



PHYSICAL REHABILITATION OF SCHOOL-AGED CHILDREN WITH MYOPIA OF I-III DEGREE

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Abstract

Physical rehabilitation of children with myopia is a difficult process and requires a long-term, systematic and stage-by-stage use of a complex of means for restoration acuity of vision. Kinesiotherapy (respiration and twist exercises), finger and articulatory gymnastics, methods of Onnuri Therapy, reflexotherapy, instrumental physiotherapy, etc. are usually used for this, and that taken together leads to the positive effect and restoration of visual system. Nevertheless, in progressive forms of myopia these physical methods are not always effective.

The objective – theoretical justification of the necessity and the essence of physical rehabilitation during myopia, analysis and summation of list of research and methodological literature concerning the study of influence of physical rehabilitation on physical development and psychoemotional state of pupils with myopia of various degrees.

Methods. Sources of literature (scientific papers, textbooks, manuals, synopses of thesis works) chosen from the electronic database of the Vernadsky National Library of Ukraine, Russian scientific electronic library «eLibrary», Web of Science, PubMed, PEDro, etc.

Results. On the basis of literary sources, it has been established that the increase in number of cases of myopia of pupils is, in the first place, connected with the increase in visual loadings. The main pathogenic link of the acquired myopia is sclera distension. Children affected by the acquired myopia have a combination of corneal thinning and the increase of its horizontal diameter and the length of the anterior-posterior axis of the eye that indicates the distension of the eye cornea. The corneal thinning is accompanied by its sensory decrement from 19 % to 57 % depending on the degree of the disease and by the decrease of the rigidity of the outer layer of the eye. The corneal thinning is one of the objective criteria of myopia progression, that involves inclusion of keratopachymetry to the complex of obligatory examinations of myopia patients for defining a rational therapeutic approaches. Children with myopia with corneal thinning form a risk group in regard to the development of retinal degeneration.

Conclusions. Myopia is a current medical and social problem of the present. Physical rehabilitation of such children is a difficult and long-term process, which requires a systematic and stage-by-stage use of its various means.

Key words: children, pupils, physical development, psychoemotional state, physical education, physical rehabilitation.

Introduction

Short-sightedness (myopia) is a type of ametropia, during which parallel rays, that come from things situated at a distance, are united in front of the eye's retina. Short-sightedness is the most common vision impairment among children and teenagers, and also it is an important problem of the public health care for the majority of world countries. According to the data of World Health

Organization, nowadays in the world there are 37 millions of the blind and 124 millions of the visually impaired, which means that more than 160 millions have serious impairments of visual analyzers. One person in four out of them has lost their sight as a child [22, 31, 32, 40].

The deterioration of vision is at the sixth place by the prevalence among all the diseases in Ukraine. Every year the number of Uk-rainians with vision



problems grows by almost 4 % [1, 30, 33-35]. Short-sightedness enters the top three of common vision impairments.

It is known that in Ukraine there are 420 thousands of adults and 250 thousands of children who suffer from short-sightedness [11, 14, 25, 35]. According to the official statistics of the Ministry of Health of Ukraine in 2015 myopia has been discovered in 17 % of primary school pupils and in 40 % of teenagers of general education schools [35]. Medical and social meaning of the problem is increased in connection to the fact that short-sightedness is developing in children and people of working age, that is why the control of the short-sightedness is a pressing medical and social issue [4, 7, 15, 41].

According to the data of domestic and foreign researchers the vision impairment is one of the most common impairments in the state of health of the children. The frequency of the mentioned pathology among pupils varies from 4,5 % to 43,7 % [6, 20, 30, 42]. According to the data of the last publications ophthalmological pathology is discovered in 18–20 % of the USA pupils [21], 15 % – in France, 13–15% – in Germany and in the Netherlands [6]; 21 % – in Poland [29, 39]. For the comparison, in a number of Russian regions up to 30–40 %, and in Ukraine up to 43,7 %. [34]. The study concerning prevalence rate of vision impairment in the pupils of 1–8 grades (the USA) has demonstrated that 9,2 % of the examined children have had short-sightedness of low degree, 12,8 % – long-sightedness [5, 28, 43]. According to the data of Ethan D., 20 % of American school children have vision problems [14]. The prevalence rate of myopia, according to the data of D. R. Fredrick and a number of authors, totals 70–90 % in certain countries of Asia and Africa, 30–40 % in European countries and 10–20 % in the United States [12]. According to the data of N. S. Logan, in Great Britain there are 50 % of white British and 53,4% of British of Asian origin are short-sighted [24]. In Greece the prevalence rate of myopia among 15–18-year-old studying youth totals 36,8 % [21]. During the last decades a tendency for the increase in the prevalence rate of the refractive error is noticed in Australia [28].

