PHYSICAL THERAPY OF PATIENTS AFTER AUTOPLASTY OF THE ANTERIOR CRUCIATE LIGAMENT AT THE FOLLOW-UP STAGE

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Abstract

Background: despite the large number of works covering the rupture of the anterior cruciate ligament of the knee joint, today there are no generally accepted tactics of physical therapy after this injury. The issue of staged rehabilitation of persons after autoplasty of the anterior cruciate ligament needs to be clarified. Objective: to develop an effective program of complex physical therapy for persons after autoplasty of the anterior cruciate ligament at the follow-up stage based on comparisons of rehabilitation programs of the two medical centers. Materials and Methods. The clinical trial involved 26 patients of different ages and genders from two medical centers (by 13 subjects) at the follow-up stage after autoplasty of the anterior cruciate ligament. Original rehabilitation program with using crossovers, balancing platforms, massage rollers, kinesiotaping and CPM was developed. Amplitude of knee flexion and extension, manual and muscular testing and some cardiovascular parameters (heart rate, systolic and diastolic blood pressure) were analyzed before and after the rehabilitation program in all participants from medical center 1 (original program) and for all participants from medical center 2 (standard program). Standard statistics was used to describe and compare the results. Results: after the course of therapy, the patients in both centers achieved the same rates of active flexion and extension of the knee, but patients from the 1 medical center reached them on average 5–6 weeks after the start of therapy. Conclusions: there is an advantage of using a comprehensive program of physical therapy (with using multi-function simulators, balancing platforms, massage rollers, kinesio-taping and CPM simulators) for individuals after autoplasty of the anterior cruciate ligament at the follow-up stage.

Keywords: *anterior cruciate ligament; autoplasty; follow-up stage; physical therapy; rehabilitation.*

Introduction

Anterior cruciate ligament rupture is the most common ligament injury in the knee joint, which without proper treatment can lead not only to the end of the sports career (in an athlete), but also to irreversible injuries in the knee joint in the long term and even greater injuries from repeated injuries. Even in non-athletes, this injury significantly impairs the quality of life [9, 12, 18].

Anatomically, women are more prone to rupture of the anterior cruciate ligament (2-8 times), but due to the more active participation of men in sports in which the anterior cruciate ligament is more often damaged, the majority of patients with this injury are men [3, 7, 22].

A torn anterior cruciate ligament does not grow on its own. It can either be reconstructed by surgery (plastic), or left as it is. Under normal circumstances, the knee can work without the anterior cruciate ligament. Many patients in their thirties who do not exercise will not experience discomfort even if the ligament is damaged. In turn, the rupture of the anterior cruciate ligament in athletes needs to be restored to sports as soon as possible, because the anterior cruciate ligament is an important stabilizer of the knee joint. Therefore, plastic surgery is required in this case [10, 15, 21].

In Ukraine, anterior cruciate ligament plastic surgery ranks the 7th out of all surgical operations. The number of plastic operations, and hence revision plastic operations, is growing every year.

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Negative results of cruciate ligament plastic surgery occur only in 10–20 % of cases [13].

Circuate ligaments are important passive stabilizers of the knee joint, and the anterior cruciate ligament is its most important stabilizer [10, 22]. The most popular practice is the use of tendons from the patellar ligament and the tendons of the semitendinosus muscles (*fig. 1*) [10].

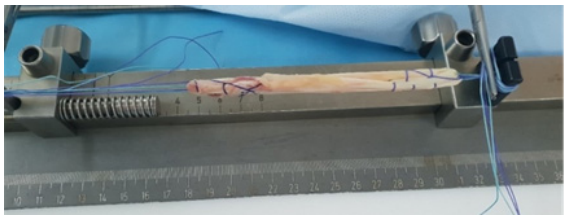

Fig. 1. Tendon graft of semitendinosus muscle ("new" ligament) of the anterior cruciate ligament, folded in four

A review of the literature and scientific sources has shown that today there are many methodological developments and works on special rehabilitation measures for the patients with anterior cruciate ligament rupture. But there is no single clear tactic for physical therapy after anterior cruciate ligament autoplasty, and only a few issues have been covered. The issue of physical therapy for persons after autoplasty of the anterior cruciate ligament at the follow-up stage needs to be clarified.

