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SCOLIOSIS IN ADULTS AND THE POSSIBILITY OF ITS CORRECTION BY POST-ISOMETRIC RELAXATION

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Negative factors contribute to the progression of scoliosis in adults and complicate its treatment, despite the fact that the disease usually stops developing after puberty. Therefore, it is very important to use physical therapy methods that stabilize the spine and normalize muscle tone. In order to increase the effectiveness of physical rehabilitation of adults with scoliosis, the use of post-isometric relaxation in complex physical therapy was studied. Using pain assessment methods; functional testing of the cardiovascular and respiratory systems were examined 20 patients with scoliosis, which formed the main and control groups of 10 people. It was found that the inclusion of post-isometric relaxation in physical therapy of patients of the main group had a more statistically significant positive effect on pain intensity, static endurance of back and abdominal muscles, the functional state of the cardiovascular and respiratory systems, increased well-being, activity and mood. The obtained results give grounds to recommend the inclusion of this technique in rehabilitation programs aimed at the correction and stabilization of frontal spinal deformity in this group of patients.

Key words: spine deformation, correction and stabilization of the spine, physical therapy, soft hand techniques, quality of life, static endurance of muscles.

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СКОЛІОЗ У ДОРОСЛИХ І МОЖЛИВОСТІ ЙОГО КОРЕКЦІЇ МЕТОДОМ ПОСТІЗОМЕТРИЧНОЇ РЕЛАКСАЦІЇ

Метою дослідження стало використання методу постізометричної релаксації в комплексній фізичній реабілітації дорослих людей з виявленим сколіозом і доведення його терапевтичної ефективності. Обстежено 20 хворих на сколіоз обох статей від 22 до 35 років, з яких сформовані дві групи (основна та контрольна) по 10 осіб. Встановлено**,** що включення постізометричної релаксації в програму фізичної терапії хворих основної групи достовірно знижує інтенсивність та змінює характер болю. Також в основній групі відзначено збільшення статичної витривалості м'язів спини і живота, збільшення рухливості хребта і функціональної активності м'язів тулуба, що формують ортоградну позу. За рахунок зміцнення м'язового корсету та використання постізометричної релаксації і спеціальних дихальних вправ, в основній групі більш достовірно стабілізувались показники функціонального стану серцево-судинної та респіраторної системи. В обох групах у динаміці реєструвались відновлення фізіологічного м'язового балансу, оптимізація рухового стереотипу та покращення психоемоційного стану за показниками – самопочуття, активність, настрій. Проте позитивні зміни були статистично більш виражені у пацієнтів основної групи. Комплексна фізична терапія, з включенням в програму реабілітації методики постізометричної релаксації, достовірно покращує якість життя пацієнтів з фронтальною деформацією хребта

Ключові слова: деформація хребта, корекція та стабілізація хребта, фізична терапія, м'які мануальні техніки, якість життя, статична витривалість м'язів.

The study is a fragment of the research project "Development of the latest promising and unvalidated tools and technologies for diagnosis, treatment and rehabilitation of different ages", state registration No. 06911.

Scoliosis in the adult population is a complex and urgent problem that attracts the attention of both orthopedists, traumatologists and physical therapists. This is due to its prevalence, often severe with a negative impact not only on the functional state of the musculoskeletal system, but also on the chest and the body as a whole, as well as the complexity of treatment [1, 3].

The prevalence of scoliosis ranges from 3.2 % to 30 % of the population in different countries. In the International Classification of Diseases of the 10th revision (ICD-10) scoliosis corresponds to the rubric

M.41 and is considered as a systemic disease with the formation of multiplanar deformity of the spine [5]. The leading component of scoliosis is curvature of the spine in the frontal plane with pathological rotation and structural torsion of the vertebrae, irreversible degenerative changes in the intervertebral discs, ligaments and surrounding muscles due to functional disorders of circulation, respiration, gastrointestinal and other gastrointestinal systems. organism [7].

Congenital deformities of the spine and its damage during childbirth, various diseases, especially those that provoke degenerative phenomena in the vertebrae (cerebral palsy, rickets, polio, tuberculosis, connective tissue diseases, metabolic disorders, osteoporosis, etc.) can lead to the development of scoliosis diseases of the spine – osteochondrosis, protrusions, hernias, etc., as well as spinal injuries. Inadequate or improper treatment at a young age, lack of treatment as such can lead to the progression of scoliosis [1, 4].

At present, scientists focus on the treatment of scoliosis mainly in children or adolescents, because after puberty, scoliosis usually stops developing (fixed), ie it progresses to 18 years, very rarely – up to 25. However, unfavorable conditions of study, work and life can "push" the progression of scoliotic disease at any age [6, 8, 9]. Thus, adults with scoliosis often need appropriate therapy, but treatment at this age becomes much more difficult.

