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The Use of a Virtual Reality System in the Rehabilitation of Children with Progressive Muscular Dystrophies

Tetiana Khrystova*
Vladyslav Pyurko**
Olga Pyurko***
Andriy Protsenko****
Tetiana Osadchenko*****
Mykhailo Oliinyk******

ABSTRACT

The research aim is to prove the effectiveness of individual programs of physical therapy and occupational therapy for children with progressive muscular dystrophy (PMD), which include game technologies of virtual reality. The following research methods were used in the work: general scientific (analysis, synthesis, synthesis of literature); clinical (clinical examination); pedagogical (observation, experiment); biomedical (development of motor functions), mathematical statistics. It has been proven that after the implementation of a synergistic rehabilitation program on the MFM scale positive changes were observed among children with dystrophic pathologies; according to the Vignos scale, no improvement in results was recorded; according to the Brooke scale - similar situation, among children with PMD Landusy-Dejerin, Emery-Dreyfus and unspecified form, the final results did not differ from the weekend, and among children with Duchenne muscular dystrophy, born PMD and Erb-Roth PMD showed deterioration of parameters.

KEYWORDS: Physical therapy, progressive muscular dystrophy, children, virtual reality technologies.

*Bogdan Khmelnytsky Melitopol State Pedagogical University, Ukraine. ORCID ID: https://orcid.org/0000-0003-1621-695X. E-mail: fizreabznu@gmail.com

* * Bogdan Khmelnytsky Melitopol State Pedagogical University, City Council of Zaporizhia Region, Ukraine. ORCID ID: https://orcid.org/0000-0001-9296-6619. E-mail: vlad.1994ak@gmail.com

***Bogdan Khmelnytsky Melitopol State Pedagogical University, Ukraine. ORCID ID: https://orcid.org/0000-0002-3681-073X. E-mail: diser0303@gmail.com

****Bogdan Khmelnytsky Melitopol State Pedagogical University, Ukraine. ORCID ID: https://orcid.org/0000-0002-9092-7015. E-mail: andrey-prozenko@ukr.net

*****Pavlo Tychyna Uman State Pedagogical University, Ukraine. ORCID ID: https://orcid.org/0000-0003-2198-7206. E-mail: taniasudjba@gmail.com

******Zaporizhzhia State Medical and Pharmaceutical University, Ukraine. ORCID ID: https://orcid.org/0000-0003-4131-7664. E-mail: oleynikmikel.1991@ukr.net

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El uso de un sistema de realidad virtual en la rehabilitación de niños con distrofias musculares progresivas

RESUMEN

El objetivo del estudio es demostrar la eficacia de los programas individuales de fisioterapia y terapia ocupacional para niños con distrofia muscular progresiva (DMP), que incluyen tecnologías de juego de realidad virtual. En el estudio se utilizaron los siguientes métodos de investigación: científico general (análisis, síntesis, generalización de la literatura); clínico (examen clínico); pedagógico (observación, experimento); médico y biológico (desarrollo de las funciones motoras), estadística matemática. Se comprobó que, tras la aplicación del programa de rehabilitación sinérgica, se observaron cambios positivos entre los niños con patologías distróficas según la escala MFM; no se registró ninguna mejora según la escala de Vignos; de acuerdo con la escala de Brook - una situación similar, entre los niños con Landusi-Deguerin, Emery-Dreyfus y forma no especificada de PMD, los resultados finales no difirieron de la línea de base, y entre los niños con distrofia muscular de Duchenne, forma congénita de PMD y Erb-Roth PMD, se observó deterioro de los indicadores.

PALABRAS CLAVE: Fisioterapia, distrofia muscular progresiva, niños, tecnologías de realidad virtual.

Introduction

In today's turbulent times, the future of the nation is determined, first of all, by the expansion of the health zone of the child population, the prevailing determinants of which are the system-environmental homeostasis of humans and ecosystems, the stability of the bioecosystem, and stable resources (Pyurko et al., 2022). The transversal unity of its physical, mental, and social sides in consolidation with the achievements of bioecomedicine can be considered the main lines of implementation of predictors of children's health (Khrystova, Kovalchuk, 2021). In the last decade in Ukraine, despite the implementation of a system of complex measures in the aspect of preserving and strengthening the health of the young generation, its deterioration has been noted (Kalynychenko et al., 2020; Khrystova, 2012). This is associated with a large mental and physical load, with a decrease in the prestige of the child's healthy behavior. The increase in the share of severe chronic diseases, in particular hereditary and congenital, in the structure of morbidity among children contributes to an increase in the frequency of such adverse consequences as limitation of life activities and social insufficiency (Znak et al., 2018; Khrystova, 2013). This is manifested in somatic weakness, the presence of organic pathology, the emergence of a

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tendency to increase the prevalence of deviations in the development of children, which indicates the urgency of the problem of improving medical, social-psychological, and pedagogical assistance to children who experience developmental difficulties from early childhood (Ravi et al., 2017; McDonald, 2002).

