateral group, which results in frontal and posterior -lateral instability [9,10, 11]. According to the Medical Aspects Committee of the Medical Society, we distinguish three

degrees of damage to the ligament [10]:

I degree - minimal fiber number broken, local painfulness, no clinical signs of instability (strain on the bone),

II degree - more fibers are broken, local painfulness, moderate instability (ligament strain injury),

III degree – majority of the fibers broken, high instability (ligament rupture).

Approximately 70% of patients reporting damage to the knee ligament apparatus are diagnosed with a complete rupture of the anterior cruciate ligament. A characteristic symptom of the damage to the anterior cruciate ligament is a clearly audible snap of damage to other knee joint structures, i.e. joint capsules, lateral ligaments do not fall to this type of mechanism. [10,11]

### **ACL reconstruction**

Over the last twenty years, the techniques of reconstruction of the anterior cruciate ligament have developed significantly. The aim of the reconstruction is to restore the stability of the knee joint, return of the normal range of movement, to restore the ability to return to physical activity and reduce the risk of complications at the site of the transplant. [2,12]

One of the most popular methods of ACL reconstruction is the transplantation of patellar tendon parts with bone elements of trailers. The patients who had this procedure had very high levels of satisfaction with the knee function. This treatment is especially recommended for people: over 40 years of age, with mild osteoarthritis, low weight, requiring reconstruction due to injuries to multiple ligaments.

The second form of reconstruction of the anterior cruciate ligament is a double-bundle reconstruction. In recent years, the level of interest in this type of graft has risen significantly. The reason for this situation is the fact that the two-bundle reconstruction gives a good anatomical, biomechanical and clinical effect. The effect of this treatment is the possibility of restoration the ACL kinetic norms [12,13].

For this type of reconstruction, trailers from tibialis muscle or semi-sinewy and semi-membranous muscles are used. However, it is preferred to use a transplant originating from the anterior tibialis muscle due to the ease of adaptation to the size of the anterior - medial and posterior - lateral tufts that make up the ACL [12,13].

### **Physiotherapeutic treatment**

Physiotherapeutic procedures to be implemented after ACL reconstruction depend on largely on the type of reconstruction, patient's age, pre-operative level of activity and co-existing injuries. This procedure must assume specific goals and they are usually the same in every age group: striving for full mobility in the joint, building adequate muscular strength and coordination, restoring the proper function of the limb and recovering the mechanisms of neurological feedback. [14] In the latter case, proprioceptive rehabilitation plays a large role, the aim of which is to increase the mobility sensitivity of the joint. This training is introduced when the patient no longer uses orthopedic help in the form of crutches and begins to load the limb. In the proprioceptive training, we distinguish between static and dynamic re-education. In the case of static re-education, we use one-sided exercises, exercises with eyes closed and exercises on unstable ground. On the other hand, in dynamic reeducation, which is most often indicated for people practicing sports, we apply exercises: in a slow pace, exercises training transition from a walk to a run and from running to sprint, jumping and changing directions [14,15].

### **Physiotherapy**

Physiotherapy treatments are selected individually for the patient and can be both supplementing the curative rehabilitation program and an independent form of physiotherapeutic treatment. Among the treatments from the physical therapy we can use: magnetic field, variable magnetic field (PST pulse signal), heat or cold, mechanical waves, electric current (TENS), water therapies and therapies with natural substances. These treatments are intended primarily to stimulate the cell membrane, increase the permeability of biological membranes, improve tissue perfusion, reduce pain, reduce inflammation and swelling. [5]

### **Kinesiotherapy**

1. Passive exercises - the essence of passive exercise is to maintain the efficiency of muscle structures and the pursuit of independent movement performed by the patient. These types of exercises work well during ACL damage, because they act on the nervous system - they clear the proprioceptive pathways. The number of repetitions in a series for these exercises is 20-30. [15]

2. Self-assisted exercises - performed with the help of a compound system (indirect support) or by paving the limb movement of the affected limb by a healthy limb (direct support). However,

the downside of these exercises is that the patient performs them incompletely due to fear of pain.

3. Active exercises - here we can do exercises in unloading, free and with resistance. In the case of the latter, they should be performed 1-2 times a day during 15-30 minutes.

4. Isometric exercises - used here to prevent muscular atrophy, gain muscle growth and to maintain muscle activity. [15]

### **Rehabilitation process in stages**

#### **Stage I (1 day-2 weeks after)**

The goal of this period is to fight pain, swelling and walk reeducation. Elements of the therapy that we can use are: PRICE scheme, lymphatic massage (improves blood and lymph circulation, passive exercise using CPM rail (improves the range of mobility and prevents postoperative adhesions), isometric exercises of the quadriceps femoris. Helpful orthopedic supplies in addition to the CPM rail are axillary crutches that allow walking on a flat surface [16].

In this phase, the patient also attempts to load the operated limb with the pain limit. This stage also allows the introduction of proprioceptive training with the help of exercises in both strength and lying. The range of flexion in the knee joint should not exceed 45 ° [16].

#### **Stage II (+2-9 weeks)**

The duration of the second stage is not completely determined. It is usually assumed to last from 2-9 weeks after surgery. The purpose of this period is to return to everyday life - return to work and daily activities. We can use: physical treatments (cryotherapy, ultrasounds, magnetotherapy, laser therapy, electrotherapy), passive exercises, self-assisted exercises, muscle stretching, proprioceptive training (one-leg exercises, two feet, on unstable ground) [15,16].

#### **Stage III (9-12 weeks)**

The aim is to achieve the full range of mobility in the joint, and to prepare for physical activity, by increasing the intensity of the exercises. We can achieve this through the use of strength training, endurance, cycling, exercises on the crane and dynamic proprioceptive training motor coordination [15].

#### **Stage IV (12-16 weeks)**

The gradual increase in the intensity of strength and endurance training, squats and falls with the load, riding the bike, exercises of adductors and abductors on the exercise devices, stretching the muscles before and after exercises [15].

Continuing the exercise of proprioception and coordination of movement: lunges, running on

various types of surfaces, jumping on one or both legs, acceleration and deceleration while running, throws, dribbling, juggling, jumping over an obstacle, jumping with a change of direction. [15].

### **Summary**

The knee joint is the most complex joint in the human body, and thus is equipped with a large number of ligaments that enable its functions and stabilization. One of them is also ACL, which gives passive stabilization in all knee movements, it also has preventive function of preventing valgus and deformations the knees. In the field of medicine, two types of reconstruction of the anterior cruciate ligament are distinguished, which depend on the degree of its damage. After reconstruction of the ACL, the important role is played by the rehabilitation process, which consists of physiotherapeutic treatments including: cryotherapy, laser therapy and sonotherapy, kinesitherapy and proprioceptive training, which supports regeneration of the anterior cruciate ligament.

### **Conclusions**

Properly selected rehabilitation process, i.e. a combination of kinesitherapy, physical therapy and the inclusion of proprioceptive training allows for faster return to everyday and professional life and return to sports training.

Proprioceptive training allows the return of a proper deep feeling in the operated limb, and thus greater control over its mobility. The training also prepares you to continue your professional life or sports disciplines.

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