

# The Effects of Rehabilitation Protocol on Functional Recovery After Anterior Cruciate Ligament Reconstruction

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## ABSTRACT

**Introduction:** The use of rehabilitation protocol which corresponds to surgical technique results in optimal postoperative outcome and functional recovery of patients to a pre-injury level of activity. The aim of this paper is to show the effects of the official rehabilitation protocol in our Institute on functional recovery of patients after anterior cruciate ligament (ACL) reconstruction. **Patients and methods:** In prospective study, we evaluated 70 males after ACL reconstruction using hamstring graft. Patients were divided into two groups according to the manner of conducting the postoperative rehabilitation. Group A consisted of 35 patients that followed postoperative rehabilitation according to the rehabilitation protocol. Group B also 35 patients, which did not undergo the rehabilitation protocol. We evaluated thigh muscle circumference and modified Tegner Lysholm Score, preoperatively and postoperatively after 1,3,6 and 12 months. In the statistical analysis, the Studentov T-test was used. **Results:** In the first postoperative month, the difference between groups in thigh muscle circumference is statistically significant ( $p < 0,05$ ). This difference between groups is statistically highly significant after 3, 6, and 12 months postoperative ( $p < 0,01$ ). Results of the modified Tegner Lysholm Score is statistically highly significant in 1, 3 and 6 postoperative months in patients from the experimental group ( $p < 0,01$ ). **Conclusion:** The positive effects of the rehabilitation protocol results in significant increase of the thigh muscle circumference and faster functional recovery of patients after ACL reconstruction.

**Key words:** rehabilitation protocol, anterior cruciate ligament, reconstruction.

## 1. INTRODUCTION

Anterior cruciate ligament ruptures are the knee's most commonly diagnosed sport injuries (1). Reconstruction is the method of choice in treatment of anterior cruciate ligament rupture for young, functional and sports active population (2). Rigorous postoperative rehabilitation is necessary for a successful surgical outcome. Current trend in rehabilitation after anterior cruciate ligament reconstruction suggest "aggressive" or "accelerated" exercise protocols (3, 4, 5, 6). The use of rehabilitation protocol which corresponds to surgical technique results in optimal postoperative outcome and functional recovery of patients to a pre-injury level of activity. The ideal rehabilitation program is based on biological and mechanical knowledge of the ligament (3). Despite a huge amount of research articles on this topic, a rehabilitation standard still has not been established, due to the complexity of this problem (7).

Aim of this work is to show the effects of the official rehabilitation protocol in our Institute on functional recovery of patients after anterior cruciate ligament reconstruction.

## 2. PATIENTS AND METHODS

This paper covers 70 males which have undergone arthroscopic assisted ACL reconstruction using hamstring graft. It is a prospective study that lasted from 2009 until 2013. Patients were divided into two groups according to the manner of conducting the postoperative rehabilitation. All patients have a similar rehabilitation program during hospitalization. After discharge, rehabilitation program had significant differences between compared groups. Group A, consisted of 35 men, average age of 27 that followed postoperative rehabilitation according to the rehabilitation protocol. As well as group B 35 men average age of 27 that did not undergo the rehabilitation protocol.

Group	Number of Subjects	Male	Female	Mean/Age	Standard deviation	Coefficient of variation
A	35	35	0	26,77	7,17	0,27
B	35	35	0	26,97	7,22	0,27
Total	70	70	0			

**Table 1.** Structure of groups A and B

The rehabilitation protocol in group A consisted of cryotherapy, neuromuscular electrostimulation for eight postoperative weeks, mobilization exercise, stretching

and strengthening exercise (despite conventional exercises, concentric and eccentric contraction of quadriceps and hamstring muscle group after 7 weeks), proprioceptive training, functional training and gait re-education. Physical therapy started on the first day after surgery and continued as an outpatient treatment program on the first week after surgery with a frequency of five times per week through four phases. The total duration of rehabilitation program was 20 weeks.

After discharge, the rehabilitation protocol in group B was implemented without the elements of recommended rehabilitation protocol or the patients did not implement any rehabilitation at all.

In order to evaluate rehabilitation progress, all patients were evaluated preoperatively and four times (1,3,6 and 6 months) after surgery. Main outcome measurement was achieved by measuring thigh muscle circumference and functional recovery by functional test – modified Tegner Lysholm Score. Thigh muscle circumference was measured by centimeter track on 10 cm above superior border of the patella by the same examiner three times (we used the mean value of the three time measurements). Modified Tegner Lysholm Score was evaluated in the form of a questionnaire. All data was analyzed using SPSS software version 19. In the statistical analysis, the Student t-test was used.

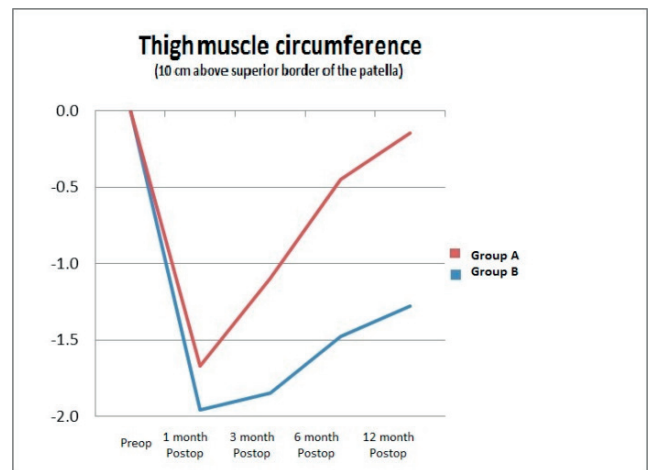
### 3. RESULTS

The results are shown in the tables and figures, where the values of thigh muscle circumference and modified Tegner Lysholm Score can be seen in patients after anterior cruciate ligament reconstruction. There was no statistical difference between groups for age (Table 1). The functional outcome in terms of thigh muscle circumference demonstrated significantly greater improvement of patients in group A (Table 2, Table 3, Figure 1, Figure 2) in all follow-up periods except in the first postoperative month ( $p < 0,01$ ).