In the treatment of scoliosis in adults, modern physical therapy is complex, including therapeutic gymnastics, massage, orthotics, if necessary – drug therapy, diet therapy, etc. [2, 7, 8]. Its measures are aimed not so much at reducing the curvature of the spine, but at eliminating pathological changes in other organs and systems of the patient's body. However, it is not effective enough. Therefore, the search for effective treatments for scoliosis in adults is an urgent problem today.

In our opinion, the main task that determines the success of treatment is, along with the mobilization and correction of curvature, stabilization of the spine in a corrective position. Correction of deformity, which is not supported by measures to stabilize the spine, is ineffective. This requires normalization of muscle tone, which is in a state of local spasm. This can be achieved using the method of post-isometric relaxation (PIR), which is based on the reflex mechanism of reducing muscle tone after pre-stress.

The efficiency of the method with the parallel use of breathing exercises and exercises with changes in direction of vision increases.

Unfortunately, this approach is not widely reflected in the modern practice of physical therapist despite the fact that the above confirms the relevance of the chosen direction of research.

The hypothesis suggests that the use of PIR in combination with traditional physical activities will help relieve severe spasticity of muscles involved in the pathological process, which will increase the effectiveness of rehabilitation of adults with scoliosis.

The purpose of the study was to determine the effectiveness of postisometric muscle relaxation in the comprehensive rehabilitation of adults with scoliosis.

Materials and methods. The research was carried out from September 2017 to October 2018 on the basis of the sports and health center "Planet of Health" (Zaporizhzhya). The study involved 20 patients of the first adult age (22 to 35 years), including 14 women (70.0 %) and 6 men (30 %). All examined orthopedist on the basis of clinical and radiological studies – measuring the angle of the scoliotic arch by the Cobba method (from 5 to 12º according to VD Chaklin), was diagnosed with right-sided thoracic scoliosis stage I-II.

Before rehabilitation measures, patients were randomly divided into two identical groups – the main (n=10) and control (n=10). During the year, both groups underwent a course of physical rehabilitation (PR) at the sports and health center according to the generally accepted program in this institution. However, for patients of the main group, the PR program was supplemented by the PIR method. The study was conducted to ensure the patients' rights and freedoms as stipulated in the Declaration of Helsinki and the Good Clinical Practice (GCP). All patients, both verbally and in writing, agreed to research.

The following methods were used to assess the dynamics of the functional state of patients in the process of rehabilitation: sociological (survey, visual analog scale of pain), medical and biological (examination, testing, functional study of cardiovascular and respiratory systems) and mathematical statistics. Surveys were conducted to clarify complaints and a more detailed picture of the general condition of patients, the nature and features of the disease and the motivation of patients to recover. A visual analog scale (VAS), which allows to estimate the intensity/severity of pain in points (from 0 to 10), was used to determine the severity of back pain. Visual diagnosis of scoliosis was based on the detection of asymmetry of the bony structures of the chest and pelvis in the frontal plane.

Frontal curvature of the spine and torso-rotational displacement of the torso were further assessed by leaning the patient forward using the Adams test [6]. The functional state of the natural muscular corset

was determined when assessing the endurance of the muscles of the back and abdomen of the left and right halves of the torso according to conventional methods. Normative indicators: strength endurance of back muscles – 1.5–2.5 min; strength endurance of the muscles of the right and left halves of the torso – 1.5–2 min; strength endurance of abdominal muscles – 25–30 movements.

To assess the flexibility of the spine used test – lean forward from a sitting position, legs outstretched and close to the floor, where the measuring ruler is attached, to which the patient extends (thus determining the division of the ruler achieved by fingers), if the mark <32 cen. is reached – the mobility of the spine is insufficient.

Functional state of the cardiovascular system was evaluated by elementary hemodynamic parameters: pulse rate (PR) – determined by pulsometry on the radial artery; arterial pressure (AP) – measured by a tonometer on the brachial artery by the method of Korotkov [7].

The condition of the respiratory system was assessed using hypoxic tests of Stange and Gench, which were performed according to generally accepted methods [7].

Subjective assessment of functional status was obtained using the WAM questionnaire (well-being, activity, mood).

When evaluating the results, the corresponding scores were set (high scores correspond to the positive state, low scores correspond to the negative state), and the ratios of individual indices were also taken into account.

The PIR method, which complemented the physical rehabilitation program in the main group, is based on the reflex mechanism of reducing muscle tone after previous muscle tension. Postisometric relaxation uses breathing exercises and changing the direction of gaze, because muscle relaxation is facilitated on exhalation and when the eyes move in the direction of stretching [2].

