

SPORT PARTICIPATION AFTER INJURY OF ANTERIOR CRUCIATE LIGAMENT

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SUMMARY

One of the most common problems involving the knee joint is an anterior cruciate ligament injury or ACL tear. Of the four major knee ligaments of the knee, an ACL injury or rupture is the most debilitating knee ligament injury. Ligament injuries in the knee joint often lead to premature end of sport career in athletes. Treatment following ACL rupture can be operative or conservative. In both cases, main goal of patient is to reach the best functional level, without risk of re-injury or degenerative changes in knee joint. Return to high level of sport performance is the indicator of successful treatment. Rehabilitation represents crucial part of treatment. Knowledge on healing processes and knee biomechanics after injury and reconstruction, along with physiological aspects of training processes, is very important for the construction of training programs. Current rehabilitation programs use immediate trainings, i.e. exercises for the increase of range of motion. In most cases, rehabilitation programs are being created relative to time which is needed for the return to certain sport activities. In this article, we would like to provide an overview of the current strategies for sport participation and rehabilitation after ACL injury. Operation, along with completed rehabilitation program, which is sport-specific, should lead to functional stability of knee joint. Furthermore, adequate muscle strength and performance can be presented as main criterias for the returning to sport activities. Another factors, such as additional injuries, sociological and psychological barriers, can also influence the return to sport activities. Therefore, they should be considered during rehabilitation process and evaluation of the treatment.

Keywords: physiotherapy, recovery, injuries, sport medicine, rehabilitation

INTRODUCTION

Elite athletes are exposed to greater risk of anterior cruciate ligament (ACL) injuries (Roos, Ornell, Gardsell et al., 1995; Bjordal, Arnly, Hannestad et al., 1997). Furthermore, risk of injury is greater among (Roos, Ornell, Gardsell et al., 1995; Bjordal, Arnly, Hannestad et al., 1997; Myklebust, Maehlum, Engebretsen et al., 1997; Hewett, Lindenfeld, Riccobene et al., 1999).

Injury of ACL lead to static and functional instability, which provoke changes in movement patterns (Berchuck, Andriacchi, Bach et al., 1990; Beard, Dodd, Trundle et al., 1994; Kvist & Gillquist, 2001) and increase risk of suffering from osteoarthritis (Gillquist & Messner, 1999).

In most cases, ACL injuries lead to premature end of sport career (Roos, Ornell, Gardsell et al., 1995; Bjordal, Arnly, Hannestad et al., 1997). Study of (Roos, Ornell, Gardsell et al., 1995) showed that only 30% of football players were active 3 years after ACL injury.

Durring operation, after ACL injury, ruptured ligament is being replaced with graft in order to reduce anterior translation of tibia in sagital plane. The main purpose of recostruction is to restore knee function, without any pain and degenerative changes in relation to operation.

It is not neccessare to operate all athletes with ACL rupture. Most common criteria are age of the athlete, additional injuries of ligaments and menisci, functional and sport requirement in relation to knee, as well as readiness and willigness of the athlete to participate actively in post-operative rehabilitation.

1. Knee joint

The knee joint is one of the strongest and most important joints in the human body. It allows the lower leg to move relative to the thigh while supporting the body's weight. Movements at the knee joint are essential to many everyday activities, including walking, running, sitting and standing.

Knee joint consists of three bones, thigh bone (*femur*), kneecap (*patella*) and tibia. Tendons connect the knee bones to the leg muscles that move the knee joint. Ligaments join the knee bones and provide stability to the knee. Morphologically it can be said that knee is composed of patelofemoral and femorotibial joint, with two sections, external and internal.

Knee joint is protected with well innerved articulated tunica, which proximally extends from articular surface of femur for patella (*facies patellaris femoris*) and forms suprapatellar knee pocket (Fulkerson & Hungerford, 1990).

1.1. Anterior cruciate ligament

Anterior cruciate ligament is interarticular and extrasynovial articular structure. It originates from a wide base on the anterior aspect of the tibia and inserts into the lateral condyle of the femur on its posteromedial aspect (Micheo, Hernandez & Seda, 2010). It has two bundles, anteromedial and posterolateral bundle (Norwood & Cross, 1979).

Anterior cruciate ligament is the main brake of tibial anterior translation and secundar line of defence on forces of great intensity which work towards the formation of valgus and varus deformities (Ninković, 2011).

All ligaments, including ACL, have just like tendons, structure which is generated , i.e. formed by forces which act on them. Tendons and ligaments have the ability of morphological adaptation due to changes in their mechanical surrounding which may arise from injuries, illnesses or inadequate training.

Anatomy of the ACL has great significance in the rehabilitation and reconstruction process. An appropriate reconstruction and comprehensive recovery would eventually enable the reconstructed ACL to mimic its original anatomy as much as possible, leading to improved functionality (Markatos, Kaset, Lallo, Korres & Efstathopoulos, 2013).

2. Treatment after ACL injury and safe returning to sport activities

The main reason why is it so important to carry out rehabilitation after ACL injury is acquirement of good functional stability and bast possible level of functionallity, as well as reducement of risk for re-injury. Training programs are focused on healthy and on injured leg, then on muscles of hip and trunk which are crucial for whole body stabilisation.

Functional stability of knee joint depends on mutual influence of passive structures and dynamical systems. It is also dependent on coordination and proprioception. Deficit of

muscle strength (Muellner, Alacamlioglu, Nikolić et al., 1998; Osteras, Augestad & Tondel, 1998; Risberg, Holm, Tjomsland et al., 1999a; Risberg, Holm, Steen et al., 1999b; Mikkelsen, Werner & Eriksson, 2000; Henriksson, Rockborn i Good 2002; Keays, Bullock-Saxton, Newcombe et al., 2003) and proprioception (Friden, Roberts, Ageberg et al., 2001) can be seen after ACL injury.

