The Duality Principle in the Physical Rehabilitation of Children with Musculoskeletal System Disorders

Nikolay Nikolaevich Efimenko¹ and Nikolay Danilovich Moga²

1. Doctor of Pedagogical Sciences, Professor, Department of Applied Psychology and Speech Therapy. Berdyansk State Pedagogical University, Berdyansk, Ukraine.
2. Candidate of Pedagogical Sciences, doctoral student, Department of Orthopedagogy, Rehabilitation and Orthopsychology. M.P. Dragomanov Kiev National State Pedagogical University, Kiev, Ukraine.

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ABSTRACT
The article provided a brief analysis of the existing philosophical approaches to the systems of physical rehabilitation of persons with the musculoskeletal system disorders. From the philosophy and methodology position, was made an attempt to improve the existing conceptual basis of the physical rehabilitation system of early and preschool age children with musculoskeletal system disorders. The existing practice of physical rehabilitation is focused on private empirical approaches. At the same time, there is no single universal concept of motor disorders overcoming, which should be based on a number of fundamental principles reflecting the objective laws of biological development and the formation of the human body in the process of phylogenesis and ontogenesis. The article considers and analyzes the principle of duality (duality). For this purpose, the main dual pairs of the children physical development were formulated, as well as the correction of their motor disorders, which marked the extreme, opposite states of the psychophysical status of the child. Further, for each pair, a dual vector of development orientation (rehabilitation, correction) was determined. Based on the principle of trinity, the authors proposed a method of “sliding along the dual spectrum”, when, in the process of correcting motor disorders, it is necessary to strictly observe the sequence of movement (slip) from one extreme to another, combining these effects. At the same time, it is not necessary to reach the extreme state in each specific situation it can be a certain target position between these opposite poles.

Introduction
To develop modern effective technologies for children physical rehabilitation with musculoskeletal system disorders, it is necessary to create a scientifically grounded theoretical and methodological basis that could ensure the formation of new methodological positions for overcoming motor disorders in children by means of physical education. First of all, it became necessary to formulate new principles for the children physical rehabilitation, which would form the foundation of a promising approach to solving this problem. In a sense, we can talk about reforming the physical rehabilitation philosophy of people with musculoskeletal system disorders.

Problem statement
The process of studying the existing physical rehabilitation systems of persons with musculoskeletal system disorders (Alexander, 1969; Aplenger, 1999; Batysheva, Bykova, Kvasova, 2016; Efimenko, 2014; Grabovskaya 2018;
Háry, 1992; Kozlova, Kozlov, Semenenko, 2014; Liem, 2004; Lowen, 1990; Lowen, 1992; Maksimov, 2014; Mastyukova, 1997; Monte, 2007-2008; Myers, 2014; Novoseltsev, 2008; Novoseltsev, 2014; Podolyaka, Podolyaka, 2016; Rogov and others, 2014; Rolf, 1977; Semerov, 2018; Shevtsov, 2009; Still, 1992; Still, 1902; Zhikarentsev, 2004) has revealed a lack of elaboration of a philosophical, theoretical and methodological basis on which it is possible to build an effective system of correction and rehabilitation of a specified persons contingent. Therefore, we assume that errors are inevitable both in the strategy of the correction process and in its tactical implementation, leading to the decrease in the overall final correctional effect. To reduce these deficiencies to a minimum and, ideally, in order to avoid their occurrence, it is necessary to provide the preliminary elaboration of the philosophical, theoretical and methodological foundations of correctional physical education (physical rehabilitation) of children with musculoskeletal system disorders.

A number of researchers have made such attempts, in particular, with respect to osteopathy (Nelson A., 2008 p. 91; Freyzher R., 2006; Stolyarov V., 2015). “Two main methodological approaches emerged eventually in osteopathy: the structural approach and the functional one (Monte J, 2008). The well-known structural approach raises no issue, while the functional approach (or functional technique) is not so clarified. Firstly, the functional technique involves the use of mental abilities of imagination and an altered state of consciousness... A special example of the functional approach is somato emotional release (Upledger J., 1999), in the course of which there used a dialogue with an “internal doctor”, work with “energy cysts”, etc. Without a doubt, the adoption of functional techniques is limited by the scope of consciousness and each doctor’s experience. The absence of elementary philosophical knowledge of matter and spirit causes confusion, and sometimes speculation on dogmatic ground” (Nelson A., 2008 p. 91). Similarly, it causes confusion in the motor rehabilitation of children with musculoskeletal system disorders with the help of physical education. This problem remains open and highly debatable. This determines the relevance of our research (Novoseltsev S., 2008, p. 92).

