Original Article

Coordination abilities responsible for technical actions in martial arts at various levels of motor dichotomy of upper limbs

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Abstract.

Pronounced motor (dichotomy) of the upper limbs is manifested when performing technical actions in a certain plane, is provided by various parameters of coordination abilities, and affects the athletic performance. Aim. Theoretical analysis indicates the need to study the issue of coordination abilities that contribute to the performance of technical actions in martial arts with a different level of motor dichotomy. The article is aimed at studying the structure of coordination abilities in martial arts. Materials and methods. The study involved martial arts (Greco-Roman wrestling, judo, sambo, hand-to-hand combat, sports karate, kickboxing, boxing, etc.) athletes with four to twelve years of experience. The sample included 165 male and female athletes. Diagnosis of motor dichotomy and coordination abilities was carried out on a ten-point scale. The results of the study were processed using a parametric method for calculating the pair correlation coefficients of K. Pearson. Definitions of concepts that are relevant to the subject of this article are presented. Results. Correlation analysis revealed statistically significant coefficients in direct dependence of preference for performing technical actions with the left hand, both hands and athletic skills of athletes. Preference to perform technical actions with the right hand has inverse correlation with sportsmanship. Discussion. In martial arts, coordination ability is one of the factors contributing to the performance of technical actions by the left hand and both hands and determining sportsmanship. Right-handed, left-handed, ambidexters have a different correlation structure of coordination abilities. Conclusion. Sportsmanship is determined by the high level of coordination of movements with pronounced ambidexterity, left-handedness and, to a lesser extent, right-handedness. The dichotomy of the upper extremities in martial arts is provided by various parameters of coordination abilities, has a different correlation structure and a different effect on the athletic performance.

Keywords. Coordination, asymmetry, dichotomy, upper limbs, technique, martial arts, athletic performance.

Introduction

Coaches and athletes are particularly interested in motor symmetry/asymmetry of the upper limbs, which affects the performance of technical actions by a certain limb (Nagovitsyn, Zhuikova, Kondratiev, Osipov, Zhavner, Vapaeva, 2018), as well as coordination abilities, sports results (Boichuk R., Iermakov S., Kovtsun V., Levkiv V., Karatnyk I., 2019; Spesyvykh, Lopatenko, Polianychko, Vorobiova, Lytvynchuk, Salnykova, 2019; Eganov, Martemyanov, Yanchik, Khalabov, 2019), the effectiveness and reliability of technical actions (Lyakh, Sadowsky, 1999). Improving coordination abilities leads to a significant reduction in the time spent on learning technical actions (Nazarenko).

With an increase in sportsmanship, the dichotomy of physical development in three-dimensional space is formed ambiguously. In particular, muscle asymmetry decreases with respect to the sagittal and transversal planes and increases when it comes to the frontal plane of the lower extremities. In the upper extremities, muscle asymmetry decreases (Kozlov, Samsonova, Stepanov, 2005).

Motor dichotomy is one of the reasons for a certain lateral phenotype and imbalance of motor functions. Paired limbs demonstrate differences in supporting active movements, forming a common motor action and directing movement in a certain plane. Motor dichotomy is unstable and can change under the requirements of any activity.

Dichotomy is associated with peripheral motor activity in the early periods of body development leading to structural changes in the cerebral cortex.

There is the most common point of view on motor symmetry-asymmetry based on the anatomical asymmetry of the motor zones of the cerebral cortex (interhemispheric and functional). One of the properties of functional asymmetry is the specialization of the right or left hemisphere and their interaction. The right hemisphere is responsible for the left half of the body, and vice versa (Bragin, Dobrokhotova, 1988).

Theoretical analysis (Nagovitsyn, Zhuikova, Kondratiev, Osipov, Zhavner, Vapaeva, 2018; Eganov, Bykov, 2015; Eganov, Martemyanov, Rzaev, 2019; Zotova, F., Mavliev, F., Nazarenko, A., Zemlenukhin, I.,

Razzhivin, O., 2019) indicates the need for studying coordination abilities depending on severity of motor dichotomy of the upper limbs limiting sports performance.