2. Purpose, subjects and methods:

2.1. The purpose of the work was to develop an effective program of complex physical therapy for persons after autoplasty of the anterior cruciate ligament at the follow-up stage based on comparison of rehabilitation programs of the two medical centers.

2.2. Subjects & Methods

The clinical trial involved 26 patients of different ages and genders at the follow-up stage after autoplasty of the anterior cruciate ligament. Rehabilitation process was conducted in two medical centers (kinesitherapy center "KinesisLife" and rehabilitation center "Your Health" in 13 patients from each center). Each patient provided informed consent to participate in the study and in the subsequent publication of the results. All studies met ethical requirements.

The selection of research methods took into account the symptoms of the injury, the course and possible complications according to the age and type of injury. Research methods included drawer test and Lachman's test, autoplasty, accurate diagnosis, anthropometry, manual muscle testing, flexion and extension amplitude in the knee joint after autoplasty. These complex methods were necessary for defining the goals of physical therapy and choosing the right rehabilitation program that can give a quality and long-term result [6, 17, 21].

Physical therapy at the follow-up stage begins 5 weeks after the surgery and lasts for up to 6 months. An important task during this period is to return the person to a normal lifestyle. When the anterior cruciate ligament is ruptured, 3 periods (motor modes) are distinguished in patients at the follow-up stage. It is on the basis of periodization by stages that we created a comprehensive individual program of physical therapy, where each of these motor modes has its own tasks, methods and means (*fig. 2*).

When performing physical therapy for persons after autoplasty of the anterior cruciate ligament at the dispensary stage, a clear sequence should be followed, which will allow to assess the need for certain procedures (*fig. 3*).

For comparison of effectiveness of the original rehabilitation program with the traditional one, we implemented them in the rehabilitation procedure for all participants from medical center 1 (original program) and for all participants from medical center 2 (standard program).

Particular attention was paid to exercises on the "crossover" simulator (*fig. 4*) [19].

Differences in the conduct of physical therapy after autoplasty of the anterior cruciate ligament at the dispensary stage in two medical centers (*table 1*).

The studied indicators were compared and analyzed. Standard statistics was used to describe and compare the results. Difference was considered to be statistically significant if two-way P was less than 0.05.

Conflict of interests

The authors of the article declare no conflict of interest.

3. Results & discussion

There was no significant difference between the parameters of the patients from different centers during the background survey (*table 2*). Thus, background flexion amplitudes in the patients from medical center 1 were 115.7 ± 1.92, medical center 2 – 115.1 ± 2.15 ($p>0.05$).

Cardiovascular parameters after the complex therapy were lower in both medical centers.

The final systolic blood pressure in patients from the medical center 1 was 121.1 ± 1.3 mm Hg, diastolic blood pressure – 71.2 ± 1.84 mm Hg, which is slightly lower than in patients 2 medical center, where the systolic blood pressure was

