

Effect of rehabilitation on knee joint function after injury and arthroscopic reconstruction of the anterior cruciate ligament

Ewa Wawrukiewicz¹, Stanisław Krajewski², Łukasz Bielawa³, Rafał Gotowski⁴,
Krystian Wawrukiewicz⁵

¹ „Rehabilitacja Wieżyca” Oddział Rehabilitacji Kardiologicznej w Szymbarku

² Bydgoska Szkoła Wyższa, Bydgoszcz

³ Akademia Wychowania Fizycznej i Sportu w Gdańsku, Wydział Turystyki i Rekreacji

⁴ Uniwersytet Kazimierza Wielkiego w Bydgoszczy

⁵ Szpital Specjalistyczny im. J. K. Łukowicza w Chojnicach

Key words: reconstruction of the anterior cruciate ligament, rehabilitation

Abstract

Breaking the continuity of the ACL and a long-term loss of its function may lead to the destruction of deep feeling receptors and thereby an abolition of joint feeling. After injury, a person has a feeling of joint's instability and feels fear of burdening the limb. This injury may provide to the damage of cartilage and menisci and as a result it leads to arthrosis development. The aim of this thesis was the analysis of rehabilitation method and its influence on a daily functioning of a knee joint among patients after the arthroscopic anterior cruciate ligament reconstruction from gracilis and semitendinosus tendons. As a hypothesis, I have assumed a thesis, that the rehabilitation program selected properly, including elements of deep feeling and strengthening training, may reset a good function of a knee joint, enabling the patient a return to activities before injury. The research included the examination of 30 patients at the age from 18 to 56 years. Patients were operated arthroscopically because of the anterior instability of a knee joint after the previous cruciate ligament injury.

The clinical evaluation was performed with an application of a range of motion measurement by the SFTR method using goniometer, front drawer "test and Lovett test. The second method of clinical evaluation was an application of subjective scales evaluating the function of a knee joint and complaints, which exist after the reconstruction: Lysholm scale. In this research, a questionnaire is applied to evaluate the method of rehabilitation as well as an application of physiotherapeutic and kinesitherapeutic procedures and, above all, proprioceptive training. After the statistical analysis of collected materials, it is confirmed that a knee function after the arthroscopic anterior cruciate ligament reconstruction was subjectively evaluated by 90% examined as a „good” result or „very good”. For the majority of examined, 74% patients return to sports activities before injury without meaningful complaints. Kinesitherapy carried out properly, taking into account the proprioceptive training and strengthening training, is more important after the ACL reconstruction than a long duration of rehabilitation.

INTRODUCTION

Damage to the anterior cruciate ligament is the second most common knee ligament injury after the collateral ligament of the medial collateral [3]. The interruption of ACL continuity and the long-term loss of its function leads to the destruction of proprioceptors, and thus the elimination of deep sensation. The person after the injury has a sense of instability of the joint and feels the fear of loading the limb. Untreated, this type of injury can lead to cartilage and meniscus damage, which in turn results in the development of degenerative changes [2].

Treatment of anterior cruciate ligament injury depends on the patient's individual expectations, his activity and the degree of damage. Currently, the reconstruction of the anterior cruciate ligament is performed mainly by the arthroscopic method, and to reproduce its continuity the graft is most often used from the semi-sinewy and slender muscle. However, good mechanical stabilization of the knee joint is not enough. An important element before the planned surgery, as well as after the reconstruction of the anterior cruciate ligament, is regaining strength, flexibility and muscular balance. The next step should be proprioception training, even in the case of a minor injury, which did not require surgical intervention [4].

The study assessed the method of rehabilitation and its influence on the daily functioning of the knee joint after arthroscopic reconstruction of the anterior cruciate ligament. The knee joint mobility test, the "front drawer" test and the Lovett test were used for clinical evaluation, as well as the IKDC 2000 knee joint subjective assessment form and the Lysholm scale, which are the simplest and most commonly used methods of knee joint treatment assessment [1,5,6,7]. To assess the method of rehabilitation, a specially created questionnaire was used, which included treatments in the field of physical therapy and kinesitherapy.

