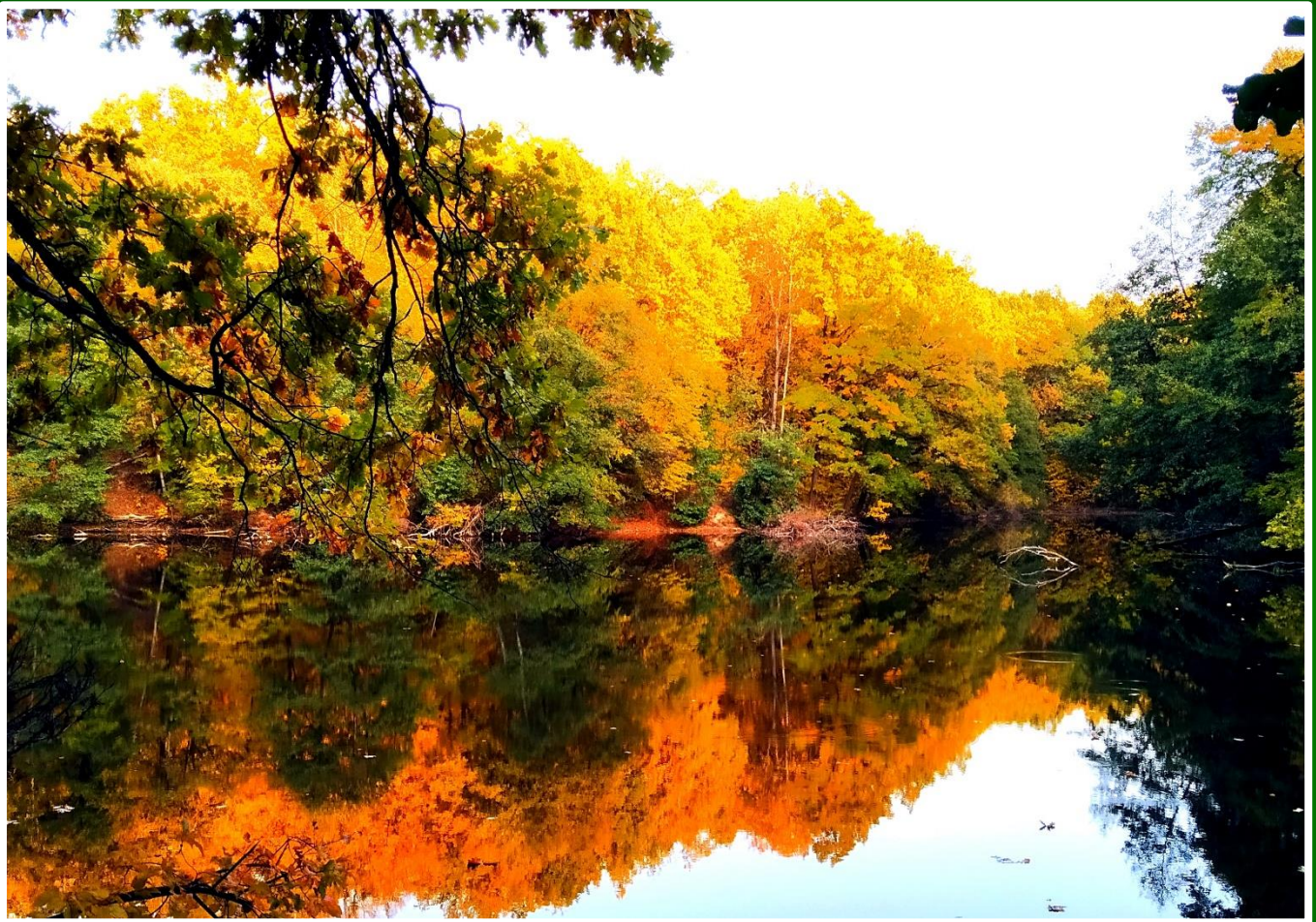




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A complex approach in rehabilitation of the patients after the anterior cruciate ligament reconstruction

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Abstract

The Purpose was to improve the treatment outcomes of patients who undergo ACL reconstruction under arthroscopic control through a comprehensive approach to their rehabilitation program.

