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PHYSICAL RECOVERY OF SOCCER PLAYERS AGED 15-18 AFTER THE ANTERIOR CRUCIATE LIGAMENT RUPTURE AT THE SPORTS REHABILITATION STAGE

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Annotation. The article presents a program of physical recovery of young soccer players after a rupture of the anterior cruciate ligament at the stage of sports rehabilitation. Statistics show that 30% of all injuries in soccer occur in the knee joints. Also, a large proportion is occupied by repeated, recurrent injuries. All this negatively affects the future professional activity of a young soccer player. The obtained positive results of the study allow us to recommend the developed physical rehabilitation program in the recovery and rehabilitation process of injured athletes.

Keywords: anterior cruciate ligament rupture, physical rehabilitation, exercise, young soccer players.

Introduction. An issue of recovering working capacity of athletes after traumatic injuries, their return to training was and still is relevant in modern sports.

Soccer is one of the most popular sports, but it is one of the most traumatic. Preparation of children in modern soccer is described with increasing physical and nervous loads and, consequently, the growth in a number of injuries. In adolescence, soccer is carried at a high impulsive level with a rather high energy expenditure, movement coordination defects, low attention span, emotional instability, as well as other factors typical for a youth stage that lead to high injury rate among players [1].

The knee joint injuries in young soccer players may affect their sports career. In case of the anterior cruciate ligament rupture, rehabilitation can take up to a year. However, the main point is that 8% of players usually finish their career with this injury, while 40% of athletes carry on playing. A percentage of recurrent injuries, according to data from researchers, is 18-25% [2-3]. Therefore, this injury severely affects the future career.

Recovery of the knee joint function and return to previous physical activity without recurrent injuries is a key for success in physical rehabilitation of an athlete [4].

Therefore, search for efficient rehabilitation measures and methods that speed up time

for recovery of working capacity is of great relevance.

The purpose of the study is to evaluate efficiency of the physical recovery course for soccer players aged 15-18 after the anterior cruciate ligament rupture at the stage of sports rehabilitation.

Methods and organization. The study took place in the Spartak Academy named after F.F. Cherenkov and the A.I. Burnazyan Federal Medical Research Center.

The study included 8 soccer players aged 15-18 who suffered the anterior cruciate ligament rupture. At the previous stage of treatment, they got arthroscopic transplantation of the anterior cruciate ligament. They all went through the stage of post-surgical physical rehabilitation. The research was carried out at the sports rehabilitation stage.

To evaluate the rehabilitation's efficiency, we used following methods: knee joint goniometry, isokinetic testing of flexor and extensor muscles of the knee joint and motor testing that includes estimation of speed-strength capabilities of athletes, knee joint stability according to Noyes (jump tests) [5] and an ability to keep body balance in the static-dynamic mode (the Romberg test).

The data were processed with the Statistica 13 software. We have also calculated the arithmetic mean and standard deviation of

the received indices. χ^2 was applied to check on the normality of distribution. The significance of differences between mean values of the examined indices in the compared group was assessed with the Student's t-test.

The physical rehabilitation course took 5 months and consisted of three periods that are different in content of general and specific exercises. It is important to note that duration of the whole sports rehabilitation stage, as well as its parts, depends on individual features of an athlete and should be corrected in the process.

Our program included: therapeutic gymnastics (TG), hydrokinesiotherapy, therapeutic massage, mechanotherapy, exercises with cardio and weight machines, physiotherapy, kinesiotaping, controlled walking and running.

Main tasks of physical rehabilitation were:

- 1) achieving symmetry of the lower limbs;
- 2) recovering general and specific working capacity;
- 3) preparing an athlete to training loads;
- 4) improving proprioception;
- 5) strengthening the stabilizing muscles.

The first (preparatory) period began from the week 3 after the surgery and carried on to the week 7.

Therapeutic gymnastic sessions were performed daily for 45 minutes and included following exercises: isometric tension exercises; myofascial release exercises; exercises with elastic bands; statodynamic exercises; proprioceptive exercises, relaxation exercises.

To reduce swelling, improve restoring processes and reduce pain sensations we used therapeutic massage 2 times a week in a course of 15 procedures.

The CPM-therapy (Continuous Passive Motion) was carried out with the Artromot-K1 device 3 times a week for 20-30 minutes. The amplitude and velocity aimed towards movement development and recovery of the knee joint function were selected individually for each patient.

The cold compression therapy was done with the Game Ready system. The procedure was made daily, exposure time at the beginning was 15 minutes and gradually increased up to 30 minutes. Temperature and compression degree were selected for each athlete

individually depending on the degree of swelling.

The muscle electric stimulation was also done each day, after the therapeutic gymnastic session, for 10-15 minutes. The electrodes were put on motor points of the front and rear groups of hip and glute muscles.

During this period, in case if pain sensations and swelling were still present, it was advisable to conduct kinesiotaping to improve the lymphatic drainage function. An application of tapes is placed on the area of the injured joint, involving the lower third of the hip and the upper third of the crus.

The main period took 9 weeks (from week 8 to week 16 after surgery).

The therapeutic gymnastic sessions were performed daily, 60-70 minutes each. On these sessions, athletes performed exercises on unstable platforms (balancing disks, hard and elastic platforms). Near the end, we added locomotor exercises (in walking and running). Different variations of walking on an agility ladder were used as special preparatory exercises to develop specific coordination abilities of the athlete: quick short steps, steps sideways, steps with quick changes of direction and changes in speed – acceleration and braking.