Properly selected rehabilitation program, containing elements of deep and strengthening sensation training, can restore the good function of the knee joint enabling the patient to return to the activity before the injury.

PURPOSE OF RESEARCH

The aim of the study is to analyze the method of rehabilitation and its influence on the everyday functioning of the knee in a patient after arthroscopic reconstruction of the transverse ligament with grafts from the semi-sinew and slender muscle.

MATERIAL AND METHODS OF RESEARCH

The study material consisted of 30 patients, aged from 18 to 56 years. The average age was 32.6 years and the average body mass index was 25.1, including 10 women with mean BMI of 23 and 20 men with mean BMI of 26.8. Patients were operated on arthroscopic surgery due to instability of the anterolateral knee joint after damage to the anterior cruciate ligament. The lesion was operated during previous knee arthroscopy. The number of injured knee joints was 15 for the left lower limb and 15 for the right lower limb. Rehabilitation before the reconstruction surgery took 10 patients.

The control group consisted of 30 people between the ages of 20 and 59. The average age was 33 years and the mean body mass index was 24.2, including 10 women with mean BMI 22.3 and 20 men with mean BMI of 24.8. These people did not have a damaged knee joint or other joint of the lower limbs.

The research was carried out once in a private doctor's office in Kościerzyna, from January to June 2017, in the form of a clinical evaluation and an interview on the method of rehabilitation. The test results were referred to norms, to the second healthy lower limb, and to the results obtained in the control group.

The clinical evaluation was carried out using the measurement of the range of motion by the SFTR method, using a goniometer, the "front drawer" test and the Lovett test. The second method of clinical evaluation was the use of subjective scales assessing the functions of the knee and ailments that occur after reconstruction - the Lysholm scale.

The research also used a questionnaire, on the basis of which the method of rehabilitation, the application of physiotherapeutic and kinesitherapeutic treatments were assessed.

DISCUSSING RESEARCH RESULTS

The results of the scope of movable property by the SFTR method

In the assessment of the results of knee extension deficits, it was not found. Only 2 people from the research group had a small deficit up to 2 ° extension in the operated limb. In assessing the results of flexion deficits, a small knee joint flexion deficit up to 10 ° of flexion was observed in 1 of the subjects, 5 ° flexion in 3 subjects, and 2 ° flexion in the operated limb in 1 person in the study group.

Table 1 Distribution of average values of the range of movable property - research group.

The range of mobility in the knee joint					
	Limb after surgery	Healthy limb		Limb after surgery	Healthy limb
	Bending	Bending		Straightening	Straightening
Average	133°	137°	Average	0°	-1°
Standard deviation	5,73	4,89	Standard deviation	1,66	3,56

Nonparametric analysis showed a statistically significant difference in the range of motion between the limb after surgery and the healthy limb. For bending motion ($p < 0.001$), for straightening motion ($p = 0.030$). This means that the limb after surgery had an inferior range of motion relative to the healthy limb, both parametrically and non-parametrically. For comparison of results, in the table below, the values achieved in the control group are presented.

Table 2 Distribution of average values of the range of movable property - control group.

The range of mobility in the knee joint					
Right lower limb			Left lower limb		
	Bending	Straightening		Bending	Straightening
Average	136°	0°	Average	136°	0°
Standard deviation	4,02	1,59	Standard deviation	3,85	1,24

The results of the functional test

In the "front drawer" test in 22 subjects, knee joint instability after arthroscopy was not demonstrated. Slight instability of the ligament to 5 mm maximal dislocation of articular surfaces was found in the remaining research group.

Lovett test results

When assessing muscle strength of the lower limb after the procedure, no significant differences were found in relation to the healthy limb. The lowest score 4 on the Lovett scale reached 1 person when straightening the knee joint, 7 people achieved a score of 4.5, and the remaining 22 people had the strength of extensor muscles at 5. However, the strength of the knee flexor muscles turned out to be slightly weaker, where 4 people the respondents achieved the result 4. The 4.5 score on the Lovett scale reached 9 people, the remaining 17 persons had flexor muscles strength at 5.

