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REHABILITATION

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Recovery of stabilizing muscles that provide a vertical position of the trunk in patients with post-traumatic deformities of the long bones of the lower limbs in the distant period

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Rehabilitation treatment in the case of posttraumatic deformities of long bones of lower extremities (PDLBLE) in the distant period after trauma is aimed at the restoration of support ability of lower extremity while walking and standing. Objective. To work out the set of the exercises targeted on the restoration of muscle-stabilizer function in patients with (PDLBLE) Methods. Research group — 40 patients who received closed injuries of the long bones of the lower limbs, initial trauma occured 6–12 months ago. Among them were 21 women. (52.5 % of persons; age 27–73 years) and 19 men (47.5 % of people, age 29–77 years). The comparison group included 40 healthy volunteers, among which there were 12 women (30 % of persons; age 24–50 years) and 28 men (70 % of people, age 31–49 years). The assessment was carried out before and after rehabilitation for 2 weeks. Parameters evaluated: pain scores on VAS, the results of restoring the support ability using the scale of Tyazhelov O. A. Results. The results of observations are given, where in addition to descriptive statistics (minimum, maximum, average meanings), parameters of support ability and VAS, in patients and volunteers before and after treatment, cumulative group indicators (CG) were calculated for each group at the beginning (CG_0) and 2 weeks after rehabilitation (CG_1); the «rehabilitation» coefficient as a ratio of group indicators before and after treatment was calculated as well. Cumulative group indicator after rehabilitation (CG_1) increased to 2 995 points, which indicates an increase in support ability. Cumulative group VAS score after rehabilitation (CG_1) decreased to 116 points from 200 points before rehabilitation — reduction of pain in patients. After rehabilitation, volunteers showed a slight increase in the cumulatory group indicator (CG_1) to 3 917 points. Conclusions. The system of rehabilitation of patients with PDLBLE in the remote period after injuries proved its effectiveness in restoring muscle-stabilizers vertical position of the trunk, pelvis, lower limbs and pain reduction.

Реабілітаційне лікування в разі післятравматичних деформацій довгих кісток нижніх кінцівок (ПДДКНК) у віддаленому періоді після травм спрямоване на відновлення опороспроможності під час ходьби та стояння. Мета. Розробити комплекс вправ, спрямований на відновлення функції м'язів-стабілізаторів у пацієнтів із ПДДКНК Методи. Групу дослідження склали 40 пацієнтів, які отримали закриті травми довгих кісток нижніх кінцівок, у всіх минуло від 6–12 міс. після ушкодження. Серед них були 21 жінка (52,5 % осіб, вік 27-73 р.) та 19 чоловіків (47,5 % осіб, вік 29–77 р.). У групу порівняння ввійшло 40 практично здорових волонтерів, серед яких було 12 жінок (30 % осіб, вік 24–50 р.) та 28 чоловіків (70 % осіб, 31–49 р.). Оцінювання проведено до та після реабілітації протягом 2-х тижнів за такими параметрами: показники болю за ВАШ, результати відновлення опороспроможності за допомогою шкали Тяжелова О. А. Результати. Підсумовано спостереження, де додатково до описових статистик (мінімальне, максимальне, середнє значення) і показників опороспроможності й ВАШ, у пацієнтів і волонтерів до та після лікування розраховували кумулятивні групові показники (КГ) для кожної групи на початку ($КГ_0$) та через 2 тижні після реабілітації ($КГ_1$) та «реабілітаційний» коефіцієнт як співвідношення групових показників до та після лікування. Кумулятивний груповий показник після реабілітації $КГ_1$ збільшився до 2 995 балів, що свідчить про збільшення опо- роспроможності. Кумулятивний груповий показник ВАШ після реабілітації $КГ_1$ зменшився до 116 із 200 балів до реабілітації — зменшення болю в пацієнтів. У волонтерів після реабілітації спостерігали незначне збільшення кумулятивного групового показника $КГ_1$ до 3 917 балів. Висновки. Запропонована система реабілітації пацієнтів із ПДДКНК у віддаленому періоді після травм довела свою ефективність у відновленні м'язів-стабілізаторів вертикального положення тулуба, таза, нижніх кінцівок та зменшенні болю. Ключові слова. Посттравматична деформація, наслідки переломів нижніх кінцівок, м'язи-стабілізатори, реабілітаційні заходи, відновлення опороспроможності.