Pacijenti	Vrijeme mjerenja	Srednja vrijednost X (cm)	Standardna devijacija SD	Koeficijent varijacije CV (%)	Interval varijacije (max-min)	
Grupa A (N=35)	Preoperativno	48,15	4,61	9,57	23,00	
	Postoperativno	1 mj.	46,49	4,70	10,12	21,50
		3 mj.	47,06	4,68	9,95	22,00
		6 mj.	47,71	4,70	9,84	23,00
		12 mj.	48,01	4,63	9,65	23,00
Grupa B (N=35)	Preoperativno	45,44	3,34	7,34	11,00	
	Postoperativno	1 mj.	43,49	3,29	7,56	11,00
		3 mj.	43,60	3,32	7,61	11,40
		6 mj.	43,96	3,31	7,53	11,40
		12 mj.	44,16	3,30	7,46	11,50

**Table 2.** The mean value of evaluation of thigh muscle circumference (10 cm above superior border of the patella) in patients group A and group B, preoperative and postoperative

The mean value of the modified Tegner Lysholm Score was better in patients of the group A. There was highly significant differences between groups in 1, 3 and 6

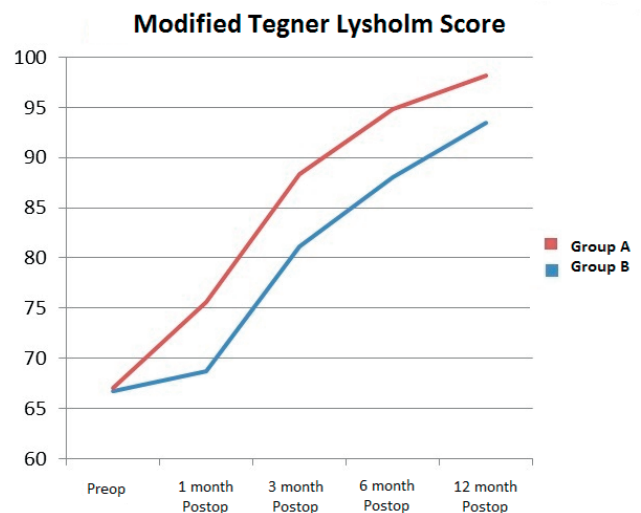


**Figure 1.** The results of evaluation of thigh muscle circumference (10 cm above superior border of the patella) in patients group A and group B, preoperative and postoperative.

month postoperatively which demonstrated their faster functional recovery after anterior cruciate ligament reconstruction (Table 3, Figure 3).

Pacijenti	Vrijeme mjerenja	Srednja vrijednost XZ	Standardna devijacija SD	Koeficijent varijacije CV (%)	Interval varijacije (max-min)	
Grupa A (N=35)	Preoperativno	67,09	10,53	15,69	36,00	
	Postoperativno	1 mj.	75,60	10,24	13,55	39,00
		3 mj.	88,31	7,99	9,05	44,00
		6 mj.	94,86	4,04	4,26	11,00
		12 mj.	98,20	2,63	2,68	8,00
Grupa B (N=35)	Preoperativno	66,74	9,33	13,98	33,00	
	Postoperativno	1 mj.	68,74	7,95	11,56	30,00
		3 mj.	81,17	5,00	5,16	19,00
		6 mj.	88,06	3,76	4,27	16,00
		12 mj.	93,51	3,07	3,28	11,00

**Table 3.** The mean value of modified Tegner Lysholm Score in patients group A and B preoperative and postoperative



**Figure 2.** The results of modified Tegner Lysholm Score in patients group A and B, preoperative and postoperative.

#### 4. DISCUSSION

Knee rehabilitation is a point of crucial importance to achieve desired good functional results (8). As variables of the evaluation process we can consider muscle strength and functional activity. Quadriceps and hamstring weakness occurs frequently after anterior cruciate ligament injury and reconstruction (9,10). Rehabilitation protocols are divided into "traditional" with restricted range of motion, weightbearing and improving muscle strength and "aggressive" with intensive physiotherapy program especially kinesiotherapy (achieving full extension immediately after surgery, and early implementation combining concentric and eccentric contraction for thigh muscle and exercise in open kinetic chain). Our rehabilitation protocol belongs to the group of "aggressive" or "accelerated" rehabilitation protocols. Better results in rehabilitation after anterior cruciate ligament reconstruction in patients from group A we have explained the use of exercises for progressive combining concentric/eccentric contractions of quadriceps and hamstring muscles and progressive proprioceptive training. Recent studies confirmed that appropriate rehabilitation program must have strength exercises in the form of closed and especially open kinetic chain but after seven postoperative weeks (11, 12, 13). Knowing that rehabilitation after anterior cruciate ligament reconstruction is a long road of recovery, it is necessary to be supervised by the rehabilitation team. New methods of muscle strength evaluation, like isokinetic testing, that are not available for all physicians, so that thigh muscle circumference and manual muscle testing remain useful tools in rehabilitation. Further investigation is needed to achieve "gold standard" in rehabilitation of patients after anterior cruciate ligament reconstruction.

Patients who implemented the "accelerated" rehabilitation protocol with professional supervision, which led to their better and faster functional recovery, than for patients whose rehabilitation program, did not include elements of the above protocol. However, the rehabilitation protocol needs to be understood as a framework where its elements are modified with great communication between the patient, the operator and the rehabilitation team.

**CONFLICT OF INTEREST: NONE DECLARED.**

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