Table 3 Distribution of mean values of muscle strength in the Lovett scale - research group.

Evaluation of muscle strength - Lovett test					
	Limb after surgery	Healthy limb		Limb after surgery	Healthy limb
	Bending	Bending		Straightening	Straightening
Average	4,72	4,98	Average	4,85	4,98
Standard deviation	0,36	0,09	Standard deviation	0,26	0,09
Coefficient of variation	7,72%	1,83%	Coefficient of variation	5,52%	1,83%

Nonparametric analysis showed a statistically significant difference in muscle strength between the limb after surgery and the healthy limb. For bending motion ($p = 0.001$), for the straightening movement ($p = 0.005$). This means that the limb after the procedure had worse muscular strength compared to the healthy limb, both parametrically and non-parametrically. For comparison, the results in the table below show the values achieved in the control group.

Table 4 Distribution of mean values of muscle strength in the Lovett scale - control group.

Evaluation of muscle strength - Lovett test					
	Limb after surgery	Healthy limb		Limb after surgery	Healthy limb
	Bending	Bending		Straightening	Straightening
Average	4,95	4,93	Average	4,95	4,97
Standard deviation	0,15	0,17	Standard deviation	0,15	0,12
Coefficient of variation	3,08%	3,5%	Coefficient of variation	3,08%	2,55%

Subjective evaluation of the patient

Lysholm's knee assessment results

In order to check whether the research group differs from the control group in terms of Lysholm scale assessment, the Mann - Whitney U test was performed. The table below presents the results obtained in the study.

Table 5 Lysholm scale assessment in both groups.

Variable	Group	<i>n</i>	<i>M</i>	<i>SD</i>	<i>AR</i>	<i>Z</i>	<i>p</i>
Lysholm	research	30	92,83	7,24	23,42	3,30	<0,001
	control	30	97,37	4,30	37,58		

n number

M average

SD standard deviation

AR Average rank

Z U Mann - Whitney test result

p significance level for the test

Analysis with the Mann-Whitney U test showed a statistically significant difference between the groups ($p < 0.050$). This means that people from the research group had a lower Lysholm score than those in the control group.

In the study using the Lysholm scale, the mean of results in the research group was 92.8 points, which corresponds to the "perfect" result. For comparison, in the control group the average of results was 97.4 points, which may indicate that despite the absence of injury, the knee joint gives minor ailments during everyday activities. The percentage distribution of results is presented in the table and graph below.

Table 6 Percent distribution of Lysholm scale results in both groups.

Result	Research group	Control group
Perfect	76,6%	96,7%
Very good	16,6%	3,3%
Good	3,3%	0%
Sufficient	3,3%	0%
Insufficient	0%	0%
altogether	100%	100%

Analysis of the rehabilitation method

Analysis using physical procedures

Analyzing the method of rehabilitation with the use of physical treatments, it can be noticed that laser treatment and magnetic field were the most frequently used treatments during rehabilitation. As many as 93.3% of the subjects had a laser, and 90% of the subjects had a magnetic field. The cryotherapy treatment was performed by 63.3% of people during rehabilitation. Muscle stimulation and whirling massage were used by only 20% of the subjects. The research shows that terapuls and ultrasounds are not a popular treatment in the rehabilitation process after ACL reconstruction.