Materials and methods. We have implemented a system of comprehensive rehabilitation of patients after the ACL reconstruction under arthroscopic control, which relied on the phase of the clinical course of the postoperative period.

Results. The study involved 40 patients who underwent anterior cruciate ligament reconstruction under arthroscopic control. Experimental group (20 people) who applied a comprehensive approach in rehabilitation after ACL reconstruction, taking into account the phase of the clinical course of the postoperative period. The second group was the control group (20 patients) in which rehabilitation was carried out under the existing program. The use of cryotherapy with adjustable pulse compression in patients of the experimental group from the first day allowed to reduce twice the use of non-narcotic analgesics. Analyzing the dynamics of flexion in the knee joint, it was found that patients of the experimental group on the 25th day performed flexion by 88.46% of the appropriate maximum. Whereas in the control group just - 69.23%. Positive dynamics were noted in the indicators of myotonometry of the quadriceps muscle and measurement of the perimeter of the knee joint.

Conclusions. The program of physical rehabilitation of patients after the anterior cruciate ligament reconstruction under arthroscopic control, which was built taking into account the phase of the clinical course of the postoperative period, has been developed and offered positive results in clinical practice. The effectiveness of the program was shown by the improvement of such indicators as: decrease in intensity of pain syndrome in the early postoperative period, increase in the range of motion in the knee joint, faster restoration of the tone of the quadriceps muscle of the thighs of patients of the experimental group as opposed to the control group.

Key words: rehabilitation, damage of the anterior cruciate ligament, arthroscopy, anterior cruciate ligament reconstruction, cryotherapy, electromyostimulation, mechanotherapy, therapeutic exercises.

Анотація

Грубар І.Ю., Грубар Ю.О., Грабик Н.М. Комплексний підхід у реабілітації пацієнтів після пластики передньої схрещеної зв'язки колінного суглоба.

Мета – покращити результати лікування пацієнтів яким виконана пластика передньої схрещеної зв'язки колінного суглоба під артроскопічним контролем шляхом комплексного підходу в програмі їх реабілітації.

Матеріали та методи. Нами була впроваджена система комплексної реабілітації пацієнтів після пластики передньої схрещеної зв'язки під артроскопічним контролем, яка опиралася на фазовість клінічного перебігу післяопераційного періоду.

Результати. У дослідженні взяли участь 40 пацієнтів, яким було виконано пластику передньої схрещеної зв'язки під артроскопічним контролем. ЕГ (20 осіб) яким застосовували комплексний підхід в реабілітації після пластики передньої схрещеної зв'язки з урахуванням фазовості клінічного перебігу післяопераційного періоду. Друга група - контрольна група, (20 пацієнтів), у яких реабілітація проходила за існуючою програмою. Застосування кріотерапії з регульованим імпульсним стисненням у пацієнтів ЕГ з першої доби дозволило в двічі зменшити застосування ненаркотичних знеболюючих препаратів. Аналізуючи динаміку згинання в колінному суглобі встановлено, що пацієнти ЕГ на 25 добу виконували згинання на 88,46% від максимально належного. Тоді, як у контрольній групі лише – 69,23%. Позитивна динаміка відмічалася в показниках міотометрії чотирихоголового м'яза стегна та вимірюванні периметра колінного суглоба.

Висновки. Розроблена та запропонована програма фізичної реабілітації пацієнтів після пластики передньої схрещеної зв'язки колінного суглоба під артроскопічним контролем, що побудована з урахуванням фазовості клінічного перебігу післяопераційного періоду, дала позитивні результати в клінічній практиці. Ефективність програми проявилася поліпшенням таких показників як: зменшення інтенсивності більшого синдрому в ранньому післяопераційному періоді, збільшенням обсягу рухів у колінному суглобі, швидшим відновленням тонуся чотирихоголового м'яза стегна пацієнтів ЕГ на відміну від КГ.