According to the data of the Medical Statistics Service, in 2011–2015 in Ukraine the diseases of

the eye and its appendages have occupied the 5th rank place (with the specific gravity 3,14 %) in the structure of morbidity (after the materials of medical visits) of the children at the age from 0 to 17 years old. The prevalence rate of the diseases of this class equals 5581,1 cases per 100 thousands of children population. In the structure of the visual organ pathology 25 % to 80 % (depending on the age) have been accounted for short-sightedness [20, 30, 32].

The acquired short-sightedness is characterized by the progressing course and may lead to a significant decrease of visual functions. It is known that in the USA short-sightedness occurs in 25 % to 33 % of the population, a more significant percent of the short-sighted within the frames of 71 %–96 % is diagnosed in people of Asian population in Japan, Taiwan, Hong Kong and Singapour [14, 22, 41–43]. A progressive short-sightedness, in the first place, lowers the adaptation of people, requires a constant wear of spectacles, correction, etc.

The knowledge of pathogenesis mechanisms, early started treatment, the use of special physical exercises, preventive measures often allows to recover sight without operative measures, that is a task of the modern recovery ophthalmology.

The objective – theoretical justification of the necessity and the essence of physical rehabilitation during myopia, analysis and summation of list of research and methodological literature concerning the study of influence of the physical rehabilitation on physical development and psychoemotional state of pupils with myopia of various degrees.

Methods

The researches have been conducted with the help of the analysis of sources of literature (scientific papers, textbooks, manuals, synopses of thesis works) chosen from the electronic databases of the Vernadsky National Library of Ukraine, Russian scientific electronic library «eLibrary», Web of Science, PubMed, PEDro, etc.

Results and discussion

For achieving a set objective, the analysis of sources of literature for determining a role of vision impairment in the medicine and in the society, a role of remedial gymnastics (RG) in the treatment of vision impairment, establishment of principles of



realization of physical rehabilitation of people with vision impairments have been conducted.

The majority of researchers, ophthalmologists, physiologists think that myopia occurs in people with deviations in the state of health, the interconnection with cold-related, chronic and infectious diseases has also been discovered [4, 18, 23, 31–33]. L. Ruban, Ye. Avetisov, A. Bunin, Ye. Lyvado, L. Kats-nelson, Yu. Kurpan, A. Nesterov, S. Shiller, D. Taylor, etc. think that changes of the locomotor apparatus (postural disorders, scoliosis) lead to pathologies of respiratory, cardiovascular systems, etc. [34, 35, 38, 40]. However, the most common cause of this pathology is, first of all, axial elongation of the eye ball, as a result of which the retina is placed behind the focal plane, which leads to the axial myopia [18, 30]. In the case when the cornea has a significantly bigger power of refraction, the system of the eye focuses rays more actively in comparison with the norm, changing the focal distance, which facilitates the appearance of the refractive myopia. The latter is diagnosed more rarely in comparison with the axial myopia.

In the aetiology of short-sightedness a significant role is played by both genetic factors [8, 15, 23, 24] as well as psychological and pedagogical ones [18]. Ye. Avetisov, A. Dashevskiy, Ye. Lyvado, L. Fomina think that anatomical and morphological malfunctions are connected to abnormalities of the sensory organs and in general come with deviations of the personal development of pupils, violation of the psychoemotional sphere in general [23, 37, 40].

A significant growth of people with myopia indicates that the studied issue is quite pressing nowadays. It is absolutely right that in the majority of cases it is diagnosed more commonly in the children at the beginning of the educational process, namely in primary and secondary school. At the age category from 7 to 13 years old this pathology is discovered more often, after 17 years – acuity of vision becomes stable [5, 6, 12, 14].