Progressive muscular dystrophies (PMD) are a group of hereditary diseases, with a debut in most cases in childhood, characterized by muscle weakness, muscle atrophy and a progressive course due to the degeneration of muscle fibers (Brooke et al., 1989; Duan et al., 2021; Wicklund, 2013; Freitas et al., 2019). Currently, there are no effective drugs for the complete treatment of muscular dystrophies, only supportive therapy is prescribed (Bushby et al., 2010; Fowler, 1982; Jameson et al., 2020; Grange, Call, 2007). A system of corrective and rehabilitation methods of treatment, including exercises with movements of the whole body and aimed at the development of fine motor skills, are important for the prevention of complications and improvement of the quality and duration of life of children of this nosology (Bothwell et al., 2003; Hinton et al., 2006; Jackson, 2008; Markert et al., 2011).

Many domestic and foreign scientists are engaged in researching the problems of development of therapeutic practices, medical technologies of rehabilitation, (Kondratenko, V., Okopnyk, O., Fomichov, K., Voronkova, V., Oleksenko, R., Kondratenko, V., Manzhula, A., Sobol, Y., Myroniuk, R.) but the digital segment of such services remains outside the area of attention. The introduction of a phased system of physical therapy for children with PMD, which begins from the first year of life and continues in preschool and school age with the use of modern technologies of digitalization of the rehabilitation process in the form of a virtual reality game system, is an urgent problem (Bohil et al., 2011; Li et al., 2009; Merians et al., 2006). Virtual reality technology provides an opportunity to individualize treatment needs, while maintaining the availability and quality of rehabilitation effects (Coons et al., 2011; Henderson et al., 2007; Parsons et al., 2009; Cho et al., 2002).

The research aim is to prove the effectiveness of individual physical therapy programs for children with progressive muscular dystrophies, which include modern gaming virtual reality (VR) technologies.

1. Materials and methods

The theoretical and methodological basis of the work was the synergistic use of scientific principles and a systematic approach, which determined a transparent approach

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to the choice of research methods, in particular: general scientific (analysis, synthesis, systematization, generalization of literary sources); clinical (clinical examination data according to the generally accepted examination scheme); pedagogical (observation, scientific experiment); medical and biological (level of development of motor functions), methods of mathematical statistics.

The research was conducted on the basis of the Municipal non-profit enterprise «Center for the provision of social services and medical rehabilitation» of the Melitopol City Council of the Zaporizhia region in 2021-2022. The experiment involved 20 children with PMD aged 6 to 9 years who have severe cognitive impairment, convulsions noted for 3 years before the beginning of rehabilitation effects, widespread weakness in the upper limbs (when performing the tests, the children could not raise their arms to mouth level). Of them, the largest number was children with Duchenne muscular dystrophy (DMD) - 56.9%, followed by Erb-Roth PMD (13.9%), congenital PMD (11.1%), PMD of unspecified form (9.7%), Emery-Dreyfus PMD (5.6%), Landuzy-Dejerin PMD (2.8%). Informed consent to participate in the research was obtained from the parents of the children who participated in the experiment.

The peculiarity of the said contingent of children with PMD was that most of the patients had not previously been involved in physical education and sports, that is, they had not received regular physical exercise. The perception of physical therapy as a necessary component of a complex of rehabilitation measures was very weak.

In this regard, when building the methodology of the introductory period of rehabilitation, it was taken into account that for most children, physical exercises and the system of regular training itself represent a new type of activity. This determined the need for the formation of motivation and a positive attitude to classes, compliance with the main general pedagogical, specific and psychological principles. Therefore, special importance was attached to establishing personal contact with each child participating in the study; built their relationships on a detailed acquaintance not only with complaints, but also on studying the way of life, habits, character traits, degree of interest in classes, main motivations. In the course of pedagogical observations, positive dynamics of not only physical, but also emotional state were noted.

Taking into account the fact that PMD is characterized by muscle weakness, muscle atrophy and a progressive course due to the degeneration of muscle fibers, all rehabilitation

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tactics were aimed at preventing the progression of the symptoms of the disease itself and its complications.

In the process of work, individual physical therapy programs were implemented, which included the following tools: therapeutic physical culture, light hand massage, orthopedic stacking, magnetic therapy, and virtual reality game systems. A new rehabilitation technology for children with PMD, the effectiveness of which was evaluated during the rehabilitation period, was a VR gaming system (Microsoft Xbox 360 Kinect; Microsoft Corporation; Redmond, Washington, USA), which is used to ensure the process of forming basic movements in children with PMD.

To optimize children's motivation, a huge selection of games was offered. Commercial games were used for children aged 6-7: «Sesame Street: Once upon a monster» or «Kinectimals». For children 8-9 years old, games were offered: «Kinect Disneyland Adventures», «Kinect Adventures» or «Kinect Rush: A Disney Pixar Adventure».