Ключові слова: реабілітація, пошкодження передньої схрещеної зв'язки, артроскопія, кріотерапія з регульованим імпульсним стисненням, електроміостимуляція, механотерапія, лікувальна гімнастика.

Аннотация

Грубар И.Я. Грубар Ю.Е., Грабык Н.М. Комплексный подход в реабилитации пациентов после пластики передней крестообразной связки коленного сустава

Цель - улучшить результаты лечения пациентов которым выполнена пластика передней крестообразной связки коленного сустава под артроскопическим контролем путем комплексного подхода в программе их реабилитации.

Материалы и методы. Нами была внедрена система комплексной реабилитации пациентов после пластики ПКС под артроскопическим контролем, которая базировалась на фазовости клинического течения послеоперационного периода.

Результаты. В исследовании приняли участие 40 пациентов, которым была выполнена пластика (ПКС) под артроскопическим контролем. Экспериментальная группа (20 человек) которым применяли комплексный подход в реабилитации после пластики (ПКС) с учетом фазовости клинического течения послеоперационного периода. Вторая группа - контрольная группа, (20 пациентов), в которых реабилитация проходила по существующей программе. Применение криотерапии с регулируемым импульсным сжатием у пациентов экспериментальной группы с первых суток позволило в два раза уменьшить применение ненаркотических обезболивающих препаратов. Анализируя динамику сгибания в коленном суставе установлено, что пациенты экспериментальной группы на 25 сутки выполняли сгибание на 88,46% от максимально должного. Тогда, как в контрольной группе только - 69,23%. Положительная динамика отмечалась в показателях миотометрии четырехглавой мышцы бедра и измерении периметра коленного сустава.

Выводы. Разработанная и предложена программа физической реабилитации пациентов после пластики передней крестообразной связки коленного сустава под артроскопическим контролем, построенная с учетом фазовости клинического течения послеоперационного периода, дала положительные результаты в клинической практике. Эффективность программы проявилась улучшением таких показателей как: уменьшение интенсивности болевого синдрома в раннем послеоперационном периоде, увеличением объема движений в коленном суставе, более ранним восстановлением тонуся четырехглавой мышцы бедра пациентов экспериментальной группы в отличие от контрольной группы.

Ключевые слова: реабилитация, повреждение передней крестообразной связки, артроскопия, криотерапия с регулируемым импульсным сжатием, электромиостимуляция, механотерапия, лечебная гимнастика.



Introduction

The knee joint has a complex configuration, its movements occur in three mutually perpendicular axes and planes, which contributes to increased traumatization. Traumatic injuries of the knee joint apparatus are dominated by damage to the anterior cruciate ligament. They occur 15-30 times more often than the posterior junction breaks [1; 2].

Full restoration of the ability to work in case of breaking the anterior junction is possible only after surgery. The use of modern technologies in the process of surgical treatment of her injuries, allowed to perform subtle manipulations with minimal traumatization of the surrounding tissues and the joint itself, improved the quality of fixation of the autograft, which puts new demands on the restorative treatment [3; 4]. Complex rehabilitation includes the phase of the clinical course of the postoperative period [5; 6].

At present, promising remedies are emerging, one of which is cryotherapy. Cryotherapy is one of the non-pharmacological methods of reducing traumatic or postoperative pain [7]. It lowers not only the surface temperature of the skin but also the intra-articular structures [8] slows the conduct of nerve signals [9], which suppresses the inflammatory response. It is considered to be a safe and economical way to manage postoperative pain, and patients have positive feedback when using it [10].

The aim of the work was to improve the results of the treatment of patients undergoing hip arthroplasty under arthroscopic control through a comprehensive approach in their rehabilitation program.

Objectives of the study: to formulate a system of comprehensive approach for the rehabilitation of patients after PSS plastic under arthroscopic control, based on the phase of the clinical course of the postoperative period; to evaluate the clinical effectiveness of the comprehensive rehabilitation program developed.

Material and methods

Participants

The study involved 40 patients who underwent anterior cruciate ligament (PSC) plastic under arthroscopic control.

The patients were divided into 2 groups. The study groups did not include patients with post-

traumatic osteoarthritis of the knee and traumatic damage to the articular cartilage.