Significant changes of the character and growth of educational loadings, continuous work in front of a computer, overwork of vision system facilitates the increase in the number of short-sighted people [34, 37, 40]. Short-sightedness is classified [19, 20, 30, 31] by the degree of acuity of vision as VIS (index of acuity of vision):

1) 0,8–0,5 – light;

2) 0,4–0,2 – medium;

3) 0,2 and lower – high;

by the correction degree:

1) low (up to 3,0 D, including);

2) medium (3,25–6,0 D);

3) high (more than 6,0 D) [1, 31, 37, 39].

Clinically short-sightedness manifests itself in reduced vision into the distance [6, 9, 19, 40]. To dominating symptoms in the ill with short-sightedness belong pain, blur-eyedness, photophobia, acuity of vision and binocular vision impairment, blurry vision of objects, vision impairment at half-lights, memory impairment, restraint of movement, etc. [7, 17, 27, 32–34].

Modern studies in the sphere of hygiene, medicine, psychology and pedagogy demonstrate that the children with visual analyzer impairment, particularly with myopia, require the use of special programs, complex psychophysical and social rehabilitation.

The study of problematics concerning the use of the methods of physical rehabilitation during the pathology of visual organs has been conducted by many doctors, scientists [5, 6, 35, 37]. Nevertheless, the analysis of the sources of literature demonstrates partial lack of a systematic approach to the study of the issue of physical rehabilitation of children with visual impairments with the aim of correction of physical development impairments, impact on the general somatic state of the ill. This in particular dictates the necessity of the search of the studies connected with the development of effective ways of correction of myopia of different aetiology, prevention of child disease progression.

Ye. Lyvado [23] has established that the decrease of the overall physical activity of pupils with an increased visual loading may facilitate the development of short-sightedness. Nevertheless, it is well-known that physical exercises in combination with special exercises strengthen accommodation, influence functions of the eye in people with short-sightedness [23, 30–33]. Scientists from the University of Cambridge have conducted the research in which more than 10 thousands children and teenagers have participated [5, 12, 20, 40]. After the conducted research the scientists have made the conclusion that an additional hour of walk in fresh air per week lowers the risk of short-sightedness development in children by 2 %. It is



established that children who have had a developed short-sightedness spend outside 4 hours less (per week) than their peers with twenty-twenty vision. The following pattern has been discovered: those children who have gone out more, have spent less time reading books and playing computer games. The main factor of the preventive measures of short-sightedness, as stated by scientists and researchers, is physical activity, necessity to scrutinize distant objects in the process of play, as well as the influence of the ultraviolet emission [7, 10, 27, 35, 37].

American ophthalmologist W. Bates has considered extraocular muscles tension to be the main cause of visual deterioration. According to thought of W. Bates [9], twenty-twenty vision is possible to recover by a complete relaxation with the following eyes exercises (for example, move a pencil at a wide amplitude on the outstretched arm and continuously follow it with the eyes right, left, down and up), then during several seconds look at the bright light, and, closing the eyes with the hand, give them rest, open wide and close the eyes, look narrowly at objects at the distance, shift glance at one's own watch – repeat all this multiple times. Such working pattern strengthen ocular muscles, train and massage eye lenses, improve blood circulation, nutrition of photoperceptors [30, 31, 35].

F. Aleksander, A. Aprelev, Ye. Avetisov have claimed that practically all the diseases in human organism are provoked by the strain and all of them may be treated by corresponding types of relaxation [4, 7, 8]. G. Peppard, T. Taylor, K. Hoyt recommend for the physical relaxation: to take off glasses and to start relaxing all the body, gradually releasing its every muscle: «Relax your psyche, relax the face, tongue, muscles around the mouth, close your eyes, relax in general» [40].