The results of the study were processed using the methods of mathematical statistics with an estimate of the average (M), its standard error (m) of the reliability of the difference (p) according to the Student's t-test; at $p<0.05$ it was considered statistically significant.

Results of the study and their discussion. Analysis of modern thematic scientific and methodological literature and Internet sources shows that scoliosis is not just a frontal curvature of the spine with torsional rotation (twisting) of the vertebrae. Scoliosis in the modern sense, is a polyetiological disease that has a range of symptoms. In the treatment of scoliosis, research is focused mainly on children and adolescents, but the progression of scoliosis occurs in adulthood under the influence of negative factors [10, 11].

To increase the effectiveness of restorative treatment of scoliosis in adults, we proposed the inclusion of post-isometric relaxation techniques in the standard set of physical rehabilitation measures.

In the initial survey, it was found that the vast majority of patients – 90 % complained of back pain after exercise, with a long stay in a uniform standing/sitting position. The pain was mainly localized in the thoracic and lumbar spine, right shoulder blade, less often in the left lumbar region. Pain was relieved at rest.

In 40 % of patients, there were complaints of a cosmetic defect associated with deformation of the spine and chest. Most patients (70 %) noted increased fatigue, 20 % of the patients were short-winded.

The intensity of back pain was assessed using VAS. Patients were asked to mark the scale on the scale, which corresponds to the intensity of pain (table 1).

Table 1

Comparative assessment of pain intensity in the examined patients with scoliosis on a visual-analog scale

Indices	Main group				Control group			
	Before rehabilitation		After rehabilitation		Before rehabilitation		After rehabilitation	
	n=10	%	n=10	%	n=10	%	n=10	%
No pain	1	10	5	50	1	10	3	30
Mild pain	3	30	5	50	3	30	5	50
Medium pain	6	60	-	-	6	60	2	20
Severe pain	-	-	-	-	-	-	-	-
Very severe pain	-	-	-	-	-	-	-	-

The results show that the majority of respondents complained of moderate pain – 60 %, mild pain was determined in 30 %, no pain was observed in 10 % of patients, severe pain was not recorded in any case. Complaints, their frequency and severity, were almost identical in patients of both study groups.

Visual assessment of scoliosis was based on the deviation of the line of the spinous processes from the middle position and the displacement of anatomical structures towards the midline of the torso.

Asymmetry of the upper arms, deviation of the line of the spinous processes from the midline (mainly to the right in the thoracic region, left to the left in the lumbar region), asymmetry of the height of

the shoulder blades, distances between the angle of the shoulder blades, as well as the muscular roller in the lumbar spine, asymmetry of the buttocks and pelvic skew.

The Adams test revealed a costal protrusion/costal hump and lumbar roller in the examined patients, which indicates a frontal curvature of the spine and torso-rotational displacement of the torso. The above signs are inherent in scoliotic spinal deformity [6].

The study of the functional state of the muscular corset in patients with scoliosis showed a violation of spinal stability, manifested by a significant decrease in static strength endurance of the back and abdomen, reduced mobility of the spine and lateral areas of the torso involved in orthograde posture.

Thus, the static strength endurance of the back muscles was 32.13±0.47 sec, abdomen 17.35±0.43 sec. When performing endurance exercises of the muscles of the right and left halves of the torso, the inclination to the right was less than to the left, which is characteristic of the right curvature of the spine, which was observed in all subjects [6].

The results of the self-assessment of the psycho-emotional state of patients with scoliosis were obtained with the help of the WAM questionnaire. The analysis of the obtained data shows that in patients with scoliosis of stage I-II in most cases there was an «unfavorable condition» on all three indicators: well-being, activity and mood, but to a greater extent on indicators of well-being and mood (respectively – 56.8 %; 46.3 %), which, in our opinion, is associated with exacerbation of the disease and deterioration of quality of life.

Analysis of the results of the study after the implementation of rehabilitation programs shows an improvement in the functional state of the muscles that form an orthograde posture in both groups, but in patients of the main group static strength endurance of the back muscles was higher than in the control group by 22.4 %, abdominal muscles – by 24.3 % ($p<0.05$).

Against the background of rehabilitation measures, the results of re-assessment of pain intensity in the examined patients with early-stage scoliosis according to VAS showed that the decrease in pain intensity was more determined in the main group than in the control group.

Scoliosis is a disease of the whole organism, which is characterized complex of morpho-functional changes not only of the spine but also of the chest cells and internal organs and can lead to disability. That's why it was the functional state of the cardiovascular and respiratory system, which in the dynamics showed positive changes (table 2).