Understanding the mechanism of coordination abilities opens up perspectives in the control of motor activity in sports training (Nazarenko).

Aim. The aim of the article is to study the structure of coordination abilities in martial arts, that ensure technical actions in the conditions of motor dichotomy of the upper limbs.

Materials and methods.

The data were obtained in 2015-2019 in Chelyabinsk. The study involved athletes (Greco-Roman wrestling, judo, sambo, hand-to-hand combat, sport karate, kickboxing, boxing, etc.) with experience from four to twelve years, aged 17 to 26 years. Motor dichotomy was assessed using a ten-point scale (Eganov, 2014). The sample included male ($n = 143$) and female ($n = 22$) athletes.

Motor dichotomy is the opposition of a pair of interconnected elements of motor action divided into two disjoint planes. The motor dichotomy of the upper limbs is considered relative to the sagittal plane, conditionally "dividing" the athlete's body into the right and left halves, which allows analyzing the competitive activity of the upper limbs (Eganov, Bykov, 2015).

Coordination abilities are characterized by accuracy, expediency, orderliness and coordination in space and time in accordance with the requirements of a changing situation.

The integral indicator of coordination abilities estimates the ability to accuracy, expediency, orderliness, adaptation of movements, etc. and is described in the works of A. Eganov, Yu. Martemyanov, V. Yanchik, A.O. Khalabov (2019), V. Lyakh, E. Sadowsky (1988), L. Nazarenko (2003).

The integral indicator of sports performance was determined by the absolute one-hundred-point scale (Eganov, 2014, p. 59). The results of the study were processed with the Pearson method, which determines the structure, degree and direction of relationships between motor dichotomy and coordination abilities. The calculations were carried out using Microsoft Excel.

Studying the structure of pronounced asymmetry will reveal its patterns and allow determining the direction of pedagogical influences depending on its severity.

Results

The coordination structure for performing technical actions at various levels of motor dichotomy in combat sports is presented in table 1. Analysis of the matrix revealed statistically significant coefficients manifested in direct dependence between the first and the third integral indicators ($r = 0.16$, $P \leq 0.05$), as well as the fourth ($r = 0.31$, $p \leq 0.01$) and the fifth indicators ($r = 0.22$, $p \leq 0.01$). This means that, in martial arts, coordination abilities are one of the factors contributing to the performance of technical actions by the left hand and both upper limbs or to performance enhancement.

The second indicator related to the technical preparedness of athletes has inverse correlation with the indicators of the preference for performing technical actions with the left hand ($r = -0.59$, $P \leq 0.001$) athletes' sportsmanship ($r = -0.20$, $P \leq 0.01$). This means that if an athlete performs technical actions mainly with his/her right hand, he/she rarely performs them with the left hand. At the same time, athletes' sportsmanship is not determined by pronounced right-handedness. Consequently, at the initial stages of training, with the equal possibility of choosing any upper limb, right-hand motor functional asymmetry should be formed to a lesser extent.

The third indicator has a direct relationship ($r = 0.16$, $P \leq 0.05$) with the first, the fourth ($r = 0.44$, $P \leq 0.001$) and the fifth ($r = 0.25$, $P \leq 0.01$) integral indicators. The preference for performing technical actions with the left hand is still inversely related to the preference for performing technical actions with the right hand ($r = -0.59$, $P \leq 0.001$).

Table 1. The coordination structure for performing technical actions at various levels of motor dichotomy of the upper limbs in martial arts

Preparedness of athletes	1	2	3	4	5
1. The integral indicator of coordination abilities, points	×				
2. Preference for performing technical actions mainly with the right hand, points	0.13	×			
3. Preference for performing technical actions mainly with the left hand, points	0.16	-0.59	×		
4. Preference for performing technical actions with both upper limbs, points	0.31	-0.10	0.44	×	
5. The integral indicator of sportsmanship, conv. units	0.22	-0.20	0.25	0.03	×

Note: at $n = 165$ $r = 0.15$, $P \leq 0.05$; $r = 0.20$, $P \leq 0.01$ $r = 0.26$, $P \leq 0.001$. Reliable correlation coefficients are shown in bold.