Research questions

Similarly, with regard to the children motor rehabilitation with musculoskeletal system disorders by means of physical education, this problem remains open and highly debatable. This is especially true for early and preschool age children with neuro-orthopedic disorders. In addition to the general methodological issues of physical rehabilitation of persons with musculoskeletal system disorders, for this category of children, specific age-related psychophysical features are significant. Children of this age category cannot be realized in the above functional approach to self-rehabilitation. In relation to them, it is necessary to transform the concept of functionality in the direction of finding correction vectors of the motor sphere on basis of the universe dual concept and the joint educational activities of the teacher and the child. This determines the relevance of our research.

Purpose of the study

The purpose is to explore the possibilities of the philosophical duality principle for its methodological and methodical transformation in relation to improving the effectiveness of physical rehabilitation of early and preschool age children with motility disorders by means of physical education.

Research methods

The basis of the research in this article are theoretical methods:

- historical method of analysis and systematization of domestic and foreign experience - used to study the degree of scientific research and determine the possibilities of practical use of the philosophical basis in developing a system of children physical rehabilitation with musculoskeletal system disorders;
- axiomatic method - used to build the phylogenetic structure of the child physical rehabilitation system and develop the theoretical foundations for overcoming motor disorders by means of physical education;
- deductive method - provides for the development of the theoretical and methodological foundations of the physical rehabilitation system of children with musculoskeletal system disorders: to form a varied methodological support for correctional physical education of a specified children contingent;
- the method of modeling the universal methodological foundation of the physical rehabilitation systems of persons with musculoskeletal system disorders for its further practical testing and verification of real effectiveness.

Findings

As it is known, any pedagogical system should be based on the fundamental principles that will create the foundation for building this system. One of such principles is, first of all, the principle of duality (dual principle) (Efimenko M., 2013). Duality is commonly understood as the duality of any state, phenomenon, process, the presence of two poles in it, reflecting the opposite of extremes.

With regard to the physical rehabilitation of children with musculoskeletal system disorders, the following main dual pairs of opposite states can be identified: Horizontal body position ↔ Vertical body position; Muscle hypotension ↔ Muscle hypertension; Muscle hypotrophy ↔ Muscle hypertrophy; Relaxation (meditation) ↔ Stress (concentration); Low starting position (posture) ↔ High starting position (posture); Body and limbs flexion ↔ Body and limbs extension; Upper body (head) ↔ Bottom body (feet); Body center (spine) ↔ Peripherals (fingers / toes); Slow Motion ↔ Fast Motion; Large muscles ↔ Small muscles; Slow isometric tension ↔ Fast isotonic contraction, etc.

For reconciliation of extremely opposite states it is necessary to present the appearance of a third state, partially flowing out of the first state, and partially reflecting the second state. In this case it is feasible to mention some kind of median or median state. In traditional philosophy, this once led to the formation of a social direction conventionally called the third way. With regard to correctional pedagogy, this approach is reflected in the principle of the trinity (Efimenko M., 2013) and its introduction to the study of this problem seems appropriate to us. “The trinity civilization is characterized by the creation of a contradiction based on dualistic thinking. This contradiction is resolved by introducing the third form. The trinity civilization mobilizes thinking to the knowledge of finer things and leads to the four-dimensional type of civilization” (Novoseltsev S., 2008, p. 92). In our opinion, this general philosophical approach can be applied to the physical rehabilitation of children with musculoskeletal system disorders. Due to this, it is necessary to determine a unidirectional motion vector in each dual pair stating from what extreme state to what other state it is essential to build a correction process. The logic of this discrete (stretched in time, interrupted) process is phylogenetically predetermined, thus it is predetermined by the process of evolutionary development.

If we take the main dual pair “Horizontal body position ↔ Vertical body position”, it is a priori clear that following the phylogenetic principle and the logic of early ontogenesis of a child, the process of physical rehabilitation, regardless of the specific nosology (cerebral palsy, spinal paresis, motor development delay or others) is supposed to be built in the following vector: from horizontal → to vertical.