The hydrokinesiotherapy was performed in a pool from week 8 after the orhtosis removal, once every 3 days for 30 minutes. Controlled swimming was a total of 1/3 of the session, the rest consisted of exercises at the pool side.

The main period included exercises with training devices (a bicycle ergometer and a cable-pull machine) for flexion and extension.

Walking was considered as an important part of the physical rehabilitation program. We started with controlled walking for 10 minutes, then we gradually added more time to 15 minutes, 3 times a week. Initially the patients walked on a treadmill with low speed – 2.5 km/h with obligatory support, then the speed was gradually increased to 3 km/h.

Duration of the final period – 8 weeks, from week 17 to week 24 after the surgery.

This period of final recovery of movement amplitude in the knee joint involves the return to sport-specific exercises. A number of training days decreases, however intensity and

difficulty of the program increase (two days a week for special exercises for the knee joint, aerobic and strength training with training devices), including controlled running every day.

The therapeutic gymnastics sessions were performed 2 times a week, the duration increased to 90 minutes. The exercises on unstable platforms were supplemented with complex coordination and simulation exercises from the selected sport. To develop the functional stability of the knee joint in different planes, we have added dynamic sideways, forward, backward movements and plyometric exercises, such as: lateral trampoline jumps, jumps on the floor in different directions, bouncing on two legs with a minimal distance from the floor. The specific exercises with soccer elements were also introduced into the physical rehabilitation program: passing the ball in pairs, dribbling, exercises with a ball in partial amplitude and at low speed, shots from different positions, with different force and speed, different kinds of movements, etc.

In this period, patients were still training on

cyclic and weight machines. Sessions on an elliptical trainer and a treadmill were added to training devices from the previous stage.

The kinesiotaping was done in order to stabilize the knee when performing plyometric exercises. Applications were changed once in 3-4 days, as well as in the preparatory period.

Results and discussion. To assess the developed program of physical rehabilitation of soccer players after the surgery, we conducted goniometry of the knee joint three times. A significant improvement of the extension indices, both active and passive, in the operated leg was found in the experimental group at the end of the pedagogical experiment (table 1).

The isokinetic testing was done at the end of the preparatory period (7 weeks after the surgery) and at the end of rehabilitation program. We evaluated difference in strength of extensor and flexor muscles of healthy and operated limbs. By the end of the 5th month after the surgery, imbalance of extensor muscles in the crus reduces to 10-18% (average index – 13.4%), flexor muscles – to 3-6% (average index – 4.6%) (table 2).

Table 1

The operated limb goniometry (flexion) results

Indicators	Observation periods			Difference in %	T _{calc} when T _{table} =2.37	P≤
	before the course	7 days after the surgery	after the course			
Active flexion, °	96.5±4.6	114.1±4.6	133.4±2.9	38.2	24.3*	0.05
Passive flexion, °	111.6±7.2	123.1±4.7	148.1±2.9	32.7	27*	0.05

Note: * – statistical significance of differences (before/after the course)

Table 2

Results of the isokinetic testing of flexor and extensor muscles in the knee joint

Indicators	Observation periods		Difference in %	T _{calc} when T _{table} =2.37	P≤
	7 days after the surgery	after the course			
Difference in strength of extensor muscles in the crus, %	62.9±18.1	13.4±3.3	78.7	25.8	0.05
Difference in strength of flexor muscles in the crus, %	28.3±3.2	4.6±1.5	83.75	26.8	0.05

There was a necessity to assess fitness of injured athletes to start the stage of initial training. For this purpose, at the end of the rehabilitation course (5 months after the surgery), we have conducted a jump test. Research of the limb symmetry index has shown that 5 months after the indices of the operated limb are close to those of a healthy limb: in the “Single leg jump” test the indices’

values were 79%, in the “Triple leg jump” test – 84%, in the “Cross jump” test – 81%, in the “6m jump” test – 72% (table 3).

Results of different versions of the Romberg test that evaluates the sense of balance and total state of proprioceptive capabilities had significant improvement: values of indices in the “Tandem” test increased by 136.6%, in the “Stork” test with eyes closed – by 136.1% (table 4).

Table 3

Results of speed-strength abilities and the knee joint stability

Tests	5 months after the surgery		Difference		Limb symmetry index
	operated limb	healthy limb	abs.	%	
One leg jump, m	1.1±0.2	1.4±0.2	0.3	27.3	78
Triple jump test, m	3.8±0.4	4.5±0.1	0.7	18.4	84
Cross jump test, m	3.0±0.2	3.7±0.2	0.7	23.3	81
6 m jump test, m	6.1±0.8	4.4±0.7	1.7	27.9	72

Table 4

The Romberg test results

Indicators	Observation periods		Difference		T _{calc} when T _{table} =2.37	P≤
	7 weeks after the surgery	after the course	abs.	%		
“Tandem” test, s	36.1±5.1	85.4±7.2	49.3	136.6	26.9	0.05
“Stork” test, s	23.3±5.9	55.0±18.0	31.7	136.1	5.6	0.05

The indices of goniometry, isokinetic testing and motor tests obtained in the final testing, show fitness of athletes to begin the initial stage of training 5 months after the surgery.

Conclusion. Therefore, use of the developed physical rehabilitation program for

soccer players after the anterior cruciate ligament surgery contributes to the improvement of athletes’ recovery, maintains high indices of the joint’s stability, functional recovery of lower limbs and better motor control of movements.

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