Experimental group (EG) (20 people) who used a comprehensive approach in rehabilitation after plastic anterior cross-linking, taking into account the phase of the clinical course of the postoperative period.

The control group (CG) included 20 patients who underwent anterior cruciate plastic, whose rehabilitation was undergoing an existing program.

Procedure

To evaluate the effectiveness of physical rehabilitation, we used the following methods of research: determination of the intensity of pain in the postoperative period on a visual-analog scale (VAS), goniometry, myotonometry and linear measurements.

Pain syndrome was evaluated on a point visual analog scale (YOUR). Each centimeter on the line corresponded to 1 point. At the mark up to 2 cm pain was classified as mild, from 2 to 4 cm – moderate, from 4 to 6 cm – severe, from 6 to 8 cm – expressed and up to 10 cm – unbearable [11].

Electromyostimulation of the quadriceps femur was performed with a Stimulus 1 apparatus using a bipolar technique with a current of up to 20 mA. Course of treatment 10-15 procedures.

One of the methods for objective evaluation of the functional state of the muscles is myotonometry, which allows to evaluate the biomechanical properties of the muscles, namely: tone, elasticity, and firmness [13]. Measurement of muscle tone was performed by determining the elasticity of the quadriceps muscle of the thigh. To record the indicators characterizing the tone, we used a Sirmay tonometer. The magnitude of the tone on the device is expressed in terms of units – myotons. Muscle tone was determined by its full relaxation and maximum tension. The difference between these values is one of the functional indicators that increases the level of training.

Periarticular knee swelling, as a reaction to surgery, was determined by a centimeter tape. Measurements were made 1.5 cm more proximal to the upper pole of the knee.

Characteristics of the experimental method

We have implemented a system of complex rehabilitation of patients after PSH plastic under arthroscopic control, which included three stages: sparing, functional and training and based on the



phase of the clinical course of the postoperative period [5; 6].

The main tasks of the process of rehabilitation of patients after plasticity of the anterior cruciate ligament were: reduction of pain in the early postoperative period, prevention of contracture of the knee joint, normalization of muscle tone, restoration of static-dynamic function of the operated limb.

The first stage of rehabilitation (sparing) corresponded to the phase of acute postoperative inflammation, which was characterized by: the presence of postoperative wounds, persistent pain syndrome, joint swelling, atony of the quadriceps hip muscle.

The objectives of comprehensive recovery at this stage were: reducing the intensity of postoperative inflammation; reduction of pain, stimulation of the contractile muscles of the operated limb, counteracting hypokinesia, support of the general activity of the patient; prevention of knee joint contracture.

To solve these problems, the following tools were used: pharmacotherapy, positional treatment (orthosis), cryotherapy with adjustable impulse compression, therapeutic gymnastics.

For cryotherapy we used a GIOCO CRYO-2 device with adjustable pulse compression. The procedure was performed twice a day at a temperature of cryoagent of 15° and exposure for 15-20 minutes.

The main form of physical rehabilitation was training in gymnastics, which began from the initial position of lying on your back, from the 2nd day after surgery. Classes included 25% of special, 75% of general developmental and breathing exercises. In the reduction of pain (3-4 days after the intervention), corresponding to the phase of primary healing, prescribed exercises in therapeutic exercises aimed at restoring the tone of the thigh and leg muscles. It also envisaged general developmental exercises for all muscle groups. Duration from 15-20 minutes and up to 30-40 minutes at the end of the stage.

II stage of rehabilitation (functional). The tasks of this stage were: elimination of contracture of the knee joint; restoration of normal walking; functional training of the anterior cruciate ligament graft; strengthening the tone and muscle strength of the operated limb. This stage corresponded to the phase of late healing (12-30 days from the time of surgery), which was clinically manifested: decrease in the intensity of pain, atony of the muscles of the operated limb, moderately expressed contracture of the knee joint, gradual restoration of the volume of movements. During this period, the complex of functional recovery was additionally applied:

mechanotherapy and electromyostimulation of the quadriceps muscle of the thigh. Self-study included movement exercises to restore muscle strength and tone. The ratio of breathing exercises to special and general-developing - 1: 2. The pace of their implementation is average. Classes included 50% of special and 50% of general developmental and breathing exercises. The duration of the main part of the lesson was 1/2 time of the whole lesson.