Let us focus on the dual pair “Low starting position (posture) ↔ High starting position (posture)”. From the standpoint of biomechanics (bioenergy), maintaining a lower posture related to the support requires minimal energy expenditure, while maintaining high posture increases energy consumption. Summarizing the analysis of this dual pair, it can be argued that in the physical children rehabilitation the process of correcting their motor development must proceed according to the following methodical vector: from low starting positions (poses) → to the higher ones.

Let us consider the dual pair “Body and limbs flexion ↔ Body and limbs extension." From the anatomy and physiology of the child muscular system, it is known that in the first months and years of life, the flexor muscles dominate in their functioning above the extensor muscles. The infant muscle flexor tone dominates up to about 5 months, after which a certain alignment occurs due to the enhancement of the extensor muscle tone. Hence the importance of natural flexion positions and postures of the child at the beginning of the lesson (the cycle of lessons) for his physical rehabilitation. In this regard, the “embryo” posture (when the body and limbs are naturally bent), applied...
when relaxing at the beginning of a physical rehabilitation lesson, is a reference, demonstrating the phenomenon of the primacy of flexion and relaxation. Summarizing the above, we can conclude about the need to adhere to the following vector in the physical rehabilitation of children: from flexion positions (poses) and movements → to extensor.

Let us study the dual pair “Top of the body (head) ↔ Bottom of the body (feet)”. It was reflected in the well-known cephalocaudal principle (Mastyukova E., 1997) of the development of a newborn and a baby: from head movements to movements in the shoulder girdle and upper limbs, then to the formation of the muscular system of the body, then to the functioning of the pelvic girdle and lower limbs. In the process of early ontogenesis (up to 1 year) in an infant we see a similar transformation of the ways of interacting with the support: by first learning (at 1.5 - 3 months) from the prone position of reclining movements with the head and arms, the child gradually vertically aligns his position to an orthogonal two-support position based on the feet and lower limbs in general. Thus, another vector of overcoming the dual contradiction in the physical rehabilitation of children with musculoskeletal system disorders emerges: it is necessary to restore the functions of the musculoskeletal system in the sequence from the head → to the feet.

Consider the next dual pair “Body centre (spine) ↔ Periphery (fingers/toes)”. In the evolutionary process firstly there was the domination of large joints adjacent to the body which allowed fish, amphibians and reptiles to move effectively in water and on land. As new types of animals appeared, their limbs lengthened, additional biolinks appeared, the common center of mass rose higher and higher over the support. From the point of view of phylogenesis, the distal parts of the limbs were formed later than the proximal ones, which means that such an optimal sequence of maturation of the desired nerve substrate is reflected in the brain. If we talk about the crown of evolutionary creation in the form of Homo sapiens, then the presence of a five-fingered hand and the possibility of subtle instrumental manipulations of it also proves that the innervation of these movements is relatively young (i.e. formed much later than the first one) in comparison with the ancient control mechanisms of large joints by the time of their appearance. The reasoning above allows us to conclude that there is such a vector of development and correction of the child's upper and/or lower limbs as (Mastyukova E., 1997): from large nearby joints → to small distant joints, or from the center → to the periphery.

Let's continue the consideration of dual pairs: “Slow Motion ↔ Fast Motion”. As physical activity is necessary to start with lying positions, then relatively slow, “amphibian and reptiles” movements with a low location of common mass center and friction of the body and limbs on the support where the movement take place must be performed. Thus, relatively low and slow modes of movement in the form of various crawls were formed, phylogenetically they were the first on land after ocean dwelling, these various crawls still remained as the main in the ancient species that exist on earth today. In such way: in physical rehabilitation it is necessary to build a correction process from relatively slow movements (types of movement) → to relatively fast movements (types of movement).