A way of rehabilitation of A. Rotov and V. Rotov [25] includes psychotherapeutic sessions with the use of various technics of the patient's relaxation, massage and self-massage. A patient is put into a light trance, with relaxation of all muscles group, conducts warming of the bridge of the nose, eye balls by the means of laying warm palms down them, by a method of verbal influence, with the eyes of the patient closed influence the central and peripheral divisions of the visual analyzer, evoking clear visual images of geometric figures in the patient, certain images during the simultaneous

warming of the nape by a tactile method, and then do a light massage of eye balls during the simultaneous performance by a patient of the intensive gymnastics of oculomotor muscles, by the method of imperative influence they adjust the psyche of the patient to the sharp sight, after which the achieved effect is secured by the independent psychocorrection without the participation of the therapist. At home the patient secures the achieved effect of improving the eye sight by conducting autopsychocorrection [8, 29, 30, 43]. It is possible to recommend this method to a school psychologist as a method of teaching autopsychocorrection to the children with short-sightedness for the following use at home.

American scientists of Florida state [6, 9, 12] have conducted a number of researches on the topic of preventive measures for myopia, after the obtained results the complex of the measures for preventing short-sightedness and its progressing that stipulates such tasks has been developed:

- general strengthening of the organism;
- activating functions of respiratory and cardiovascular systems;
- strengthening of the muscular-ligamentous apparatus;
- improvement of the blood circulation in the eye tissues;
- improvement of the activity of the ocular muscles, and, first of all, of the muscle of accommodation;
- strengthening of the sclera.

In accordance to these tasks during the lesson of physical education in the school it is necessary to do both combined developing and special exercises. Considering that the children who suffer from short-sightedness more commonly have postural disorders, most frequently – slouch and scoliosis, weakness of the connective-tissue apparatus, as well as a tendency to bend body and head forward excessively during the visual work at a close distance, it is necessary to attach a great importance to exercises for strengthening extensor muscles, correcting, respiration exercises, which in the first place intensify lung ventilation, blood circulation of oxidation-reduction processes in the organism, etc.

In addition, respiration exercises are a means of periodical physical exertion decrease. There



are also special exercises which strengthen the extraocular muscles that are used in the myopia rehabilitation. One of the simple ways of training the eye muscles: perform sequential doing of four exercises which contain pressing the eyelids with their following relaxation, circular movements of the eye balls in clockwise and anticlockwise manner, horizontal movement of the eye balls to the left and to the right with the maximum possible amplitude [3, 27, 30, 25].

The majority of doctors, ophthalmologists, rehabilitation therapists point that they have most commonly used such means of rehabilitation as remedial gymnastics, therapeutic massage and therapeutic swimming in researches with the study of the corresponding issues. These exact procedures are considered to be the best option for the correction of the physical development and psychoemotional state of children and teenagers. The main way of physical rehabilitation is physical exercises which are done in the form of gymnastic, sporting applied exercises, etc. [25, 35, 40]. Systematical physical exercises influence positively the functional state of visual analyzers of pupils, facilitate the recovery of the visual functions impairments [7, 18, 31, 32]. Positive changes can be seen during performance of endurance exercises, performance of special exercises, therapeutic swimming – all these means of physical rehabilitation stabilize the general and psychological state of pupils [2, 33, 36].

The main theoretical problem of the correction direction of the physical rehabilitation of children with myopia is grounding of specificity of the content, forms and methods of the correction influence, which, as opposed to common didactic principles of education, are based on the understanding of the structure of the primary defect and on the distinctness of the physical development of children with the visual organ impairment. Activation of the visual functions is necessary to conduct through the active motor performance of the children. A significant number of physical exercises and variability of their performance allows to create a selection of the most efficient complexes of exercises in each particular case. Correction work by the means of physical education is used in the way of influencing all the functions of the organism with the aim of improvement and development of damaged functions and organs [10, 13, 38].

For the right coordination of all the actions connected to the performance of physical exercises it is necessary to coordinate the activity of all the analyzers. With the help of the analyzers a human receives new information concerning what movements the parts of its body do each split second. In the process of study of the movements children gradually improve their muscular, visual, tactile, auditory presentation [4, 7, 32]. Pupils with the pathology of short-sightedness are recommended to perform three groups of exercises every day: exercises during which the leading analyzer is visual; auditory; motor one.