Table 2

Dynamics of functional indicators of the cardiovascular and respiratory systems in patients with scoliosis of both groups during the study, (M±m)

Indices, units	Main group		p	Control group		p
	Before rehabilitation	After rehabilitation		Before rehabilitation	After rehabilitation	
HR, beats per minute	79.4±1.76	69.6±1.52	<0.05	79.5±1.69	74.1±1.65	<0.05
SBP, mm Hg	121.6±2.65	114.6±2.69	>0.05	121.3±2.51	117.3±2.76	>0.05
DAP, mm Hg	79.9±1.43	72.2±1.52	<0.05	80.1±1.45	78.2±1.54	>0.05
tests Stange, (sec)	46.5±1.31	61.9±1.06	<0.05	46.1±1.25	51.6±1.12	<0.05
test Gencha, (sec)	23.1±0.65	31.4±0.51	<0.05	23.2±0.87	24.2±0.76	>0.05

Analysis of the dynamics of functional indicators revealed positive changes in the functional state of patients in both groups, but some parameters showed differences between groups. At the beginning of the study, the heart rate (HR) in thematic patients with early-stage scoliosis tended to increase (main group – 79.5±1.69; control – 79.4±1.76 beats/min).

After rehabilitation measures in patients of the main group there was a decrease in PR by 12.3 % compared to baseline ($p<0.05$), in patients of the control group – by 6.8 % ($p<0.05$), the difference between the groups was statistically significant. Systolic blood pressure (SBP) in the main group decreased by 5.8 % and in the control group by 3.3 %, but the results had no statistically significant difference ($p>0.05$).

In patients of the main group diastolic blood pressure (DBP) decreased by 9.6 % compared to baseline ($p<0.05$), in the control group – by 2.4 % ($p>0.05$), the difference between the groups was statistically significant.

Respiratory arrest time in the examined patients improved compared to baseline: in the main group by 33.1 % ($p<0.05$), in the control group – only 21.9 % ($p<0.05$), the difference between groups was statistically significant.

The time of respiratory arrest on exhalation had a similar dynamics, in the main group this indicator also improved to a greater extent – by 35.9 % ($p<0.05$), and in the control group only by 24.3 % ($p>0.05$), the difference between the groups was statistically significant.

After the rehabilitation course, the following changes were determined according to the indicators of the WAM questionnaire – in patients of the main and control groups, positive changes were noted for all three indicators, namely: in the main group «well-being» improved by 31.7 % ($p<0.01$), in the control group – only 25.0 % ($p>0.05$); «activity» increased by 22.1 % ($p<0.01$) in the main and by 13.2 % ($p>0.05$) in the control. In both groups, the «mood» significantly improved – in the main group by 34.4 % ($p<0.001$), in the control – 21.3 % ($p<0.05$), which indicates an improvement in physical, psychosocial and emotional aspects of patients on scoliosis, which was statistically significantly more pronounced in the main group.

Thus, the results of the study showed that the improvement in spinal muscle traction, cardiorespiratory system and psychoemotional status in the main group of patients was statistically significant, in contrast to control patients, in whom changes were statistically less significant. Complementing traditional methods of physical rehabilitation [2, 7] with PIR, enhances the formation of physiological muscular corset of the spine in adulthood. The use of additional training with the inclusion of mild manual effects to remove the blocks of the vertebromotor segments create conditions to improve the work of internal organs and eliminate pain. This will reduce the use of drugs that are commonly used to correct pathological changes in complex therapy [7, 8]. Normalization of psycho-emotional processes in patients indicates a positive effect of PIR elements on the excitability of the cerebral cortex and subcortical formations, which is very important in the physical therapy of people of active working age.

Conclusions

1. The results of the study probably showed the effectiveness of PIR in the complex physical therapy of scoliosis in adults. Thus, after completing the course of physical therapy in patients of the main group static strength endurance of the muscles of the back and abdomen was higher than in the control group by 22.4 % and 24.3 %, respectively ($p<0.05$); the intensity of pain for VAS in them also became much lower compared to control.

2. In both groups the dynamics of restoration of physiological muscle balance, activation of main hemodynamics, venous and lymphatic outflow, trophic and regenerative processes in segmentally affected areas, restoration of optimal motor stereotype and improvement of psychoemotional state were registered, but all changes were more positive in patients of the main group.

3. After rehabilitation measures, the functional state of the cardiovascular and respiratory systems in patients of the main group improved to a greater extent than in the control, as evidenced by the average PE (difference between groups $p<0.05$), systolic ($p<0.05$) and diastolic ($p<0.05$) blood pressure, respiratory tests Stange ($p<0.05$) and Gench ($p<0.05$). According to subjective data and all indicators of the WAM questionnaire, there were probably more pronounced positive changes in the main group than in the control group.

The effectiveness of PIR in the complex physical therapy of scoliosis in adults gives grounds to recommend the inclusion of this technique in rehabilitation programs aimed at correcting and stabilizing the frontal deformity of the spine in this group of patients.

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