Stage III of rehabilitation (training) corresponded to the recovery phase. The training phase lasted up to eight weeks or more. Stage objective: complete restoration of the function of the operated joint, which would meet the vital needs of the patient. Common criteria were: restoration of amplitude of movements, stability of a knee joint, restoration of force and tone of a four-headed hip muscle not less than 85% in comparison with a healthy limb. At this stage of comprehensive rehabilitation, a great deal of attention has been paid to walking again, with specific exercises for individual muscle groups. Classes were held several times a week, on an even track 200 meters long, gradually increasing the distance. Classes included exercises with a gradual exercise bike. The ratio of special and generally developing exercises to breathing - 1: 3. The duration of the main part was 2/3 of the total class time.

Statistical analysis

The experimental data were analyzed for the presence of normal distribution. In both groups, normal distribution was detected. The difference between the control and the experimental groups was analyzed using the Student's t-test.

Results

On the first operative day, against the background of application of cryotherapy with adjustable impulse compression, the average values of pain syndrome in your EH was 7.21 ± 0.12 points. In KG used the traditional method of cryotherapy. The average value of pain syndrome for your was 7.43 ± 0.15 points ($p > 0.05$), which corresponded to the indicators of severe pain.

On the third day after the intervention, in the EG, the intensity of pain on the background of the use of cryotherapy significantly decreased and amounted to 5.21 ± 0.17 points, whereas in the comparison group 7.16 ± 0.09 points for YOU. On the sixth day after the intervention, the intensity of pain in the first group was 2.47 ± 0.12 points, while in the second it decreased to 4.72 ± 0.19 points. Thus, the pain syndrome in EG patients was 1.9 times lower than in CG (Fig. 1).

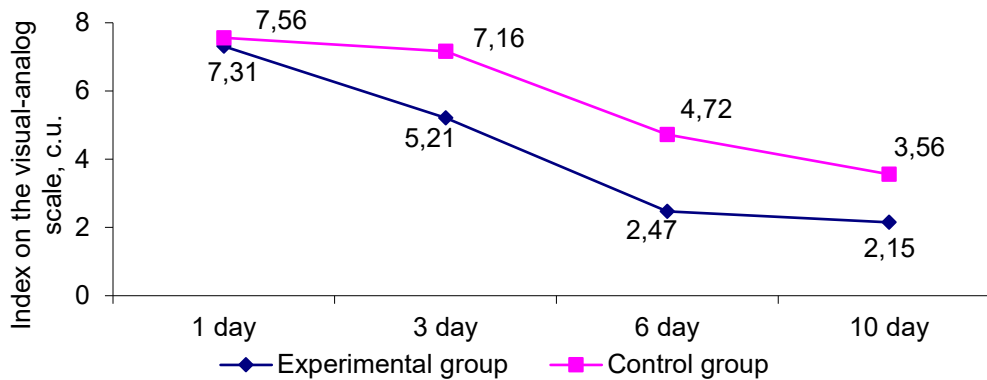


Fig. 1. Intensity of pain on visual analog scale in experimental group and control group

The progressive reduction of pain in most patients with EC allows the second day after surgery to refuse the use of narcotic painkillers. From the third day to twice reduce the use of non-narcotic painkillers (dexalgin). And then analgesics were used only symptomatically.

The same difference persisted until the tenth day after surgery, the experimental group - 2.15 ± 0.12 points, the control group 3.56 ± 0.16 points on the visual analog scale ($p < 0.05$).

Thus, the use of cryotherapy with adjustable pulse compression has shown its effectiveness in reducing the intensity of pain in patients after plasticity of the anterior cruciate ligament.