The positive influence of the water on the child's organism is defined by their physical, chemical and biological features, which are successfully applied for the reach of the determined pedagogical tasks in the practice of physical education and sport. It has been discovered that in the children over 14 years old with short-sightedness who do not have physical exertions, such qualities as coordination, accuracy, motor skills, flexibility, speed and activity of movements deteriorate [3, 5, 10]. To compulsory exercises belong morning exercises, walks, self-training for reduction of the drawbacks of motor skills development, cold trainings, swimming, participation in competitions with facilitated programs [31, 32, 36]. Positive peculiarities of the use of physical exercises are, first of all, their adequacy, universality, absence of negative side effect during the use of optimal exertions.

Thus, the illness leads to the restriction of the motor activity of the children, which, in its own turn, strengthens the illness and requires an early rehabilitation. It is known that physical exercises facilitate correction of disadvantages of physical and functional development, improvement of the visual functions. For the effective use of physical exercises as means of compensation and correction of damaged and underdeveloped functions it is necessary to know the peculiarities of development and formation of movements of the children with short-sightedness and to determine the means and conditions of study [31, 32, 36].

In order to influence effectively the physical and psychoemotional state of the children with myopia it is necessary to take into consideration that performance of weight, speed, speed-weight exertions and endurance exercises until



the significant decrease in the muscular work is accompanied by the deterioration of the state of the visual functions, negative deteriorations of the cardiovascular and respiratory systems. The performance of the individual physical exertions facilitates the improvement of the state of the visual functions, stimulates development of the main physiological systems of the organism. It is necessary to approach the children on a case-by-case basis, for which it is necessary to study their preparation and functional possibilities, consider the data of medical examination, results of pedagogical and psychological observations, check tests.

To the ways of correction of short-sightedness belong correction with wearing glasses, the use of contact lenses [1, 2, 4]. Physical rehabilitation of the children with myopia includes remedial gymnastics, physiotherapy [1, 4, 5], hardware methods, video and computer correction of the sight, massage [11], infrasonic massage, therapy of colour impulses, swimming [15, 38], psychocorrection, etc. [8, 27]. The methods of reflexotherapy of corporeal and micropunctural systems are included in the program of physical rehabilitation for remediation of functional disorders [13, 17, 19, 35].

Traditional self-massage of acupuncture points around the eye is used for the decrease of the eyes' weariness and for the delay in development of myopia [22, 25, 27]. Nevertheless, unfortunately, the use of many ways of the preventative measures, methods of rehabilitation have not always facilitated the decrease in the number of appearance of short-sightedness and its progressing, and this requires the creation of new approaches concerning the conduction of the rehabilitation actions and the use of complex programs of rehabilitation. The duration of the rehabilitation in the pupils with short-sightedness varies from 3 to 9 months, with consideration for preparatory, main, final and the maintenance periods [11, 19, 20].

The important attention in the program of rehabilitation is necessary to be paid to the conduction of the methods of psychotherapy in the form of conversations, creation of the motivations for the active participation in the process of physical rehabilitation, introduction of the main didactic principles of physical education while performing remedial gymnastics [13, 17]. Psychotherapeutical influences, autogenic trainings program the

motivation for conducting rehabilitation [25, 32, 33]. The volume of the general exertion during performing complexes of morning and remedial gymnastics each person with myopia has to regulate independently, altering starting positions, simplifying or complicating the exercises depending on the state of health.

Before the beginning of the rehabilitation measures it is necessary to conduct the estimation of the state of the organism, take into consideration all the clinical implications forms of the disease, severity of the course of the disease, adaptive capabilities. Consequently, there is a need for conducting an individual selection of measures and methods of the rehabilitation by the character, intensity, speed, action rate, regulation of duration and frequency of their use. Complex use of the means of remedial gymnastics and methods of reflexotherapy secures a better efficiency of the influence of the rehabilitation measures [4, 18, 30, 32].

O. Bismak recommends to mitigate the weariness of the eyes with the use of brief physical activity breaks, self-massage of the eyes while conducting gymnastics during the day [11]. For confirmation of the effective rehabilitation with the use of methods of reflexotherapy with pupils and students with myopia there is a complete examination which includes the classic ophthalmological methods of research with the best possible correction and without it, determining dynamic and static refraction, tonus of the accommodation, reserve of the positive part of the relative accommodation [7, 10, 13, 32].