Keywords. Post-traumatic deformity, consequences of lower limb fractures, muscle-stabilizers, rehabilitation measures, restoration of support ability

Introduction

The general attitude towards the development of post-traumatic deformities (PD) has always been associated with non-operative treatment of fractures. It was believed that the improvement of modern methods of fixation and implants, especially the development and wide implementation of locked devices (plates and rods), would contribute to a significant reduction in the number of fusions with residual deformation. But this problem does not lose its relevance even today.

There are many factors that can contribute to the development of PD during fracture treatment. The main cause of malunion is the inability to maintain the reposition of the fracture nonoperatively or operatively, because the key to a good functional outcome of the treatment of any fracture is to achieve and maintain the reposition of the fragments, regardless of whether fixation in a bandage or an external or immersed fixator was used. The most important factors in the development of complications involve features of the general condition, as well as osteoporosis, diabetes [1], non-compliance with the load regime, as well as the following iatrogenic phenomena: incorrect surgical technique, including suboptimal methods of fixation; violation of the technology of conservative treatment. Analyzing the factors that contributed to the development of PD after osseous osteosynthesis, Anneberg M. and Brink O. suggest distinguishing “primary deformation”, which was formed directly because of the surgeon's actions (iatrogenic phenomenon) and “secondary deformation”, occurring when the repositioning of fragments is lost during the postoperative period [2].

The presence of a segmental bone defect or multifragmentary fracture is also of great importance, because this causes the development of PD with a significant shortening of the damaged segment due to the lack of cortical contact, which leads to the complication of fracture repositioning.

PD can form in all three planes (coronary, sagittal, axial) and be accompanied by a shift in length and width with a decrease in both the length of the damaged segments and the lower limb. It can also lead to intra-articular distortions [3].

PD acquire clinical significance due to the development of complications, which are divided into short-term and long-term. The most frequent clinical symptoms in patients with PD of long bones in the long-term post-injury period are pain and impairment of bearing capacity during walking and standing.

Also, deformations can be accompanied by joint contractures. This necessarily leads to a change in the position of the pelvis and compensatory changes in the sacroiliac joints and the lumbar spine [4]. There are changes in the load conditions of the muscles-stabilizers of the vertical position of the trunk, sacroiliac joints, pelvis and lower limbs [5, 6]. Over time, overloading of individual muscles, ligaments, and anatomically related muscle groups will appear [7]. This is accompanied by the development of enthensopathy, pain, impaired body resistance when walking and standing [8, 9, 10, 1 1].

Purpose: to develop a set of exercises aimed at restoring the function of the muscles that stabilize the vertical position of the trunk, pelvis, and lower limbs in patients with post-traumatic deformations of the long bones of the lower limbs in the remote period after the injury.

Material and methods

The research was discussed and approved at the meeting of the Bioethics Committee of the State Establishment Professor M. I. Sytenko Institute of Spine and Joint Pathology of the National Academy of Sciences of Ukraine (Protocol No. 222 dated 20.12.2021).

The study involved 40 subjects selected from the group of patients who received injuries of the long bones of the lower limbs. The inclusion criteria were the following characteristics: the presence of PD, which was formed after conservative or operative treatment of closed extra-articular fractures of the hip or lower leg; the period after the injury was at least 6–12 months; age from 25 to 79 years. The study group included 52.5 % women (21 persons) and 47.5 % (19 men). The age of the women ranged from 27 to 73 years with a median of 45 years, and the average weight was 74 kg; men of 29–77 years with a median of 51 years, average weight of 90.8 kg (descriptive statistics are provided in the form of Me (LQ; UQ), where Me is the median, LQ is the lower quartile, UQ is the upper quartile).