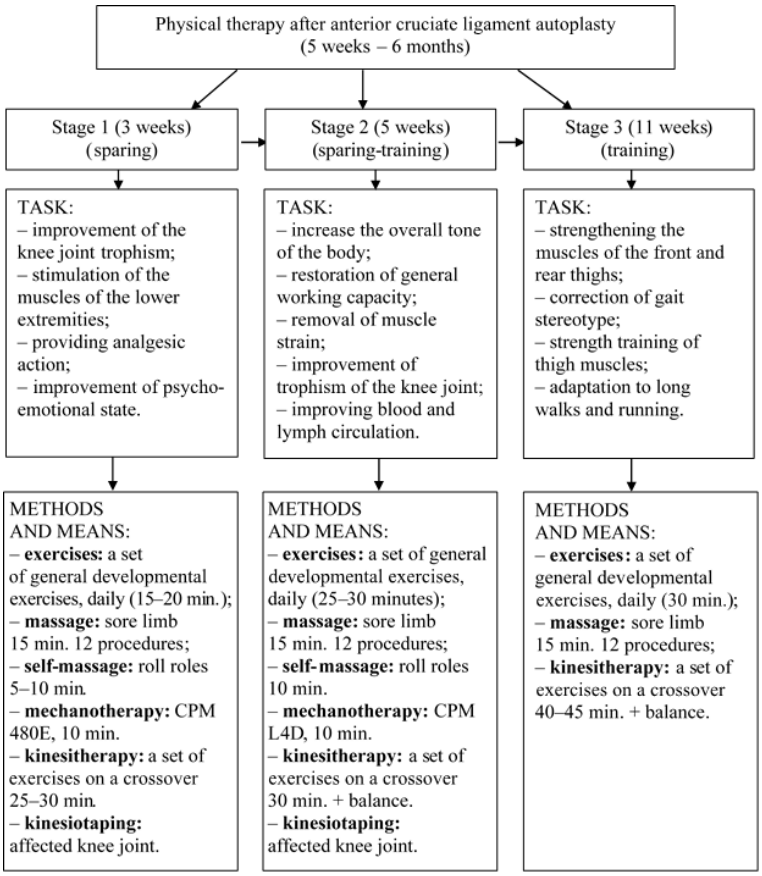

Fig. 2. The program of complex physical therapy after autoplasty of the anterior cruciate ligament at the follow-up stage

122.4 ± 1.76 mm Hg, and the diastolic blood pressure was 76.3 ± 2.71 mm Hg.

Diastolic blood pressure in medical center 1 patients after the rehabilitation course was lower than in those from medical center 2 patients (71.2 ± 1.84 vs. 76.3 ± 2.71 mm Hg).

After the introduction of the proposed approaches to physical therapy, the heart rate in 1 medical center patients was 3.9 beats/min lower than the background; in patients 2 medical center – 2.1 beats/min.

The indicators of the amplitude of knee flexion in patients of both centers were significantly higher after the rehabilitation with no difference between centers. Indicators of the muscle strength in flexion and extension of the knee (according to the manual muscle test) before rehabilitation in patients of both groups were evaluated at 2 points, after therapy – at 4 points.

After the course of therapy, the patients in both centers achieved the same rates of active flexion and extension of the knee, but patients from the 1 medical center reached them on average 5-6 weeks after the start of therapy, while patients in the comparison group – 6–7 weeks, i.e. patients 1 medical center reached the goal 1–2 weeks faster than patients 2 medical center.

Tendon grafts use the patellar ligament, semitendinosus tendon, quadriceps femoris tendon, and synthetic tendon [1, 4]. There is still a dispute between orthopedists and traumatologists about the choice of tendon graft; it is historically believed that the tendon of the knee ligament is stronger, but this technique has several disadvantages, mostly esthetic (a large scar on the front of the knee), pain during movements, longer recovery time [2, 11, 16]. The autograft from the tendons of the semitendinosus muscle meets all the strength characteristics of the ligament, allows different options for fixation, and this is the least traumatic method of reconstruction [8, 14].

The method of application of physical exercises in each case depends on the diagnosis and stage of the disease, individual characteristics of the patient, his level of physical fitness, age and comorbidities, based entirely on the principle of individual approach [5].

The technique is based on exploratory causes based on manual muscle testing, kinesiological correction and therapeutic movement aimed at