One of the most important indicators of the functional condition of the operated joint should be considered the restoration of its volume of movement. In the postoperative period, patients of both groups were used fixation of the knee joint with

an orthosis in the extension position. The average duration of fixation was 10-12 days. To restore the volume of movement in patients of the main group at the initial stage used mechanotherapy with the device "Artromot 200". We investigated the dynamics of flexural movements of the operated joint on the 12th, 25th, and 30th days from the time of surgery. The dynamics of these changes are shown in Fig. 2.

Analyzing the dynamics of knee flexion in the aforementioned terms, it is possible to note the improvement of the results of restoration of movements of the experimental group as opposed to the control ($p < 0.05$). Higher efficiency of the program is established by calculating the amount of movements per day from the maximum proper (bending - 130°). Thus, on the 25th day, the vast majority of EG patients flexed the operated joint 88.46% of the maximum. Whereas in KG, it was only 69.23% ($p < 0.05$).

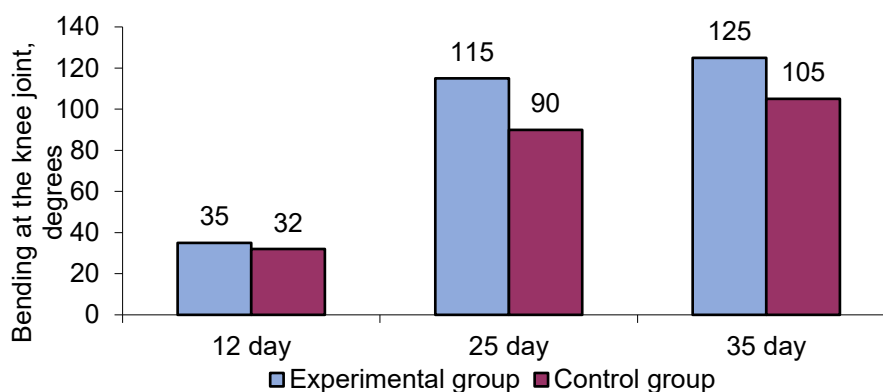


Fig. 2. Dynamics of flexion of the knee joint in the experimental group and control group

Myotonometry indices in the experimental and control patients at the initial examination (on the 12th day after surgery) were not significantly different, whereas the results on the 25th and 35th days after the intervention were significantly

different ($p < 0.05$). Thus, at 35 days after surgery, the average resting tone of the quadriceps muscle in the EG was 63.79 mionton (average 70 mionton) and in the control - 56.47 mionton. The voltage tone was 73.48 and 64.68 mt respectively.

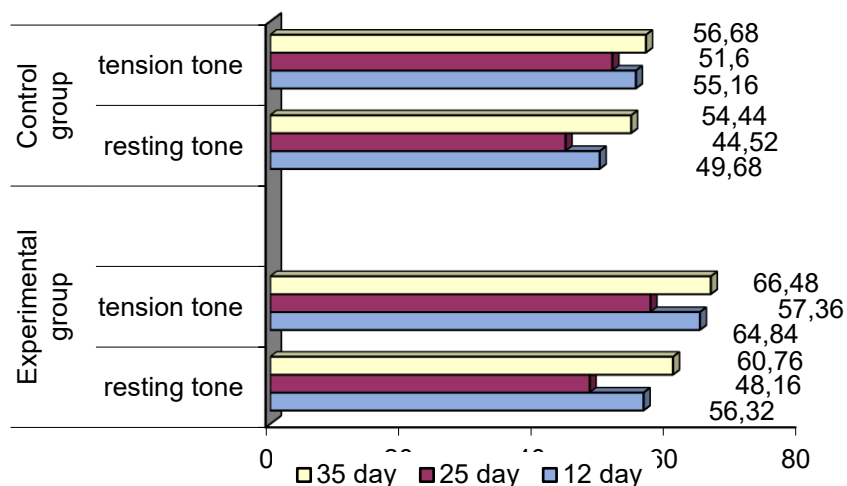


Fig. 3. Indicators of myotometry of the quadriceps muscle of the hip of the experimental group and control group

On the first day after the intervention, the mean peri-articular edema in the experimental and control groups was 44.16 ± 0.71 cm and 46.86 ± 0.58 cm, respectively. 0.61 cm in EG and $45.12 \pm 0,96$ cm in KG. Thus, the perimeter of the knee joint of the EG patients decreased by 2.84 cm in the first 3 days compared to the CG ($p < 0.05$). Similar dynamics were observed on the 15th day after surgery.