The control group consisted of 40 healthy volunteers, among whom there were 30 % women (12 people) and 70 % (28 men). The age of the women ranged from 24 to 50 years with a median of 57 years, the average weight was 72 kg; men — in the range of 31–49 years with a median age of 35 years, average weight — 83 kg.

Pain indicators were assessed according to VAS, results of the recovery of the function of the muscles-stabilizers of the vertical position of the trunk, pelvis, and lower limbs was assessed using the O. A. Tyazhelov scale before and after the rehabilitation course for 2 weeks [12]. This scale allows, with the help of generally recognized clinical tests, to evaluate the function of the muscles involved in maintaining the vertical position of the trunk, pelvis, and lower limbs while standing and walking. All these muscles of postural balance. In the case of PD of long bones, the proprioceptive innervation of the lower limbs may change, which will undoubtedly affect the postural balance strategy and the coordinated contraction of the stabilizing muscles of the spine, pelvis, and lower limbs. To achieve our goal, given that we are interested in increasing the functional capabilities of the muscles that stabilize the vertical position of the trunk, pelvis, and lower limbs through rehabilitation, this scale is sufficient [13, 14].

Table 1

Scale for assessing the functional state of muscles responsible for postural balance

№	Sign	Points
1	Pain: – absent; – moderate during load; – constant	 15 10 1
2	Lameness: – absent; – moderate; – expressed	 8 5 1
3	Trendelenburg symptom: – absent; – appears over time; – positive	 15 10 1
4	Duchenne's sign: – absent; – positive in movement; – positive in standing	 15 8 1
5	Additional support while walking: – not used; – is not used constantly; – is used constantly	 8 5 1
6	Stability of single-support standing: – stable; – unstable; – impossible	 15 5 1
7	Strength and endurance of paravertebral muscles: – can be in the “boat” position for 30 seconds; – can perform “boat”; – cannot perform “boat”	 8 5 1
8	Foot load asymmetry (%): – less than 25; – from 25 to 50; – more than 50	 15 10 1
9	Subjective assessment of bearing capacity: – good; – satisfactory; – bad	 8 4 1
	Total points	100
	Assessment of muscle function: – good; – satisfactory; – bad	 80–100 60–80 < 60

Table 2

Set of exercises to restore the coordinated contraction of the muscles that stabilize the vertical position

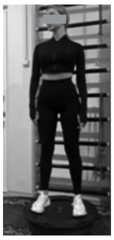
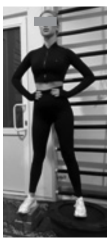
Image	Description
	1. Initial position (IP) of standing on two legs on an unstable platform for 1–2 min. To facilitate the stabilization of the body, it is possible to hold on to the support with the hands. Exercises are aimed at improving coordinated muscle contraction *m. erector spinae, m. gluteus maximus, medius, m. biceps femoris, m. rectus femoris*
	2. In IP, standing on two legs on an unstable platform, the weight of the body is transferred from the left leg to the right, and vice versa, followed by circular rotations in the knee joints in both directions. It should be performed 5-6 times. To facilitate the stabilization of the body, it is possible to hold on to the support with the hands. Exercises are aimed at improving coordinated muscle contraction *m. erector spinae, m. gluteus maximus, medius, m. biceps femoris, m. rectus femoris, m. gastrocnemius*
	3. In IP, standing on two legs on an unstable platform, it is necessary to squat down, bending the legs at the knees to 90°. It should be performed 10-30 times. Exercises are aimed at improving coordinated muscle contraction *m. erector spinae, m. gluteus maximus, medius, m. biceps femoris, m. rectus femoris, m. iliopsoas*
	4. In IP, standing on two legs on an unstable platform, arms along the body. Raise the hands up. Return to IP and perform 10 times. Exercises are aimed at improving coordinated muscle contraction *m. erector spinae, m. gluteus maximus, medius, m. biceps femoris, m. rectus femoris, m. gastrocnemius*
	5. In IP, standing on two legs, keep the left leg on an unstable platform, the right one on a stand. Maintain balance for a minute. The exercise is aimed at improving the coordinated muscle contraction of *m. erector spinae, m. gluteus maximus, medius, m. biceps femoris, m. rectus femoris, m. gastrocnemius*