The leading place among the means of physical rehabilitation of the short-sighted belongs to physical and respiration exercises of the combined developing direction, special exercises for the eyes and fingers, exercises for the correction of the posture [7, 15, 17, 31].

In the basis of the rehabilitation process concerning myopia there is the right teaching of the technique of the physical exercises performance. Preventative measures of the vision impairment of the people with short-sightedness combines following the regime of visual exertions, during which the work at a short distance has to be limited maximally, the lighting should be sufficient. Patient with light and medium degrees of short-sightedness are recommended to give rest to the eyes each 15 minutes while working at a short distance. Patients



with high degree of myopia are recommended to take such breaks each 10 minutes. Orthoptic exercises, which are directed at the improvement of the functional state of the ciliary muscle, are recommended for the prevention of the process of the myopia progressing [11, 17]. This requires continuous effort and, unfortunately, does not always lead to the expected results.

A special attention in the program of the rehabilitation is necessary to be paid to the creation of the motivation concerning the active participation in the process of the physical rehabilitation, conscience treatment to the conduction of the remedial gymnastics in the teenagers. Regular apportioned physical exertion trainings stimulate and train, adapt the organism of pupils to the physical exertions, lead to the functional adaptation of the organism and the visual organ immediately. A complex use of the remedial gymnastics and methods of reflexotherapy leads to the significant improvement of the physical development of teenagers and increase in their functional abilities. Fulfilment of recommendations concerning adherence to hygiene during the visual exertions facilitates the retention of the visual functions and preventative measures against possible complications [7, 15, 31].

Thus, the lead position in the rehabilitation measures for pupils with the short-sightedness pathology occupies the remedial gymnastics with the use of the complex of combined developing, orthoptic, special, respiration exercises and yoga exercises, twist, etc. Exercises have to be directed, in the first place, at the improvement of the functional state and the activity of ocular muscles, particularly the ciliary muscle, to the improvement of the physiological blood supply in the eye tissues and in general, to the prevention of the processes of the myopia progressing, to the training of the accommodation reserves.

To special exercises [19, 31, 32, 36] belong twist exercises, while doing which it is recommended to use rotational movements: twist of the eye balls with opened and closed visual analyzers, twist of eyelids, brows, jaws and the neck. It is confirmed [7, 17, 32], that the muscular activity stimulates metabolic, oxidation-reduction and regenerative processes in the organism of a person of any age category. I. Akhmadulina [2, 3] has confirmed the information that special exercises facilitates the appearance of

the proprioceptive impulses, which are connected to sectors of the central nervous system facilitating the improvement of the trophism of the connected to them tissues and organs by the mechanism of motor and visceral reflexes. The development of motor skills of the hand with the help of conducting finger gymnastics facilitates the formation of firm psychophysical, psychophysiological, sensory and intellectual capacities of the pupil. T. Redkovets and Romman Haytham J. M. have suggested to include exercises which are closely connected with the articulation and sound exercises for the activation of the functions of the visual organ [31, 32] Under the influence of the reflexotherapy painful feelings are allayed, electrophysiological characteristics of the neuromuscular apparatus are improved, the muscle tone is normalized, the thermal asymmetry disappears or partially disappears, vasospasms decrease, etc. Onnuri Therapy [17], as one of the kind of the reflexotherapy of the micropunctural system, is considered effective due to the fact that it allows to solve tasks concerning the correction of disorders of the oculomotor muscles, facilitates the improvement of the acuity of vision, decrease in topalgia symptoms, normalization of vegetative-trophic functions, activation of the functions of the gastrointestinal tract, etc. [10, 32, 33].

It is known that in case of short-sightedness more than a half of the ill have distension and narrowing of the thickness of the cornea. In this respect ophthalmologists have developed a new way of treatment and of rehabilitation of the progressive short-sightedness, which is directed at the improvement of the metabolism of the cornea and its structure by the use of the electromagnetic pulse field under the technology of O.V. Skrynnyk in combination with solcoseryl, which normalizes the processes of metabolism, stimulates the synthesis of ATP, favours the synthesis of collagen, migration and proliferation keratic blasts of the corneal stroma [19]. The literature, thesis works provide the data that after the use of the solcoseryl in the pure form an increased sensitivity of the cornea with all the degrees of myopia is noted, while its thickness, rigidity and also the acuity of vision, accommodation have not change significantly after the treatment [20, 30].