Classes with children with PMD were conducted in a separate office with an area of 15 m2. Air humidity and temperature were maintained within 70-80% and 20-24°C, respectively. The number of sessions per rehabilitation course is 10, the frequency of sessions is daily, with a break on Sundays, during daytime hours (from 3:00 p.m. to 6:00 p.m.), in between children's meals. The duration of the procedure was 20 to 30 minutes, with the duration of the active phase being strictly 15 minutes and the inactive phase being 5 to 15 minutes, depending on the chosen game.

During the game/exercises on the VR game system, the children performed movements with the whole body, while the movements and their repetition were voluntary and performed physiologically, the intensity and pace of the exercises were determined by individual capabilities, which corresponds to the approaches to the rehabilitation of children with PMD. When performing exercises on the game console, the use of high-intensity strength training and eccentric exercises, which can cause damage to children with PMD, is excluded. VR games are aimed at developing not only large, but also fine motor skills, which is important for children with PMD, since fine motor skills affect the quality of life of patients (children can maintain motor independence longer). Also, when using games in the rehabilitation process, it was possible to maintain the level of motivation in children, which is essential for the successful rehabilitation of children with this nosology.

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The effectiveness of the VR game system was evaluated using specially selected scales that reflect the dynamics of gross and fine motor skills in the rehabilitation process of children with PMD.

Vignos scale. This scale was used to assess the ability to move the lower limbs (Vignos, Archibald, 1960). According to this scale, patients were divided into 10 functional classes, according to their ability to move.

Brooke scale. This scale was used to assess the ability to move the upper limbs (Brooke et al., 1989). According to this scale, patients were divided into 6 functional classes according to their ability to move.

MFM scale. This scale is a general assessment of motor abilities of patients with neuromuscular diseases (Motor Function Measure, 2003/2005) (Bérard et al., 2005). The MFM scale allows for a comprehensive assessment of proximal, distal and axial motor disorders. It contains 32 items, which include static and dynamic assessments, divided into three dimensions (Dimensions): dimension 1 (D1) – «standing and moving» (13 items), dimension 2 (D2) – «axial and proximal motor weakness» (12 points), dimension 3 (D3) – «distal motor weakness» (7 points, 6 of them - upper limbs). D is the sum of points according to dimensions D1, D2, D3.

The digital material obtained in the research process was processed using Statistica version 10.0 general purpose data processing software package. The reliability of differences between groups (comparison of the average values of the indicator for each group) was determined using the Student's test (t).

2. Results and discussion

Based on the generalization and systematization of scientific and methodological literature (Znak et al., 2018; Duan et al., 2021; Wicklund, 2013; Jackson, 2008), it can be stated that the number of children with PMD is increasing every year, both in Ukraine and throughout the world. The main causes of various forms of PMD are related to the human genetic apparatus, namely autosomal deletions, or the sex X chromosome. These genetic changes are manifested in the phenotypic sphere by progressive muscular dystrophies. In order for a child with such a pathology to have the opportunity to develop, both socially and intellectually, it is advisable to use non-drug methods of restorative treatment along with drug ones (McDonald, 2002; Brooke et al., 1989; Bushby et al., 2010; Jameson et al.,

2020; Grange, Call, 2007; Jackson, 2008). Methods of physical therapy and occupational therapy are constantly updated and improved. Thus, along with therapeutic gymnastics, various mechanical and automatic devices that allow training the musculoskeletal system, recently virtual game systems have been used (Coons et al., 2011; Henderson et al., 2007; Parsons et al., 2009; Cho et al., 2002). They can be used in hospital inpatient settings and at home, which makes it possible to eliminate the barrier of territorial inaccessibility to rehabilitation services (Bohil et al., 2011; Li et al., 2009; Merians et al., 2006). VR improves the function of the musculoskeletal system, fine motor skills, coordination abilities, muscle strength and quality of life of children with PMD.

The structural and logical analysis of the obtained results (Figs. 1-6) showed that the overall average assessment of motor abilities of children of primary school age with PMD before restorative treatment was 77.11±7.25% (D – general motor development) $p=0.001$), according to the first measurement (D1) – 58.61±3.71% ($p<0.001$), according to the second measurement (D2) – 90.06±7.11% ($p=0.018$), according to the third measurement (D3) – 88.31±6.58% ($p=0.017$). The average score according to the Vignos scale of all examined children at the beginning of the study was 2.92±0.58 points ($p=0.001$), according to the Brooke scale – 1.53±0.11 points ($p=0.007$).

It should be noted that the average results of indicators of various scales are largely determined by the clinical picture of various types of PMD. We characterize the vectors of changes in motor functions of children with PMD depending on the PMD type.

As a result of initial testing of the motor function of children of primary school age with DMD, the following parameters were recorded (Fig. 1): according to the MFM scale, D – 74.68±6.12% ($p<0.01$), D1 – 52.38± 4.37% ($p=0.006$), D2 – 90.99±8.22% ($p<0.02$), D3 – 87.16±7.08% ($p<0.001$); on the Vignos scale – 3.2±0.41 points ($p<0.001$), on the Brooke scale – 1.44±0.09 points ($p=0.005$).