Table 3

Set of exercises to strengthen the muscles responsible for the body's endurance

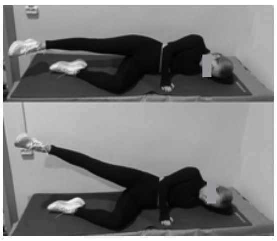
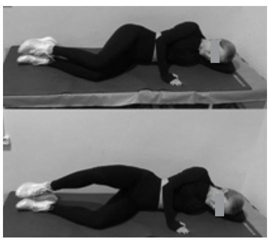
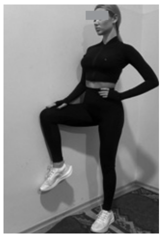
Image	Description
	1. In IP, standing on two legs. The legs are fixed with a rubber band. Walking, copying the walk of a “bear”. Strengthens *m. erector spinae, m. quadrates lumborum, m. gluteus maximus, medius, m. biceps femoris, m. rectus femoris, m. gastrocnemius*
	2. In IP standing on two legs. Perform a lunge forward with the left leg, bending the lunge leg to an angle of 90°. During execution, the foot should be turned outward at an angle of 5°–10°. Repeat 20-30 times with each leg. Strengthens *m. erector spinae, m. gluteus maximus, medius, m. biceps femoris, m. rectus femoris, m. gastrocnemius*
	3. IP standing on two legs, lunge back. At the same time, the supporting leg is bent at the knee to an angle of 90°. Perform 20–30 times with each leg. Strengthens *m. erector spinae, m. gluteus maximus, medius, m. biceps femoris, m. rectus femoris, m. gastrocnemius*
	4. IP lying on the left side. The left leg is bent at an angle of 90°. Raise the straight right leg to an angle of 30°–40°. Perform 40-50 times. Similarly on the right side. Strengthens *m. iliopsoas, m. quadratus lumborum, m. gluteus maximus, medius*
	5. IP lying on the left side. Bend the legs at the knees to an angle of 90°. Raise the knee of the right leg up, without separating the feet from each other. Perform 30-50 times. Similarly on the right side. Strengthens *m. iliopsoas, m. quadratus lumborum, m. gluteus maximus, medius, m. transverse abdominis, m. obliquus abdominis*
	6. IP standing on the right leg on the stand. Lower the left leg down to the floor, lowering the pelvis. Then raise the leg to the previous level, raising the pelvis. Perform 10-20 times. Similarly on the left leg. Strengthens *m. iliopsoas, m. quadratus lumborum, m. gluteus maximus, medius*
	7. IP standing near the wall on the left leg. The right leg is bent at the knee to an angle of 90°. Press the right foot against the wall for 30 seconds. Relax. Perform 10 times. Similarly on the right leg. Strengthens *m. iliopsoas, m. quadratus lumborum, m. gluteus maximus, medius, m. transverse abdominis*
	8. IP standing on two legs, feet shoulder width apart, fixed with a rubber band. Take a step aside. Take 10 steps in one direction and 10 in the other. Strengthens *m. iliopsoas, m. quadratus lumborum, m. gluteus maximus, medius, m. tensor fascia latae*
	9. IP standing. Feet shoulder width apart. Sit on the right leg. Perform 5-6 times. Similarly on the left leg. Strengthens *m. iliopsoas, m. quadratus lumborum, m. gluteus maximus, medius, m. biceps femoris, m. rectus femoris, m. gastrocnemius*
	10. IP standing. Legs shoulder width apart, fixed with a rubber band. Move the right leg to the side 5 times, then forward 5 times, back 5 times. Perform with the left leg. Strengthens *m. iliopsoas, m. quadratus lumborum, m. gluteus maximus, medius, m. tensor fascia latae*