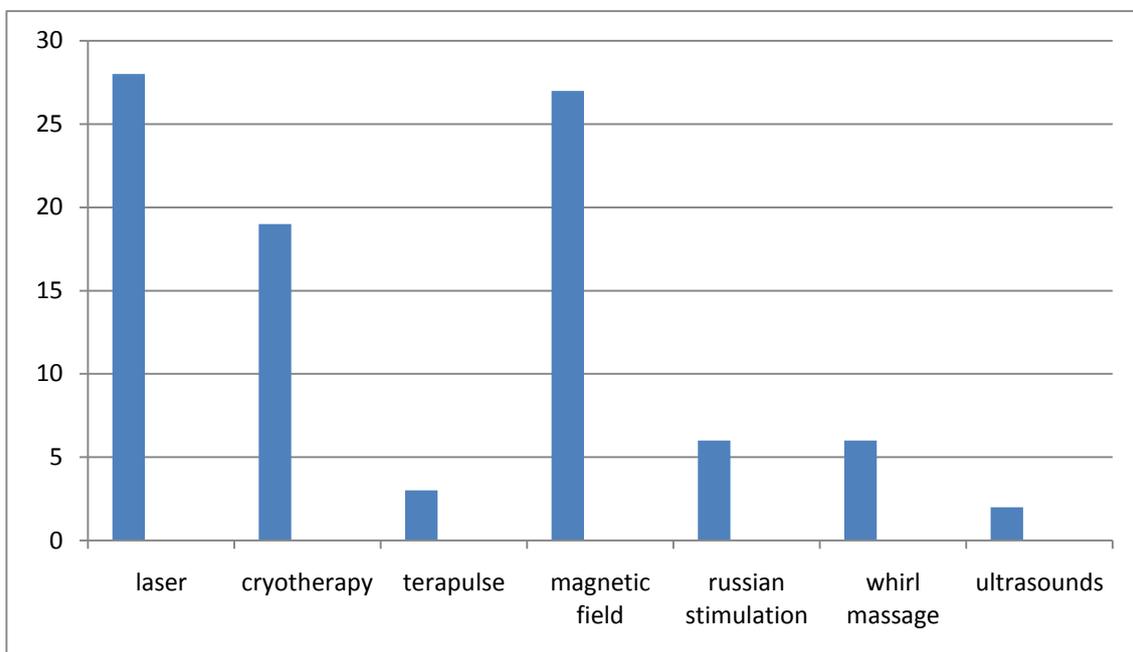


Figure 1 Physiotherapy treatments used in the rehabilitation process.

Analysis of the rehabilitation method using kinesitherapy

Evaluation of the rehabilitation method with the use of exercises shows that the majority of respondents had any training to strengthen muscle strength. 100% of patients performed isometric exercises. Cycling cycloergometer training had 80% of people during rehabilitation, and 86.7% of patients underwent resistance training.

Balance training was not such a popular treatment anymore. 76.7% of the respondents performed exercises on the operated limb, more than half of the people had 63.3% of the equipment added to this exercise, for example, they were reflecting the ball with the second lower limb. Just over half of the patients, 56.7%, exercised their balance on an equivalent platform, and only 43.3% of people were out of balance, eg when sitting on a football with a foot resting on the ground.

76.7% of respondents also had deep sensory training. Most often it was training with a sensomotor disc and a gym ball. Training at the BOSU Balance Trainer was no longer so common, because only 40% of the patients had exercises using this equipment. More than half or 60% trained on unstable ground, and walking 56.7%. Standing on uneven ground was made by 40% of respondents, and a small number of people, because only 20%, walked on such a ground. Squats on the operated limb had less than half of the people, or exactly 46.7%.