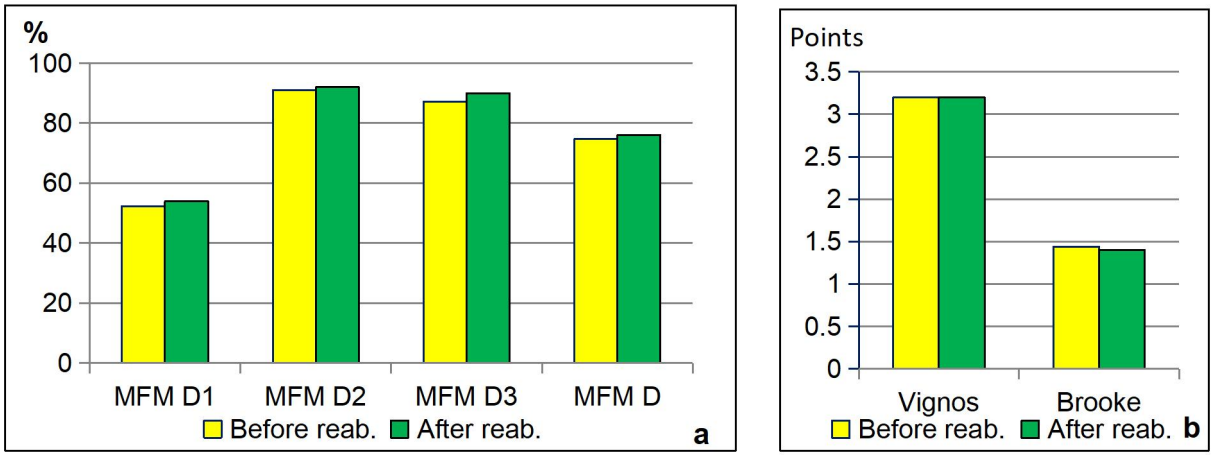

Fig. 1. Dynamics of indicators of motor development of children with DMD according to the MFM, Vignos and Brooke scales.

In children 6-9 years old with PMD Landuzi-Dezherin at the beginning of the experimental study, the following results of the state of motor abilities were obtained (Fig. 2): according to the MFM scale, D – 95.32±8.36 (p=0.002), D1 – 96 ,17±9.07% (p<0.003), D2 – 91.67±7.86% (p<0.001), D3 – 100.0±9.27% (p=0.02); on the Vignos scale – 1.0±0.08 points (p<0.001), on the Brooke scale – 1.0±0.07 points (p=0.002).

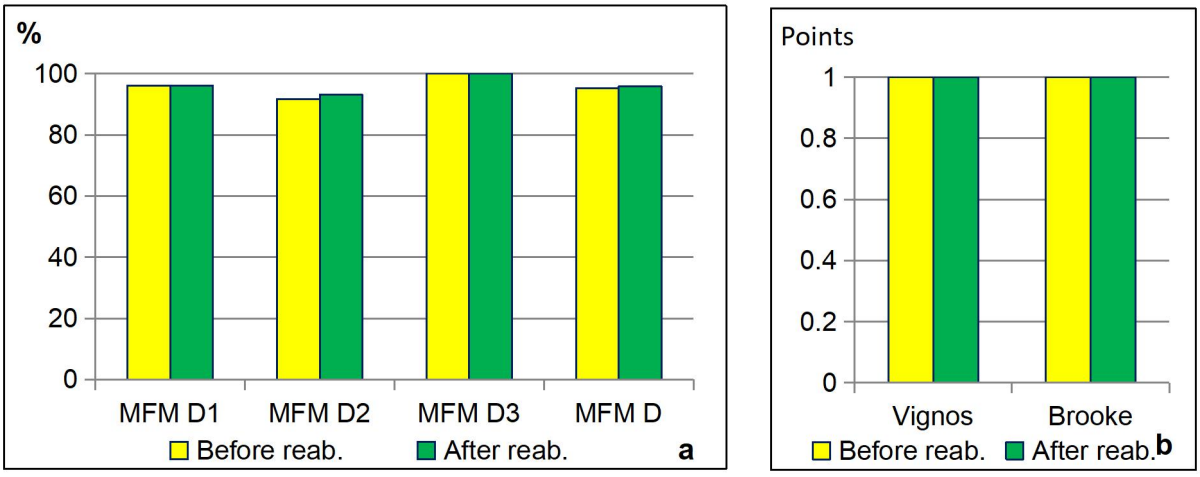

Fig. 2. Dynamics of indicators of motor development of children with PMD Landuzi-Dezherin according to the MFM, Vignos and Brooke scales.