Table 4

Exercise to strengthen knee joint stabilizer muscles

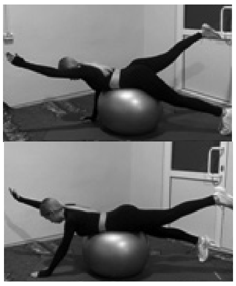
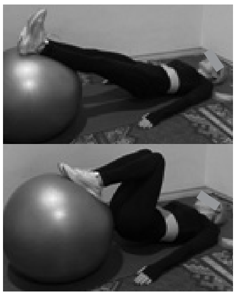
Image	Description
	IP standing, feet shoulder width apart. Squat to an angle of 90° in the knee joints, without taking the heels off the floor. Perform 12 times

Table 5

Set of exercises with fitball

Image	Description
	1. IP lying on the back. Feet on the fitball, hands along the body, pelvis on the floor. Raise the pelvis up, trying to straighten the body. Return to IP. Perform 12 times. Strengthens *m. iliopsoas, m. quadratus lumborum, m. gluteus maximus, medius, m. tensor fascia latae, m. quadriceps femoris, m. soleus, m. gastrocnemius*
	2. IP lying on your back, feet on the fitball. Raise the right leg up, lifting the pelvis as well, perform a “bridge” with the right leg raised up with support on the shoulders and the left leg. Return to IP. Perform 3-8 times. Do the same with the left leg. Strengthens *m. iliopsoas, m. quadratus lumborum, m. gluteus maximus, medius, m. tensor fascia latae, m. adductor brevis, longus, magnus, m. quadriceps femoris, m. biceps femoris*
	3. IP standing on the knees, bend the arms, resting the forearms on the fitball. Roll the fitball up to the knee joints. Return to IP. Perform 6-12 times
	4. IP lying on the back on the fitball, with fitball at the level of the shoulder blades, legs bent at the knees, arms outstretched. Roll the fitball towards the left side and back, maintaining balance. Perform 6-12 times. Strengthens *m. iliopsoas, m. quadratus lumborum, m. gluteus maximus, medius, m. tensor fascia latae, m. quadriceps femoris, m. biceps femoris*

Продовження таблиці 5

Image	Description
	5. IP lying on the stomach on the fitball, maintaining balance. Raise a straight right leg. Perform 10 times. Perform 10 times with the left leg. Strengthens *m. iliopsoas, m. quadratus lumborum, m. gluteus maximus, medius, m. tensor fascia latae, m. biceps femoris, m. quadriceps femoris*
	6. IP lying on the stomach on the fitball. Stretch out, maintain balance. Raise the left hand 12 times, then the right hand in the same way. Strengthens *m. iliopsoas, m. quadratus lumborum, m. gluteus maximus, medius, m. tensor fascia latae*
	7. IP lying on the stomach on the fitball. Stretch out, maintain balance. Raise the left arm and right leg at the same time. Then do the same with the right hand and left foot. Perform 12 times. Strengthens *m. iliopsoas, m. quadratus lumborum, m. gluteus maximus, medius, m. tensor fascia latae, m. erector spinae, m. biceps femoris, m. quadriceps femoris*
	8. IP lying on the back, feet on the fitball. Perform a “bridge” — bending the knees, roll the fitball towards you. Strengthens *m. iliopsoas, m. quadrates lumborum, m. gluteus maximus, medius, m. tensor fascia latae, m. transverse abdominis*

Each indicator of this scale has three degrees of evaluation, which was performed in points (Table 1).

The coefficient of asymmetry of load (CAL) of the feet was calculated as follows: the patient stood on the scales, one foot on one, the other on the others in an anatomical position, feet shoulder width apart. Calculation involved determination of the part of the body mass of the left and right lower extremities. The difference between the larger and smaller value was normalized (divided) by the larger value and multiplied by 100 %. It should be noted that different localization of PD (femur, tibia and fibula) affected the function of the trunk and lower limbs, therefore, O. A. Tyazhelov's scale was chosen. It is used to understand the functions of the muscles not only of the hip stabilizers, but also of the knee, supracalcaneal and tibial joints, the pelvis, and the spine.