Let's consider the dual pair “Relaxation (meditation) ↔ Stress (concentration)”. The initial impulse in the birth and development of human childhood in the womb is a meditative impulse. In the future, as it develops, this meditative state is replaced by a stress state (concentration), which is visually presented during childbirth, when the newborn experiences a psychophysiological shock during the transition from one state to another. In the future, in the period of newborn and subsequent infancy, the child is in a state of sleep most parts of the day, i.e. some kind of meditation. From the relaxed muscles the slags are easier washed out as well as the decay products of vital activity. A pre-relaxed muscle contracts better. That is why all massage treatments begin with relaxing techniques. That is why before the difficult duel the fighters relax as much as possible, accumulating energy for the fight. That is why the overwhelming number of psychotherapeutic techniques is based on the primacy of neuropsychic and physical relaxation (relaxation). Let’s draw next dual vector: from states and exercises in relaxation (meditation) → to states and exercises in stress (concentration).
Dual pair: "Large muscles ↔ Small muscles". We have already dealt with this issue in part, considering the dual vector “from the center → to the periphery”. That is where the large muscles are with a predominance of red (slow) muscle fibers in them at the center of the body. In the distal parts of the limbs (arms and legs), relatively small muscles dominate, in which white (fast) muscle fibers predominate.

The basis of this relationship is the phenomenon of a “whip” or a ballistic wave, the essence of which can be expressed as follows: the stick of the whip moves at a relatively slow speed at the backswing of the whip, and at the tip of the whip the speed is many times higher than the primary value. This is based on the principle of conservation of kinetic energy in a closed mechanical system: the greater mass is, the slower speed is, and, conversely, the smaller mass gets, the greater speed becomes. Thus, the process of physical rehabilitation should have the following vector orientation: from large muscle arrays → to small muscles.

Let’s consider one more dual pair: "Slow static tension ↔ Fast dynamic contraction." So, particularly, the main posture (standing pose in the two-support position) is provided by the muscle arrays that are large, slow and enduring to a long-term isometric mode. Different movements and motor actions take place already in the mode of predominance of fast, relatively short isotonic contractions (Myers T., 2014). Summarizing all written above, let us designate the orientation of another dual vector: physical rehabilitation should take place in the direction from slow and relatively long muscle stresses → to fast and short muscle contractions.

Another important factor in the physical rehabilitation of children is the dual pair muscle Hypotonia ↔ muscle Hypertension. It acquires special importance for the children with spastic paresis. For example, a child has a flexion spastic paresis in hands. Before starting hands training, it is necessary to relax the flexor muscles of the upper limbs, stretch them, return them to a more natural tonic state, which will improve their blood supply and, therefore, their contractile ability (Nelson A., 2008). By the middle of correctional training, it is necessary to achieve a peculiar dystonic state, when the flexor and extensor arm muscles alternate their contractions, achieving a certain equilibrium balance. In the final part of correctional training emphasis should be placed on stimulating hypertonus of the antagonist muscles (particularly the extensors), which, by the mechanism of reciprocal innervation, will automatically relax the initially contracted flexor muscles. So the physical rehabilitation process have to follow: from relaxation (which already exists) → to stress, toning which must be achieved.

A similar dual pair is muscle Hypotrophy ↔ muscle Hypertrophy. In the first case, we mean the underdevelopment of child body muscles or limbs most often caused by their insufficient nutrition and innervation due to paresis or paralysis of the central or peripheral level. Such muscle is even visually defined as less prominent, less flat and thin. The opposite state of the muscles - hypertrophy - is characterized by an increase in the volume and strength of the muscle fibers in their various ratios due to targeted and regular strength training loads. That’s why the dual vector should be directed from the state of muscle hypotrophy → to the state of muscle hypertrophy.

Conclusion
In this article we did not set the goal to consider all existing dual pairs that can be methodically implemented in the process of physical rehabilitation of children with musculoskeletal system disorders. We have shown the mechanism of the dual pair operation on some basic examples. The dual state extremes of the child's musculoskeletal system were identified and the correct orientation of the dual vector in each of the considered dual pairs was determined: from what and to what should be directed correctional and rehabilitation process by a specialist (table 1). This movement from one pole to another has a specific duration, i.e. stretched in time during one lesson as well as throughout the whole cycle of sessions, which greatly resembles a peculiar slide. Thus, the new method of physical rehabilitation appears, which we called the method of sliding along the dual spectrum.
Horizontal body position → Vertical body position
Body and limbs flexion → Body and limbs extension
Upper body (head) → Bottom body (feet)
Body center (spine) → Peripherals (fingers / toes)
Slow Motion → Fast Motion
Relaxation (meditation) → Stress (concentration)
Large muscles → Small muscles
Slow isometric tension of muscle fibers → Fast isotonic contraction of muscle fibers
Muscle hypotension → Muscle hypertension
Muscle hypotrophy → Muscle hypertrophy

References