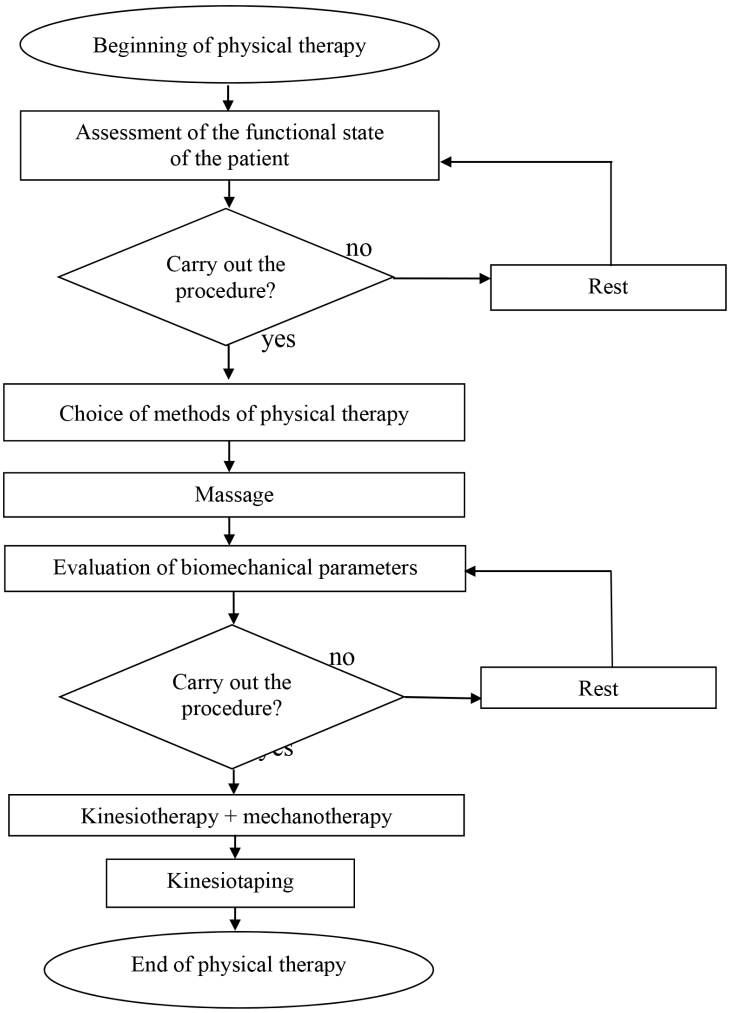

Fig. 3. The sequence of procedures of the physical therapy program after autoplasty of the anterior cruciate ligament at the dispensary stage

Fig. 4. General view of the multifunctional simulator "Crossover"

eliminating muscle imbalance, forming an optimal motor stereotype, restoring blood flow and innervation [19] with is a fine background for the long-term results [21].

Kravchenko B. M. described the method of rehabilitation of patients after autoplasty of the anterior cruciate ligament only with the help of a crossover and massage, without the use of additional modern means of physical therapy [19].

Physical therapists find a solution to the problem of recovery and stabilization of the knee by using only coordination exercises [20, 23].

The use of additional modern means of physical therapy can significantly accelerate the recovery of patients after autolpastic anterior cruciate ligament.

The proposed program of physical therapy can be used in practice by specialists in physical therapy, physiotherapists in the work of rehabilitation centers and on the basis of sports clubs.

Table 1

Comparison of rehabilitation programs of two medical centers

Structural element	Physical therapy programs	
	1 medical center	2 medical center
Kinesiotherapy with a specialist in physical therapy	5 times a week 40–45 min.	3 times a week 30–45 min.
Mode of kinesitherapy	Passive, passive-active, active	Passive, passive-active, active
Equipment	Rollers, rubber, crossovers, CPM, balls, Blackroll, various balancing platforms	Rollers, balls, rubber, crossovers, percussion portable massager
Exercises	A set of exercises of general and special orientation	A set of general developmental exercises
Therapeutic massage	Sick limb	Sick limb
Kinesiotaping	Sick limb	–
Mechanotherapy	CPM 480E, CPM L4D	–

Table 2

Comparative dynamics of the studied parameters of the state of the musculoskeletal system and the general condition of the patient's body after autoplasty of the anterior cruciate ligament in two medical centers

Indicators	Medical center	Background survey X±m	Final survey X±m	Changes, %	Difference, P
Amplitude of knee flexion	1	115.7±1.92	135±2.42	22.31	< 0.0001
	2	115.1±2.15	135±1.81	22.1	< 0.0001
Amplitude of knee extension	1	0	0	0	
	2	0	0	0	
MMT, points	1	2	4	100	
	2	2	4	100	
HR, beats/min	1	65±2.16	61±1.97	3.9	< 0.0001
	2	65±2.1	* 63±1.27	2.1	0.0072
Systolic BP, mm Hg	1	124.9±1.2	121.1±1.3	3	< 0.0001
	2	124.9±1.31	*122.4±1.76	1.5	0.0004
Diastolic BP, mm Hg	1	76.6±1.54	71.2±1.84	7	< 0.0001
	2	77.7±1.97	*76.3±2.71	1.8	0.1450

Conclusions

Physical therapy program at Medical Center 1 using crossovers, balancing platforms, massage rollers, kinesiotaping and CPM was more effective than the standard program used for patients at Medical Center 2.

The results of the research may indicate that our program of physical therapy for patients after the anterior cruciate ligament autoplasty is more effective than the standard program. We can assume that the proposed individual physical therapy program can allow people to recover more quickly and efficiently from the negative effects of autoplasty of the anterior cruciate ligament of the knee joint at the follow-up stage.

The proposed program of physical therapy can be used in practice by specialists in physical therapy, physiotherapists, occupational therapists, in the work of rehabilitation centers and on the basis of sports clubs.

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