Low initial results on all scales of assessment of children's gross and fine motor skills at the beginning of the implementation of the synergistic program of physical therapy and occupational therapy were obtained among patients with congenital PMD (Fig. 3): according to the MFM scale, D – 56.15±4.81 (p< 0.01), D1 – 28.69±1.97% (p=0.001), D2 –

74.66±6.91% (p=0.003), D3 – 74.56±6.85% (p< 0.002); on the Vignos scale – 5.88±4.93 points (p<0.01), on the Brooke scale – 2.88±2.03 points (p<0.001).

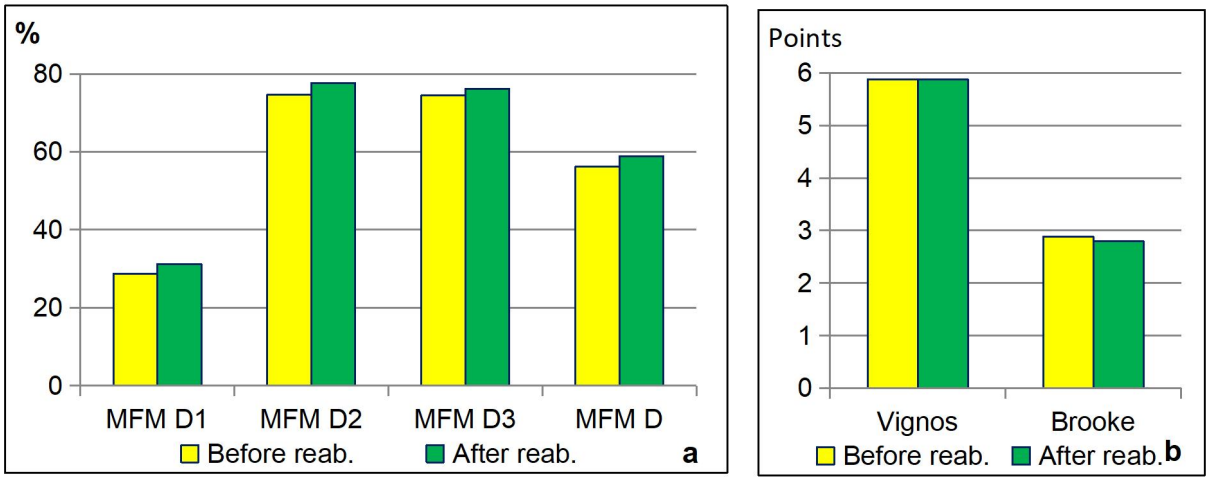

Fig. 3. Dynamics of indicators of motor development of children with congenital PMD according to the MFM, Vignos and Brooke scales.

Monitoring of motor function at the beginning of the experimental study among children with Erb-Roth PMD showed the initial parameters at the following level (Fig. 4): according to the MFM scale, D – 89.94±8.21 (p=0.003), D1 – 79.36 ±6.58% (p<0.005), D2 – 97.11±9.17% (p<0.001), D3 – 96.90±8.94% (p=0.01); according to the Vignos scale – 1.4±0.08 points (p=0.005), according to the Brooke scale – 1.1±0.05 points (p<0.002).

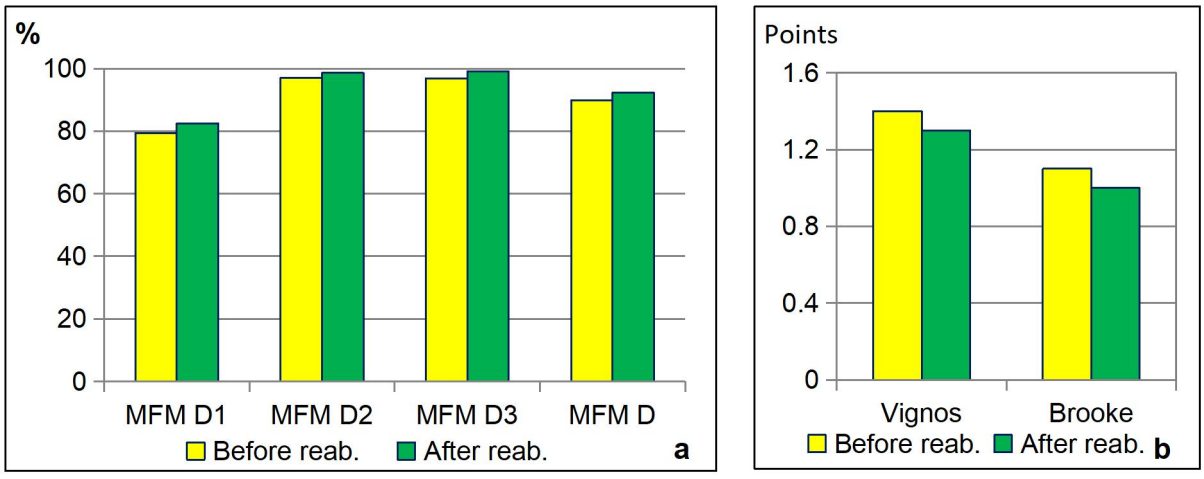

Fig. 4. Dynamics of indicators of motor development of children with Erb-Roth PMD according to the MFM, Vignos and Brooke scales.