Standard scales for functional assessment of hip and knee muscles were not used.

All patients and volunteers practiced therapeutic gymnastics developed by us twice a day. It consisted of several blocks and had an effect on restoring balance on both sides on the following muscles: *m. tibialis anterior, m. fibularis longus, tractus iliotibialis, m. tensor fascia latae, m. biceps femoris, m. adductor longus, m. adductor brevis, m. rectus femoris, m. gluteus medius et maximus, m. erector spinae, m. iliopsoas, m. quadrates lumborum, m. transverse abdominis, m. obliquus abdominis* (Tables 2–5).

If patients could not perform some exercises, they skipped them or did a simplified version.

Results and discussion

To analyze the results of observations, in addition to descriptive statistics (minimum, maximum, average value) and indicators of the function of the muscles-stabilizers of the vertical position of the trunk, pelvis, lower limbs, and VAS in patients and volunteers before and after treatment, cumulative group indicators (CG) were calculated for of each group at the beginning (CG_0) and 2 weeks after rehabilitation (CG_1) and the "rehabilitation" coefficient as the ratio of group indicators before and after treatment.

The results of treatment were evaluated before and 2 weeks after rehabilitation (Table 6).

Before rehabilitation, according to O. A. Tyazhelov's scale, patients were assessed as follows: 6 psubjects — 18 points; 15 — 50; 12 — 58, 3 — 56; 4 subjects — 63 points. That is, in 36 patients, the overall assessment of the functions of stabilizer muscles was poor, and only in 4 satisfactory.

The cumulative group score of CG_0 was 1,974 points.

After rehabilitation, 3 patients scored 56 points on this scale; 5 — 63, 6 — 58; 5 — 76; 8 — 77; 12 — 86; 1 person — 96 points. Thus, only 9 subjects had a poor overall assessment of stabilizer muscle functions. Thanks to training, the overall assessment of muscle function became satisfactory in 18 patients, and good in 13 (Table 6).

The cumulative group index after the rehabilitation of CG_1 increased to 2,995 points, which indicated an increase in the function of the stabilizer muscles of the vertical position of the trunk, pelvis, and lower limbs in patients. The "rehabilitation" coefficient of the indicator of the function of stabilizer muscles (RCsupp.) was 1.49.

Before rehabilitation, according to the VAS scale, 12 patients rated pain at 6 points, 12 at 4, 8 at 5, 4 at 7, and 4 patients at 3 points. The cumulative group index of VAS CG_0 before rehabilitation was 200 points (Table 7).

Table 6

Indicators of the function of muscles-stabilizers of the vertical position of the trunk, pelvis, and lower limbs before and after rehabilitation

	Before rehabilitation (total of 40)								After rehabilitation (total of 40)									
	6	15	12	3	4	min	max	average	3	5	6	5	8	12	1	min	max	average
Point	18	50	58	56	63	18	63	49,35	56	63	58	76	77	86	96	56	96	73,86
CG_0 = 1 974									CG_1 = 2 955									

Table 7

VAS indicators in patients before and after rehabilitation

	Before rehabilitation (total of 40)								After rehabilitation (total of 40)						
	12	12	8	4	4	min	max	average	12	20	4	4	min	max	average
Point	6	4	5	7	3	3	7	5	5	2	3	1	1	5	2,90
CG_0 = 200; CG_1 = 116															

Table 8

Indicators of the function of muscles-stabilizers of the vertical position of the trunk, pelvis, and lower limbs in volunteers before and after rehabilitation

	Before rehabilitation (total of 40)										After rehabilitation (total of 40)					
	11	9	7	3	3	3	4	min	max	average	25	11	4	min	max	average
Point	100	95	93	97	92	94	89	89	100	95,28	100	95	93	93	100	97,93
CG_0 = 3 811; CG_1 = 3 917																

After rehabilitation, according to the VAS scale, 12 patients rated pain at 5 points, 20 at 2 points, 4 at 3 points, and 4 at 1 point. The cumulative group score of VAS CG_1 after rehabilitation decreased to 116 points. The "rehabilitation" coefficient of the patient's VAS index (RCVAS) was 0.58 (Table 7). This indicated a significant reduction in pain in patients.