2.1. Neuromuscular training

The main purpose of neuromuscular training is to improve the ability of neural system to generate optimal and much faster muscle contraction, then to improve coordination and balance, as well as re-learning of certain skills and movement patterns (Risberg, Mork, Jenssen et al., 2001). The importance of neuromuscular training has been showed in following prospect controlled studies where the incidence of ACL injuries was much lower in athletes who undergo proprioceptive training (Caraffa, Cerulli, Progetti et al., 1996; Hewett, Lindenfeld, Riccobene et al., 1999).

Closed chain kinetics exercises had become very popular and they are very often recommended in rehabilitation after ACL injury because it is believed that they are much safer than the other exercises (Shelbourne i Nitz, 1990; Palmitier, An, Scott et al., 1991; Bynum, Barrack i Alexander 1995; Panni, Milano, Tartarone et al., 2001; Henriksson, Rockborn i Good 2002; Pinczewski, Deehan, Salmon et al., 2002; ; Jansson, Linko, Sandelin et al., 2003).

However, there is no enough evidence to support this statement (Beynnon & Johnson, 1996; Fitzgerald, Axe & Snyder-Mackler, 2000; Morrissey, Hudson, Drechsler et al., 2000; Mikkelsen, Werner i Eriksson 2000).

2.2. Range of motion

Most of the authors began with training for improvement of Range of motion immediate after operation. Early post-operative mobilisation of knee joint eliminates adverse effects of immobilisation on graft stiffness and consecutive muscle strength. Braces limitates range of motion and in some cases prevent antero-posterior translation. When braces were used in the first 6 weeks after surgery, there were no beneficial effects on knee joint (Nielsen & Yde 1991; Feller, Bartlett, Chapman et al., 1997; Kartus, Stener, Kohler et al., 1997; Muellner, Alacamlioglu, Nikolić et al., 1998; Möller, Forssblad, Hansson et al., 2001).

2.3. Full weight-bearing on injured leg

In 21 of 34 reviewed articles, full weight-bearing on injured leg was allowed immediately after surgery, depending on pain, swelling in the injured knee joint and on degree of extension loss.

Effects of early weight-bearing on knee laxity still has not been tasted in details. Study of (Tyler, McHugh, Gleim et al., 1998) compared patients who immediately after surgery began with full weight-bearing activities with patients who started doing that 2 weeks after surgery. After 7 months of following they didn't find any differences among these two groups of patients.

3. When to return to light and contact activities?

Decision on weather to return to sport-specific activities or not is in most cases empirically based. Unnecessarily delaying the return to unrestricted activities is undesirable, but so is a premature return because it can lead to graf injury.

In the reviewed studies, patients were usually allowed to return to light activities such as running at 2-3 months after surgery and to contact sports after 6 months. It is

necessary to test muscle strength i level of performances 6 months after surgery because most of athletes return to sport at this period of time.

According to IKDC (*International Knee Documentation Committee*) less than a 10% deficit at the one-leg jump test implies to normal knee function. Of course, these limits must be considered together with other criteria for returning to sports such as asymptomatic knee (no pain or effusion, full range of motion), associated injuries and psychological factors (Morrey, Stuart, Smith et al., 1999; Risberg, Holm, Steen et al., 1999a; Shelbourne & Davis, 1999; Ross, Irrgang, Denegar et al., 2002).

From previous statements we can conclude that an athlete should only return to sports practices with the approval and under the supervision of their health care provider. When available, it is desirable that athletes work closely with their team's certified athletic trainer.

4. Recommendations for return to sports

One of the main indications for the reconstruction of ACL is that patient is being allowed to return to sport activities (Webb, Corry, Clingeffer et al., 1998). Beside that, rate of return to a high level of athletic activity has been a critical indicator of the success of ACL reconstruction (Deehan, Salmon, Webb et al., 2000).

However, the question has been raised whether the only effect of ACL reconstruction in some individuals is „to give the patient enough security to reach the goal of going back to strenuous sports, and then ruining the knee?“ (Gillquist & Messner, 1999).

In order to safely return to sport activities, athletes must complete rehabilitation program which is in accordance with following requirements, presented in figure 1 of this article.

Figure 2. Factors and criteria that influence a safe return to sports

REHABILITATION	Muscle strength and performance Evaluated by isokinetic test and one leg hop test <10-15% deficit	SAFE RETURN TO SPORTS	Social i.e. family, pregnancy, finished college, etc.	OTHER FACTORS
	No pain or effusion full ROM Evaluated by: clinical examination		Psychological factors i.e. motivation, scholarship, fear of re-injury, etc.	
	Functional knee stability Evaluated by: clinical examination and objective measurements ex motion analysis		Static knee stability Evaluated by: clinical examination and objective measures ex KT-1000	
SURGERY				

CONCLUSION

The trend in rehabilitation after ACL injury is healing towards accelerated programmes with an early return to sports. In addition, return to sport activities is considered as a valid indicator of successful treatment. However, both the question of whether the return to sport can be safe and the reason why the patient does not return to sports must be taken into consideration.

The goal of reconstruction is to improve stability but even after ACL reconstruction, sagittal translation may be increased. Furthermore, this is not correlated to knee function or a return to sports. Many patients can participate in sports despite a large difference in sagittal translation or a torn ACL, emphasising the importance of functional stability and good muscle function.

Based on current knowledge and patient compliance, some criteria should be fulfilled before allowing the patient to return to sports. These are a completed rehabilitation with adequate muscle strength and performance and as a result, knee functional stability. Surgery should result in a stable knee evaluated by static measures of sagittal translation. Other factors, such as associated injuries and social and psychological hindrances may influence the return to sports.

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