A comprehensive check of the initial motor skills of children aged 6-9 years who suffer from Emery-Dreyfus PMD on all scales made it possible to obtain satisfactory results (Fig. 5): on the MFM scale, D – 92.19±7.76 ($p<0.001$), D1 – 86.54±7.17% ($p=0.003$), D2 – 95.97±8.92% ($p<0.001$), D3 – 94.05±8.14% ($p=0.004$); according to the Vignos scale – 1.25±0.07 points ($p<0.01$), according to the Brooke scale – 1.0±0.06 points ($p=0.003$).

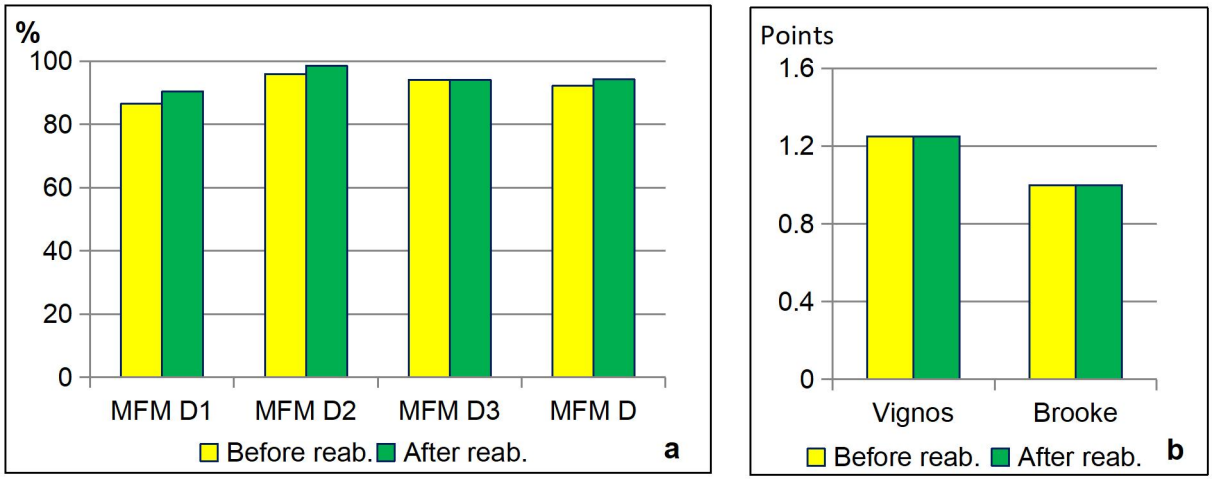

Fig. 5. Dynamics of motor development indicators of children with Emery-Dreyfus PMD according to the MFM, Vignos and Brooke scales.

In children of primary school age with an unspecified form of PMD, the state of the motor sphere before carrying out synergistic rehabilitation measures was at the following level (Fig. 6): according to the MFM scale, D – 83.19±6.81 ($p=0.002$), D1 – 72, 89±6.54% ($p<0.001$), D2 – 88.29±7.73% ($p=0.003$), D3 – 91.84±8.23% ($p<0.005$); according to the Vignos scale – 1.57±0.08 points ($p=0.001$), according to the Brooke scale – 1.57±0.07 points ($p<0.002$).

So, in the process of comparative analysis of the initial level of development of motor function of children with PMD, it was established that patients with PMD Landuzi-Dejerin have the highest (best) indicators of motor development on all scales (exception - D2), in second place - children with PMD Emery-Dreyfus (exception – D2, D3), then – children with Erb-Roth syndrome (exception – D2, D3), children with DMD and children with PMD of unspecified form. Patients with congenital pathology had the lowest motor ability scores on all scales among children with PMD.

To determine the vector of changes in the motor function of children with PMD, the values of indicators in dynamics were calculated: the difference between initial and final

values during the period of rehabilitation effects.

