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Study on the effectiveness of the accelerated rehabilitation strategies of the knee in professional athletes after anterior cruciate ligament injury

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Abstract

Accelerated rehabilitation's goal is the return of the athlete to sport activity in a minimum time period, under maximum physical integrity, which was lost. In order to obtain effective functional rehabilitation, the rehabilitation process needs to begin immediately after the surgical procedure: to address first the damaged joint; to be related to the functional needs and possibilities of the patient; to stimulate the patient's capacity and will. Selecting and introducing to the rehabilitation plan techniques, methods, procedures and means that would allow for a postoperative precocious mobility [1] to avoid oedema, hemarthrosis, hyarthrosis, articular blockage, venostasis will result in gaining flexibility, mobility and stability of the knee joint.

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Key words: accelerated rehabilitation, precocious mobility, anterior cruciate ligament reconstruction, kinesitherapeutic intervention, professional athletes, descriptive statistics.

1. Introduction.

Functional integrity of knee ligament determines, to a great extent, the human behaviour and motor performance. Injuries in the knee ligaments result in laxity and articular instability with the inability to control knee function in different activities. The deficits of functional biomechanics consist in the decrease of muscle strength and tissue elasticity [2]. Within sport activities, most injuries in the knee ligaments occur by noncontact mechanisms [3]. Accelerated rehabilitation addresses the intervention methods and procedures by kinesitherapy to be used, upon

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determining the treatments' objectives. Muscle re-toning addresses preponderantly ischiotibials, because quadriceps' toning could determine tensions on tibial tuberosity, being recommended isometry and co-contraction [4]. Knee rotator muscles were generally trained by achieving muscle control in a closed kinesthetic chain by different exercises, techniques and methods of contraction and on balance boards for stimulating neuromuscular proprioceptors [5]. Preoperative initiation improved patients' compliance with the postoperative rehabilitation program, shaping the habit of conscious involvement of the psychical sphere in the performance of motion, which allowed faster regaining of the function.

2. Work methodology.

2.1. *The goal of this research* is represented by the optimization of intervention techniques and methods by kinesitherapy in the accelerated rehabilitation of the lower limb in professional athletes having traumatic injuries of the external anterior cruciate ligament on the one side, and on the other side, drawing-up the intervention plan by kinesitherapy from the immediate postoperative moment until the athlete's return to sport.

2.2. *The objective of this research* aims at testing a kinesitherapy program based on planning the procedures specific to kinesitherapy depending on the entire range of associative procedures and techniques of intervention and treatment which can accelerate and amplify the regaining of the functional capacity of the damaged joints.

2.3 Work hypotheses.

1st Hypothesis: The organization of the functional rehabilitation process depending on the following kinesitherapeutic objectives: precocious mobility of knee joint, including full knee extension, precocious postoperative loading under tolerance conditions, precocious introduction of exercises in a closed cinematic chain, results in the acceleration of the functional rehabilitation of the lower limb after anterior cruciate ligament injury.

2nd Hypothesis: By determining control tests for the quality of the rehabilitation process and regular assessment of the results obtained by the patient, from the moment of the trauma and until the return to sport activity, an objective and permanent feedback will be ensured, that will lead to the increase of the effectiveness of the entire functional rehabilitation process of the lower limb after anterior cruciate ligament injury.

2.3. *Presentation of the sample of subjects.* Our sample was made up of 15 subjects, professional athletes, having anterior cruciate ligament injuries, which needed ligament reconstruction and functional rehabilitation.

2.4. *Kinesitherapeutic objectives of the program for accelerate rehabilitation program of the athletes having injuries in the anterior cruciate ligament:* control of the acute signs of injury, acute symptoms of injury, recovery of articular mobility, recovery of the extensibility of soft tissues, recovery of muscle strength, recovery of joint mobility, restoration of anterior biomechanics, maintaining muscle strength, maintaining tissue flexibility, maintaining sports abilities.

2.5. *Research methods used:* study of the bibliographic material; interview method; observation method; case study method; experiment method; statistical- mathematical method.

3. Results obtained and discussions based on the results obtained

In terms of age, most of the subjects were under 25 years old. Subjects' age varied between 18 and 36 years old, with a mean of 20,73 years old. Table 1 presents the descriptive statistical indicators.

Table 1. Subjects' age. Descriptive statistical indicators.

Indicator	
Mean	20,73
Median	20
Module	18
Standard deviation	4,45
Minimum	18
Maximum	36

In terms of functional class in which the subjects entered sport activity, the overwhelming majority (80%) entered into the 1st class (intense sports activity), and three of them into the 2nd class (average sports activity). We are presenting further-on the frequency table (table 2) for the feature under study. Table 2 presents the functional class-frequency.

Table 2. The functional class. Frequency table

	Absolute frequency	Relative frequency (%)
1 st class	12	80%
2 nd class	3	20%
Total	15	100%

Evolution of knee laxity.

Knee laxity measured by the test “Anterior drawer manoeuvre” evolved positively, tending to decrease. This fact is noticed from the analysis of the synthetic table (table 3) presented below. By doing the Wilcoxon statistical test, a statistically significant value was obtained ($Z = -3,482$, $p < 0,001$) – in other words, between preoperative assessment and the one in the end of rehabilitation, the difference was significant.