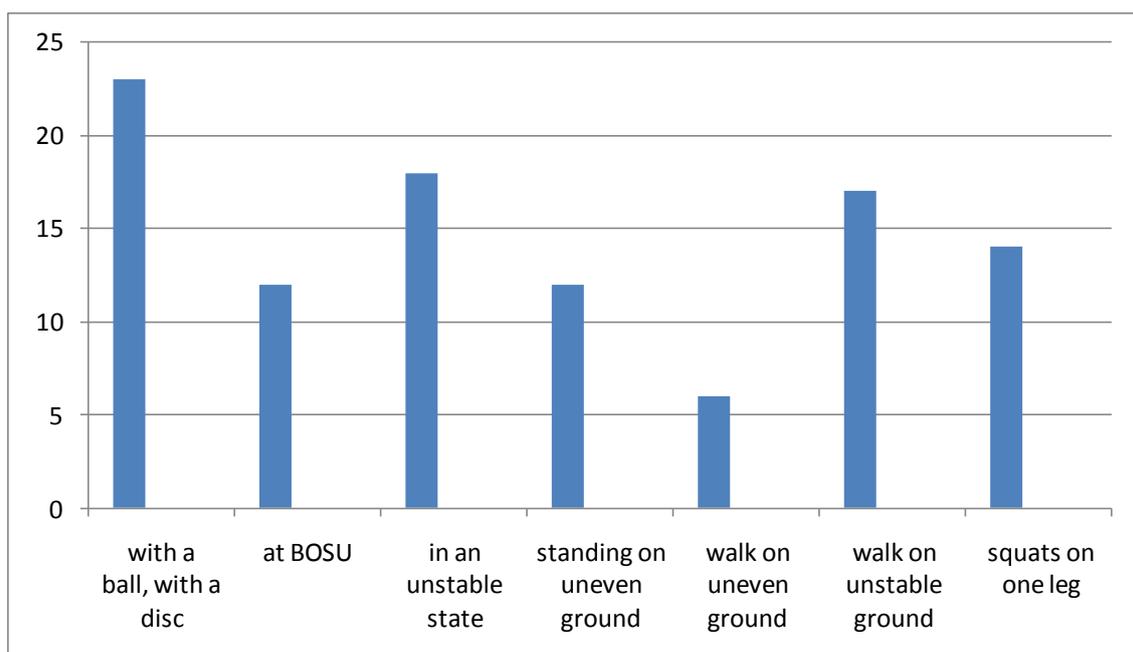


Figure 2 Types of proprioception exercises used in the rehabilitation process.

Conclusions

Based on the conducted research, the following conclusions were obtained:

1. The function of the knee after arthroscopic reconstruction of the anterior cruciate ligament by 90% of the subjects was assessed as "good" or "very good".
2. For the majority of respondents (74%) it was possible to return to the sports activity before the injury without any significant ailments.
3. Correctly performed kinesitherapy including proprioception training and strengthening training is more important after ACL reconstruction than the long duration of rehabilitation.
4. To obtain a "good" and "very good" result in assessing the subjective function of the knee, it must pass a minimum of one year after the reconstruction of the anterior cruciate ligament.

BIBLIOGRAPHY

1. Czamara A. Zastosowanie wyznaczników do oceny funkcjonalnej efektów rehabilitacji po rekonstrukcji więzadła krzyżowego przedniego. *Ortopedia Traumatologia Rehabilitacja* 2010; 6(6): 519-533.
2. Górecki A., *Uszkodzenia stawu kolanowego*. Warszawa : PZWL, 2002.
3. Marciniak W., Szulc A., Wiktora Degii *ortopedia i rehabilitacja*. Tom II, Warszawa: PZWL, 2013.
4. Ratusznik M., *Trening propriocepcji po urazach kończyn dolnych*. *Praktyczna fizjoterapia & rehabilitacja*, 2016; 75(09): 42-46.
5. Risberg MA, Holm I, Steen H, Beynnon BD. Sensitivity to changes over time for the IKDC form, the Lysholm score and the Cincinnati knee score. *Knee Surg, Sports Traumatol, Arthrosc* 1997; 7: 152-159.
6. Stębowska J., Dejewski I., Hoffman J., Porzych K., Kędziora-Kornatowska K., Cubala A., Żukow W., *Ocena funkcji stawu kolanowego po rekonstrukcji więzadła krzyżowego przedniego*, *Humanities dimension of rehabilitation, physiotherapy*, Bydgoszcz 2012; 39-66.
7. Stolarczyk A, Kurdziel J, Nagraba Ł, Mitek T, Nowak P. Wpływ fizjoterapeutycznego postępowania na wyniki leczenia uszkodzeń więzadła krzyżowego przedniego w zależności od okresu, w jakim wykonano rekonstrukcję. *Artroskopia i Chirurgia Stawów* 2009; 5(2): 11-24.