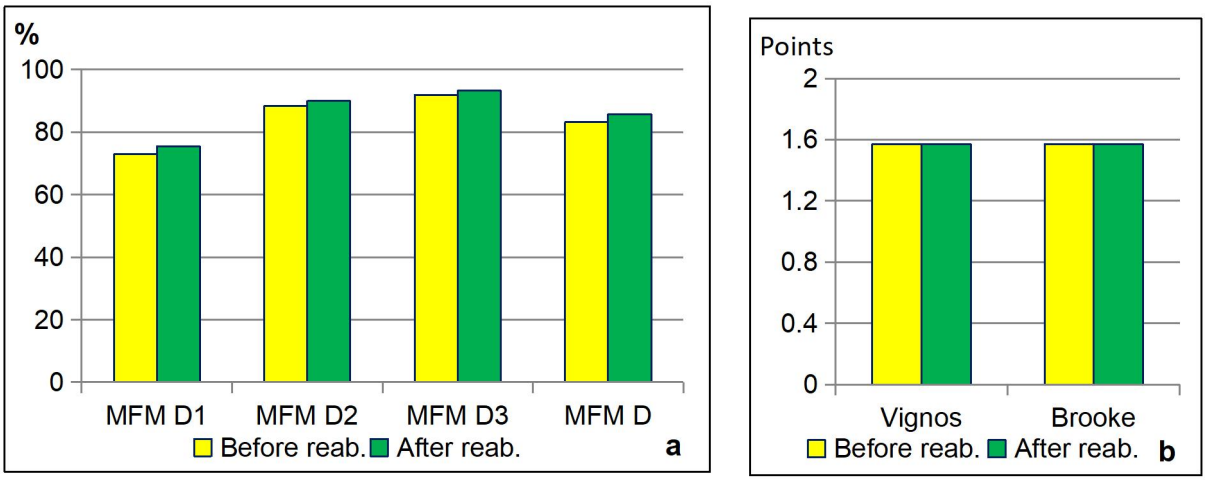

Fig. 6. Dynamics of indicators of motor development of children with PMD of an unspecified form according to the MFM, Vignos and Brooke scales.

A comparative analysis of the state of motor functions after the application of individual programs of physical therapy using the VR system (Fig. 1-6) showed that according to the data of the MFM scale, the average score for measuring D in children with PMD at the end of the study was 78.89±7.02% (p=0.001), D1 – 60.68±5.17% (p<0.001), D2 – 91.51±8.39% (p=0.020), D3 – 90.57±7.10% (p =0.014). The average score on the Vignos scale among elementary school children with neuromuscular pathologies after rehabilitation was 2.88±0.59 points (p=0.001); according to the Brooke scale - 1.50±0.10 points (p=0.012).

Depending on the type of PMD in children with impaired motor function, statistically significant changes in the average value were found as a result of the implementation of a complex program of physical therapy and occupational therapy using the BP system.

During the study period, the average changes in parameters of motor functions among children aged 6-9 with DMD were equal (Fig. 1): according to the MFM scale, D improved by 1.36% (reached values of 76.04±6.23, p=0.001), D1 – improved by 1.55% (53.94±4.91%, p<0.001), D2 – increased by 1.01% (90.0±8.14% (p<0.002), D3 – increased by 2.88% (90.04±8.08%, (p=0.005); according to the Vignos and Brooke scales, the results remained at the initial level, no probable changes were observed.

A slightly different picture was observed during the systematization of the dynamics of the average indicators of motor abilities among the studied children with PMD Landuzi-

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Dezherin (Fig. 2); after the implementation of a synergistic program of physical therapy and occupational therapy, they were at the following level: according to the MFM scale, D improved by only 0.52% (equal to 95.84±8.46, p<0.002), D1 and D3 did not change compared to according to the initial data, the highest positive dynamics was noted according to the D2 measurement - the results increased by 1.4% (93.07±8.93% (p<0.005); according to the Vignos and Brooke scales, no probable changes in motor parameters were recorded.

In children of primary school age with congenital PMD against the background of using the VR system, the average motor indicators underwent the following changes (Fig. 3): according to the MFM scale, D improved by 2.74% (reached values of 58.89±5.31, p<0.003), D1 – improved by 2.53% (31.22±2.63%, p=0.001), D2 – increased by 2.95% (77.61±6.83% (p<0.002), D3 – increased by 1.63% (76.19±6.67%, p<0.005); according to the Vignos scale, the dynamics of motor abilities were not noted; according to the Brooke scale, a slight deterioration of the results by 0.13 points was noted (the final data were equal to 2.75± 0.09 points, p<0.001).

After carrying out a complex of physical therapy and occupational therapy measures, monitoring of the average motor function indicators of children with Erb-Roth PMD according to the studied scales showed the following results (Fig. 4): according to the MFM scale, D improved by 2.32% (reached values of 92.26±8 .77, p<0.005), D1 – improved by 3.18% (82.54±7.41%, p<0.004), D2 – increased by 1.5% (98.61±8.90% (p =0.003), D3 - increased by 2.27% (99.17±9.43%, p=0.001); according to the Vignos and Brooke scales, a slight deterioration of the actual data by 0.1 points was noted in both cases (p<0.001) .

During the experiment, the dynamics of the average indicators of motor development of children with Emery-Dreyfus PMD according to the MFM, Vignos and Brooke scales are characterized by the following vectors (Fig. 5): according to the MFM scale, D results improved by 2.08% (reached values of 94.27±8 .71, p<0.004), D1 – improved by 3.86% (90.4±8.56%, p=0.005), D2 – increased by 2.64% (98.61±8.85% (p <0.002), D3 – no probable changes were recorded, the indicators remained at the initial level; according to the Vignos and Brooke scales, there were also no probable changes in the manifestation of children's motor abilities, the actual results remained at the initial level.