Table 3. Synthetic table on results evolution in the test “Anterior drawer manoeuvre”

score	Scores frequency – initial	Scores frequency - final
0	0	11
1	0	3
2	7	1
3	8	0
Mean scores	2,53	0,33
Standard deviation	0,52	0,62

Knee laxity measured by the test “Pivot shift” evolved positively, tending to decrease. This fact is noticed from the analysis of the synthetic table (table 4). By doing the Wilcoxon statistical test, a statistically significant value was obtained ($Z = -3,493$, $p < 0,001$) – in other words, between preoperative assessment and the one in the end of rehabilitation, the difference was significant.

Table 4. Synthetic table on the evolution of results in the test „Pivot shift”

score	Scores frequency - initial	Scores frequency - final
0	0	14
1	0	1
2	9	0
3	6	0
Mean score	2,40	0,06
Standard deviation	0,51	0,26

Knee laxity measured by Lachman test evolved positively, tending to decrease. This fact is noticed from the analysis of the synthetic table (table 5) which follows. By doing the Wilcoxon statistical test, a statistically

significant value was obtained ($Z = -3,502$, $p < 0,001$) – in other words, a significant difference was observed between the preoperative assessment and the one in the end of rehabilitation.

Table 5. . Synthetic table on the evolution of results in Lachman test

score	Scores frequency – initial	Scores frequency - final
0	0	10
1	0	4
2	7	1
3	8	0
Mean scores	2,53	0,40
Standard deviation	0,52	0,63

The evolution of the articular effusion (articular pleurisy) evolved in a positive sense, tending to decrease. This fact is noticed from the analysis of the synthetic table (table 6) presented below. By doing the Wilcoxon statistical test, a statistically significant value was obtained ($Z = -3,535$, $p < 0,001$) – in other words, between preoperative assessment and the one in the end of rehabilitation, the difference was significant.

Table 6. . Synthetic table on the evolution of results in the articular effusion.

score	Scores frequency – initial	Scores frequency - final
0	0	15
1	1	0
2	4	0
3	10	0
Mean scores	2,60	0,00
Standard deviation	0,63	0,00

The evolution of articular mobility. By using the paired sample t- test, the study indicated that the differences obtained between successive tests in the test of Flexion are statistically significant ($p < 0, 01$) for all test pairs, indicating, beginning with the assessment made 6 weeks from the surgery, a statistically significant increase of the flexion capacity. Additionally, the results showed that the difference obtained between successive tests in the test of Extension Deficit is statistically significant ($p < 0,001$) for preoperative test, as compared with the test in the first week, fact which indicates a statistically significant reduction of the extension deficit. The next table (table 7) presents the results of the t- test.

Table 7. T – test results - Flexion

test		Difference between pairs		t	p
		mean	std. deviation		
Initial test – test at 1 week	flexion	22,13 ⁰	34,10 ⁰	2,51	0,025
Test at 1 week– test at 6 weeks	flexion	-40,53 ⁰	4,17 ⁰	-37,62	0,000
Test at 6 weeks– test at 8 weeks	flexion	-1,47 ⁰	0,92 ⁰	-6,20	0,000
All subsequent tests	flexion	Lack of differences			
Initial test – test at 1 week	extension deficit	-2,60 ⁰	1,72 ⁰	-5,84	0,000
All subsequent tests	extension deficit	Lack of differences			

The evolution of muscle strength – quadriceps and ischiotibials. The results of the paired sample t-test show that the differences obtained between successive tests in the test for Quadriceps strength are statistically significant ($p < 0,001$) for all the test pairs; this fact indicates the statistically significant increase of quadriceps strength. The study shows that the differences obtained between successive tests in the test for ischiotibials strength are statistically significant ($p < 0,001$) for all the tests pairs; this fact indicates the statistically significant increase of quadriceps strength. The study indicated that the differences obtained between successive tests in the test for ischiotibials strength are statistically significant ($p < 0,001$) for all the tests pairs; this fact indicates the

statistically significant increase of the strength in ischiotibials muscles. The next table (table 8) presents the results of the t-test made.

Table 8. Results of t-test. –*Quadriceps – ischiotibials strength*

test	Difference between pairs		t	p
	mean	std. deviation		
Initial test – test at 1 week	-6,93%	1,87%	-14,36	0,000
Test at 1 week– test at 6 weeks	-18,33%	2,35%	-30,21	0,000
Test at 6 weeks– test at 10 weeks	-15,47%	2,42%	-24,79	0,000
Test at 10 weeks– test at 12 weeks	-5,20%	1,74%	-11,57	0,000

The evolution of proprioception. By using the paired sample t-test, the study showed that the differences obtained between preoperative tests and testing at 12 weeks are statistically significant ($p < 0,001$); this fact indicates a statistically significant increase of the proprioception capacity. The next table (table 9) presents the results of the t-test made.

Table 9. . Results of t-test – *Proprioception.*

	Difference between pairs		T	p
	mean	std. deviation		
Initial test– test at 12 weeks	-63,20%	4,38%	-55,90	0,000

Conclusions

The identification of the operational objectives specific to each stage of rehabilitation and the observance of the intervention strategies by kinesitherapy lead to a good functional rehabilitation of the knee, with precocious return to social activity (at 7 - 10 days postprocedure) and with restarting the specific sports trainings at 4 months postprocedure and of the competition activity at 6 months preoperative, which verifies hypothesis no. 1.

By choosing the kinesitherapeutic intervention strategy and submitting the ligament, from the first moments of the kinesic program, to an appropriate tensile strength, avoiding at the same time, excessive external forces which might break or detach its fixation points on the tibia and / or femur, associated with control tests of the quality of the rehabilitation process ensures an objective and permanent feedback and is correlated with the increase in the effectiveness of the functional rehabilitation process of the lower limb after the anterior cruciate ligament injury, which verifies hypothesis no. 2.

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