Analyzing the results of the function of the stabilizer muscles of the vertical position of the trunk, pelvis, and lower limbs in volunteers before rehabilitation, it was determined that 11 patients had 100 points on the scale, 9 — 95, 7 — 93, 3 — 97, 3 — 92, 3 — 94, 4 patients — 89 points. As a conclusion, it is a good assessment. The cumulative group index of CG_0 of the stabilizer muscle function before rehabilitation was 3,811 points.

After rehabilitation, 25 volunteers had 100 points on the scale, 11 had 95 points, 4 subjects had 93 points. The cumulative group score of CG_1 of stabilizer muscle function increased to 3,917 points after rehabilitation. The "rehabilitation" coefficient of the indicator of resilience of volunteers (RCsupp.-vol.) was 1.027 (Table 8).

It should be noted that the changes indicated an improvement in the function of stabilizer muscles in volunteers after rehabilitation.

Our gymnastics complex is based on the theory of Myers T. about anatomical myofascial connections that provide complex coordinated body movements: walking or single-support standing [7]. This theory is based on many years of anatomical research, which proved that muscles form kinematic myofascial chains [7, 15]. That is, the overload of a single muscle will necessarily be accompanied by the load of the ligaments of this muscle and their chain, which is anatomically connected with it. According to the hypothesis of Myers T., the effect on anatomically related muscles can affect the tilt of the pelvis. In previous studies, we proved that massage and selective therapeutic gymnastics can affect radiometric parameters of the pelvis and spine, significantly increase the bearing capacity of the pelvis and trunk [16].

Therapeutic gymnastics is aimed at restoring the functional capabilities of *m. tibialis anterior, m. fibularis longus, tractus iliotibialis, m. teres fascia latae, m. biceps femoris, m. adductor longus, m. rectus femoris, m. gluteus medius et maximus* and attachment points of these muscles.

Irwin R. W. believes that a violation of the axis and length of the lower limbs leads to deviations in the position of the pelvis and spine. That is, the balance of the muscles of the lower limbs, pelvis, spine and postural balance changes. It is the violation of postural balance that causes changes in bearing capacity, walking, and single-support standing [17]. Strengthening postural balance is a fundamental skill in everyday human life [18]. Therefore, one of the blocks of our gymnastics helps to restore postural balance [19].

Part of the exercises of the complex is aimed at restoring the balance of the muscles that ensure the "spinal-pelvic" rhythm during walking [19].

Conclusions

The proposed system of rehabilitation of patients with post-traumatic extra-articular deformations of the long bones of the lower limbs in the remote period proved its effectiveness in restoring the muscles-stabilizers of the vertical position of the trunk, pelvis, lower limbs and reducing pain.

It consists of sets of exercises based on the theory of Myers T. The gymnastics technology was developed taking into account the influence and restoration of balance on both sides of the following muscles: *m. tibialis anterior, m. fibularis longus, tractus iliotibialis, m. tensor fascia latae, m. biceps femoris, m. adductor longus, m. adductor brevis, m. rectus femoris, m. gluteus medius et maximus, m. erector spinae, m. iliopsoas, m. quadrates lumborum, m. transverse abdominis, m. obliquus abdominis.*

The complex includes exercises that are aimed at restoring postural balance and the muscles that ensure the "spinal-pelvic" rhythm during walking.

Conflict of interest. The authors declare no conflict of interest.

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RECOVERY OF STABILIZING MUSCLES THAT PROVIDE A VERTICAL POSITION OF THE TRUNK IN PATIENTS WITH POST-TRAUMATIC DEFORMITIES OF THE LONG BONES OF THE LOWER LIMBS IN THE DISTANT PERIOD

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