Summarizing the effect of physical therapy and occupational therapy using the VR

system on the motor content of children with PMD of an unspecified form allows us to state that during the study period the average indicators changed as follows (Fig. 6): on the MFM scale, D improved by 2.52% (reached level 85.71±7.83, p<0.002), D1 – improved by 2.57% (75.46±7.12%, p<0.003), D2 – increased by 1.6% (89.89± 8.66% (p=0.004), D3 - increased by 1.35% (93.19±8.58%, p<0.001); according to the Vignos and Brooke scales, there were no probable changes in the manifestation of children's motor abilities, the actual results remained at the initial level and scored 1.57±0.08 points in both cases (p<0.01).

Thus, in the process of a structural-logical generalized analysis of the state of the motor sphere of children of primary school age with PMD after the implementation of a synergistic program of physical therapy and occupational therapy using the BP system, it was proved that according to the MFM scale (D, D1, D2 and D3) in the dynamics, positive changes among children with different types of dystrophic pathologies (the exception is the measurement of D3 in children with Emery-Dreyfus PMD), according to the Vignos scale, the results did not improve, in most cases the indicators remained at the initial level, and in children with Erb-Roth PMD they slightly decreased; according to the Brooke scale, positive dynamics were also not noted in any case, among children with PMD Landuzy-Dejerin, PMD Emery-Dreyfus and PMD of an unspecified form, the average final results did not differ numerically from the initial values, and among children with DMD, congenital PMD and Erba-Roth PMD, deterioration of average parameters was observed.

It should be noted that to assess the effectiveness of new technologies in the rehabilitation treatment of children with PMD, it is more appropriate to use the indicators of the MFM scale, which characterize fine motor skills. The Vignos and Brooke scales mainly characterize the state of gross motor skills, which cannot be significantly changed under the influence of BP means. Therefore, it is better to use these scales only to assess the state of gross motor skills in children with PMD.

Conclusions

The following conclusions can be drawn on the basis of the conducted experimental research.

1. The analysis of scientific and methodological and special literature on the topic of the work showed that the number of children with PMD is increasing every year, both in Ukraine and throughout the world. In order for the child to develop both socially and

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intellectually, the synergistic use of non-drug and drug rehabilitation methods, which are constantly updated and improved, is necessary. In the conditions of the modern information society, along with therapeutic gymnastics, various mechanical and automatic devices that allow you to train the locomotor system, recently virtual game systems have been used. They can be used in hospital inpatient settings and at home, which makes it possible to remove the barrier of territorial inaccessibility to rehabilitation services. Digital content improves the function of the musculoskeletal system, fine motor skills, coordination abilities, and muscle strength of children with PMD.

2. In the course of the research, individual programs of physical therapy and occupational therapy for children with various types of PMD were developed and implemented, which included the following tools: therapeutic physical culture, light manual massage, orthopedic stacking, magnetic therapy, virtual reality game systems. An effective rehabilitation technology for children with progressive muscular dystrophies of primary school age is a virtual reality gaming system (Xbox 360 Kinect).

3. In the process of comparative analysis of the initial level of motor function development of children with PMD, it was established that patients with Landusi-Dejerin PMD have the best indicators of motor development on all scales (exception - D2), in second place - children with Emery-Dreyfus PMD (exception - D2, D3), then - children with Erb-Roth syndrome (exception - D2, D3), children with DMD and children with PMD of an unspecified form. Patients with congenital pathology had the lowest motor ability scores on all scales among children with PMD.

4. In the process of a structural-logical generalized analysis of the state of the motor sphere of children of primary school age with PMD after the implementation of a synergistic program of physical therapy and occupational therapy using the BP system, it was proven that positive changes were recorded in the dynamics according to the MFM scale (D, D1, D2 and D3) among children with different types of dystrophic pathologies (the exception is the measurement of D3 in children with Emery-Dreyfus PMD), according to the Vignos scale, no improvement in results was recorded, in most cases the indicators remained at the initial level, and in children with Erb-Roth PMD they slightly decreased; according to the Brooke scale, positive dynamics were also not noted in any case, among children with PMD Landuzy-Dejerin, PMD Emery-Dreyfus and PMD of an unspecified form, the average final results did not differ numerically from the weekend values, and

among children with DMD, congenital PMD and ErbPMD - the deterioration of the average parameters was observed in the mouth.

5. To assess the effectiveness of new technologies in the rehabilitation treatment of children with PMD, it is more appropriate to use the indicators of the MFM scale, which characterize fine motor skills. The Vignos and Brooke scales mainly characterize the state of gross motor skills, which cannot be significantly changed under the influence of BP means. Therefore, it is better to use these scales only to assess the state of gross motor skills in children with PMD.

The developed synergistic programs of physical therapy and occupational therapy for children with PMD can be used in neurological and traumatology-orthopedic departments of treatment and prevention facilities, in rehabilitation centers, as well as in sanatorium-resort conditions.

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