Athletes who prefer to perform technical actions mainly with the left hand should pay more attention to the development of coordination abilities. At the initial stages of training, with the equal possibility of choosing the leading upper limb, especially with pronounced or latent left-handedness or ambidexterity, it is preferable to teach technical actions to be performed with the left hand as the sportsmanship of athletes is directly dependent on the preference for performing technical actions with the left hand and inversely (less efficient) with the right hand. In some cases, an athlete should be trained to perform some technical actions with the left hand.

The fourth indicator has a direct relationship ($r = 0.22$, $P \leq 0.01$) with the first ($r = 0.44$, $P \leq 0.001$) and the third integral indicators ($r = 0.25$, $P \leq 0.01$).

The fifth indicator is directly related to the first integral indicator and inversely to the second indicator. According to the data obtained, the indicator of preference for performing technical actions with pronounced ambidexterity did not reveal a reliable relationship ($r = 0.03$, $P \geq 0.05$) with the integral indicator of sportsmanship.

Our data disagree with the results obtained by Nagovitsyn, Zhuikova, Kondratiev, Osipov, Zhavner, Vapaeva, (2018), who studied the influence of ambidexterity on sports performance of Greco-Roman wrestlers. The authors found that the asymmetry of the upper limbs is less pronounced among low-skilled wrestlers. With the growth of sports qualifications, the ambidexterity of technical and tactical actions in wrestlers can significantly improve their sports results.

The correlation structure of athletes who prefer to perform actions mainly with the right hand has eight correlations with the following parameters of coordination abilities: time differentiation of individual phases of action; quick response to the opponent's movements; time consistency of movements of body parts; accuracy of dynamic and spatial characteristics; efficiency of motor actions during contact; forecasting a motor situation; rationality of motor activity, and motor skills of the fingers.

The correlation structure of those who prefer to perform technical actions mainly with the left hand has 13 connections with the following parameters of coordination abilities: time consistency of movements of body parts; speed of motor actions during contact; quick response to a dynamic situation; maintaining stability and balance; adaptation of actions in a changing situation; stability of biomechanical characteristics; the time of mastering a new action; timeliness of the performance of motor actions in a duel; relaxation and tension of muscle groups; timeliness and adequacy of movements; the correctness of the movement; motor skills of the legs (feet) and an integral indicator of coordination abilities.

The correlation structure of athletes with pronounced ambidexterity includes all the parameters of right-handed and left-handed athletes, which total 21 correlations.

Thus, the different structure of athletes with different severity of dichotomy is obvious. First, dichotomy is provided by various parameters of coordination abilities. Second, dichotomy has a different structure for coordination abilities and a different effect on the sports result. Third, the pronounced ambidexterity of the hands requires a greater degree of development of coordination abilities.

Thus, the analysis of the coordination structure with pronounced motor functional asymmetry of the upper extremities revealed that sportsmanship is determined by the high level of coordination abilities, preference for performing technical actions mainly with the left hand and, to a lesser extent, the degree of right-handedness.

Conclusion

An analysis of coordination abilities that ensure the performance of technical actions in athletes with a different level of motor dichotomy of the upper extremities revealed that sportsmanship was determined by a high level of coordination of movements with pronounced ambidexterity, left-handedness and, to a lesser extent, right-handedness. Directional effects on strengthening left-handedness during training are a reserve for increasing the sportsmanship of athletes.

At the initial stages of training, in the presence of hidden left-handedness and ambidexterity, it is preferable to teach technical actions with the left hand. In some cases, if it is possible to choose the mainhand, the formation of left-sided motor asymmetry should be preferred. If the choice of the main hand is equally possible, the right-sided motor asymmetry should be formed to a lesser extent.

The dichotomy of the upper extremities in martial arts is provided by various coordination abilities, has a different correlation structure and a different effect on the athletic performance. The pronounced ambidexterity and left-handedness of the upper limbs requires the development of coordination abilities compared to those who prefer to perform technical actions mainly with the right hand.

A further study can be connected with developing a training methodology for targeted influence on coordination abilities in accordance with the coordination structure, on the indicators of ambidexterity, left-side asymmetry of the hands and its experimental justification.

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