Houshang Khan Ahmadi recommends to use, along with remedial, special exercises (twist exercises),



procedures with the use of the electromagnetic pulse field in combination with the solcoseryl for an additional preventative and health benefit of pupils with the progressive short-sightedness. This method of treatment has been used for pupils of primary and secondary school with the pathology for the progressive short-sightedness [20].

O.V. Skrynnyk, Houshang Khan Ahmadi have provided the information that after the use of the electromagnetic pulse field in combination with the solcoseryl (EMPF-phoresis of solcoseryl) it have been possible to notice the improvement of the acuity of vision in all the ill with the light, medium and high degrees of myopia both with the correction and without it of pupils of primary and secondary general education school.

In the result of the use of the electromagnetic pulse field (EMPF) reserves of both absolute and

relative accommodation have grown, the state of the cornea has significantly improved (its thickness has increased), the eye rigidity indices have changed (Friedewald coefficient and elastolift with myopia of light and medium degrees have increased to the normal values, by $(0,0037 \pm 0,0004)$ and by $(0,0057 \pm 0,0004)$ and by $(1,3 \pm 0,2)$ mm and $(2,0 \pm 0,1)$ mm correspondingly, while with myopia of high degree have also increased significantly: by $(0,0079 \pm 0,0003)$ and by $(2,8 \pm 0,2)$ mm). It is worth noticing that with the myopia of light and medium degrees the thickness of the cornea has become the same as in the control group of emmetropes.

Table 1 demonstrates the data of the comparative analysis of the effectiveness of EMPF-phoresis of solcoseryl and the separate use of these factors – EMPF and solcoseryl eye gel – while treating the progressive short-sightedness.

Table 1

The Increase of the Functional and Biometrical Parameters of the Eye after Various Methods of Treatment of the Ill with Short-Sightedness [20]

| Parameter | Type of Treatment | | |
|---|---------------------|-----------------------|-----------------------------|
| | Solcoseryl Eye Gel | EMPF | EMPF-phoresis of Solcoseryl |
| Low Degree Myopia | | | |
| | n = 44 | n = 44 | n = 124 |
| Corrected visual acuity | 0,0 | $0,08 \pm 0,01^*$ | $0,15 \pm 0,01^{**}$ |
| Reserve of absolute accommodation (D) | $0,1 \pm 0,1$ | $0,9 \pm 0,1^*$ | $1,7 \pm 0,2^{**}$ |
| Cornea thickness in the centre (mm) | $0,002 \pm 0,002$ | $0,002 \pm 0,002$ | $0,007 \pm 0,001^{**}$ |
| Cornea thickness peripherally (mm) | $0,004 \pm 0,001$ | $0,007 \pm 0,001^*$ | $0,023 \pm 0,003^{**}$ |
| Rigidity coefficient | $0,0003 \pm 0,0001$ | $0,0013 \pm 0,0001^*$ | $0,0037 \pm 0,0004^{**}$ |
| Corneal sensitivity (a number of perceived touches) | $0,6 \pm 0,1$ | $0,8 \pm 0,1$ | $2,1 \pm 0,1^{**}$ |
| Medium Degree Myopia | | | |
| | n = 40 | n = 40 | n = 98 |
| Corrected visual acuity | 0,0 | $0,07 \pm 0,01^*$ | $0,13 \pm 0,01^{**}$ |
| Reserve of absolute accommodation (D) | $0,1 \pm 0,1$ | $1,0 \pm 0,1$ | $1,6 \pm 0,1$ |
| Cornea thickness in the centre (mm) | $0,003 \pm 0,001$ | $0,007 \pm 0,001^*$ | $0,018 \pm 0,002^{**}$ |
| Cornea thickness peripherally (mm) | $0,004 \pm 0,001$ | $0,008 \pm 0,001^*$ | $0,040 \pm 0,003^{**}$ |
| Rigidity coefficient | $0,0003 \pm 0,0001$ | $0,0011 \pm 0,0002^*$ | $0,0057 \pm 0,0004^{**}$ |
| Corneal sensitivity (a number of perceived touches) | $1,3 \pm 0,1$ | $1,4 \pm 0,1$ | $2,6 \pm 0,1^{**}$ |
| High Degree Myopia | | | |
| | n = 40 | n = 40 | n = 50 |
| Corrected visual acuity | 0,0 | $0,05 \pm 0,01^*$ | $0,07 \pm 0,01$ |