The mean values of the perimeter of the knee joint EG were 39.12 ± 0.46 cm, while the CG data were 43.32 ± 0.62 cm, respectively, which is higher by 4.20 cm ($p < 0.05$).

Discussion

In recent years, there has been an increase in work that claims that the reduction in strength and dysfunction of the quadriceps hip, which plays a major role in stabilizing the knee joint, is also a risk factor for osteoarthritis of the knee [11]. Therefore, it is of interest to use the combined effect of therapeutic exercise and electromyostimulation of quadriceps with sinusoidal modulated currents, suggesting their potential effect in the prevention of post-traumatic osteoarthritis in patients after anterior cruciate ligament.

Another important indicator that directly affects the process of recovery of the quadriceps muscle is the myotometry and the measurement of the perimeter of the hip muscle.

Muscle tone is an important indicator that reflects the dynamics of functional recovery of patients after injuries of the musculoskeletal system. Muscle dysfunction caused by surgery and therapeutic mobilization may actually precede and accelerate the deterioration of the condition of the

cartilage of the knee [12] and be a prerequisite for the development of post-traumatic osteoarthritis.

Literature sources [14, 15, 16] indicate that due to the destruction of the anterior cruciate ligament, the articulation biomechanics as a whole suffers: joint instability and pathological displacement of the joint surfaces relative to each other occur. This adversely affects the cartilage coatings of interacting bone units - they begin to suffer from irrational loads during movements. If the ligamentous apparatus is not corrected in time, gonarthrosis can develop, which leads to serious degeneration of not only the articular cartilage, but also of the menisci. But the operation requires a certain period of physical rehabilitation, which is used depending on the recovery period. The authors [17, 18, 19] point out that after plastic surgery of the cruciate ligaments of the knee joint, it is supposed to move for only 1 month on crutches, not resting on the leg.

The immobilization of the operated department lasts about the same amount, which is achieved through the use of a plaster cast, splint or orthosis, rigidly fixed in the full extension position. Joint loads throughout this period are excluded. For 2 weeks, starting from about 3 days, isometric exercises are performed to reduce the PHMB, flexion / extension of the ankle, in the supine position, careful raising of the limb with retention is done.

Additionally, the patient undergoes physiotherapy sessions: magnetotherapy; UHF, electromyostimulation, etc. Somewhere after 4 weeks, by gradually increasing the load on the leg, they smoothly switch from crutches to a cane, and then - to walk without supporting devices.

At this stage, the rigid retainer is changed to a semi-rigid orthosis, preferably a skeleton model.



The rehabilitation technique used by us corresponded to the data given in the sources [18, 19, 20]. However, specific physiotherapeutic effects were applied comprehensively and were constantly adjusted according to the data of operational monitoring of the patient's condition. In this regard, the data obtained are new in comparison with the available literature data.

Conclusion

1. We have been fragmented and reprimanded by us for the program of physical rehabilitation after the plastic surgery of the front crossed ring of the ring of the loaf with arthroscopic control, which is encouraged with the improvement of the phase shifting of the clinical cycle.

2. Warm up Efektivnist pidtverdzhuetysya polipshennyam such pokaznikiv yak: zmeshennya

intensivnosti bolovogo syndrome in Rann pislyaoperatsiynomu periodi, zbilshennyam obsyagu ruhiv kolinnogo Suglob, shvidshim vidnovlenniam tome chotirohholovogo m'yaza Stegna at patsientiv eksperimentalnoi groupies on vidminu od kontrolnoi groupies.

Prospects for the farthest. We're important to directly increase the relative temperature of the optimal temperature of the agent in case of victorious therapy and regulate the pulse frequency and the frequency of the procedure given during the process of arthroscopic surgery.

Conflict of interest

The authors state no conflict of interest.

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