Notes: * – possibility of differences between I and II groups;

** – possibility of differences between II and III groups ($p < 0,05$)



After the use of the solcoseryl in its pure form an insignificant increase of the sensitivity of the cornea at all degrees of myopia is discovered, while its thickness, rigidity as well as the acuity of vision and accommodation have not changed significantly after the treatment.

After the use of the EMPF the improvement of the vision acuity without the correction has been noted in all the patients: with the light degree of myopia on the average by $0,07\pm 0,01$, with the medium degree – by $0,05\pm 0,01$, with the high degree – by $0,04\pm 0,01$. The acuity of vision with the correction has increased correspondingly by $0,08\pm 0,01$; $0,07\pm 0,01$ and $0,05\pm 0,01$ with different degrees of myopia. In the result of the use of the EMPF the reserves of both absolute and relative accommodation have grown: with the light degree of myopia by $0,9\pm 0,1$ D and $1,0\pm 0,1$ D, with the medium one – by $1,0\pm 0,1$ D and $0,9\pm 0,1$ D, with the high degree – by $0,5\pm 0,1$ D and $0,5\pm 0,1$ D.

In a long term the observation, the health benefit after the EMPF-phoresis of solcoseryl has preserved in 70 patients (53 %) during 6 months, in 62 (47 %) – 5 months, in relation to which it is recommended to repeat the courses of treatment every 5–6 months, in other words twice a year. Stabilization of short-sightedness has been noted at the term of observation in 6 months – in 95,6 %, 2 years – 78,7 % of the patients.

The results of the researches of O.V. Skrynnyk, Houshang Khan Ahmadi indicate the fact that the way of the treatment and of the rehabilitation of the acquired progressive short-sightedness by the means of the EMPF-phoresis of solcoseryl has a positive impact on the state of the cornea of the eye, increases its sensitivity, normalizes its thickness. Furthermore, the acuity of vision improves substantially, the reserves of both absolute and relative accommodation grow significantly. These results of the researches help to have a better grip of the complex mechanism of the development of myopia, facilitate the scientifically grounded approach to the issue of the treatment and rehabilitation of myopia in pupils and can come into use in practical ophthalmology during the treatment and preventative measures of the corresponding pathology of the visual analyzer.

The analysis of the literary sources has allowed to establish effective ways of physical rehabilitation of pupils with myopia. A special attention has to be paid to regular apportioned physical exercises, complex use of remedial gymnastics, massage, methods of reflexotherapy and hygiene of the visual analyzers. All these means facilitate the functional adaptation of the organism, of the visual organ immediately; preservation of visual abilities of the human organism and prevention of complications, etc.

Conclusions

On the basis of the literary sources, it has been established that the increase in a number of cases of myopia of pupils is, in the first place, connected with the increase in visual exertions.

The main pathogenic link of the acquired myopia is sclera distension and the corneal thinning which is connected to the increase of its horizontal diameter and the length of the anterior-posterior axis of the eye, that is a cause of the short-sightedness progressing. The corneal thinning is accompanied by its sensory decrement from 19 % to 57 % depending on the degree of the disease and by the decrease of the rigidity of the outer layer of the eye. Children with myopia with the corneal thinning form a risk group in regard to the development of retinal degeneration.

Physical rehabilitation is used for the restoration of the acuity of vision of the children with myopia. Physical rehabilitation of such children is a difficult and a long-term process that requires a systematic stage-by-stage use of its various means: respiration and twist exercises, finger and articulatory gymnastics, Onnuri Therapy, reflexotherapy, instrumental physiotherapy, etc.

According to the sources of literature, it is recommended to use methods which are directed at the restoration of the general health, visual abilities and training of the accommodation of the organ of vision in rehabilitation of pupils with short-sightedness.

Conflict of interest

The author claims that there is no conflict of interest.



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