

Publication date: 01.12.2023
DOI: 10.24412/2782-6570-2023_02_04_3
UDC 769.922; 612.062

EVALUATION OF ISOMETRIC EXERCISES FOR PREVENTION OF PATHOLOGICAL INSTABILITY OF THE HIP JOINT IN YOUNG RHYTHMIC GYMNASTS

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Annotation. In rhythmic gymnastics, the level of choreographic training largely depends on the natural physical qualities of athletes, where the requirements for the volume of movements in the hip joint are imposed from the moment of professional selection, with special attention being paid to the maximum amplitude of movements and the maximum external rotation in the hip joint. However, reaching extreme values of the range of joint movements increases the risk of their instability and is the cause of injury. The article considers the results of the use of special exercises for the formation of the muscle and ligament system of the hip joint and assesses the dependence of the morphological structure on the development of the functional capabilities of the hip joints of young gymnasts.

Keywords: rhythmic gymnastics, volume of movements, inversion, rotation, abduction.

Introduction. One of the factors of developing physical capabilities is the inheritable program of individual development, where interaction of inherent and acquired functional capabilities of the body's structures justify efficiency of forming motor skills [4]. The natural leg inversion, maximum abduction and external rotation of the hip joint are attributed to physical capabilities of the so-called professional suitability [1, 4]. With a proper inversion, both knees are freely moving sideways along the line of the upper arms, forming a straight line with the hips in grand plie – a full or large bend of the knees [1]. In case of insufficient inversion, hips are not fully horizontal and an unfolded angle between them is formed. Proper inversion is due to the correct position of the pelvis and depends on the morphological structure of the hip joint. Increased bend angle is an obstacle for hip rotation outward [5]. Natural ligament elasticity may help in overcoming this obstacle. External rotation in the hip joint is made with muscles and ligaments that form the joint, where the main stabilizer for external rotation and frontal movement of the hip joint is the iliofemoral ligament [1]. When estimating inversion, the main focus is put on the hip joint structure. Its structure allows to perform such movements as: extension and flexion; abduction and adduction; rotation. The cotyloid cavity and head of

the femur are the biggest and strongest joint of the human body, it is the most heavily loaded when moving [2-3]. In case of the morphologically thicker cotyloid cavity and elastic ligaments, there is a prospect for good leg inversion for gymnasts, since the opposite conditions (head of the femur that is deeply seated in the cotyloid cavity combined with hardened ligaments) do not contribute to that [3]. Such rotation is considered as pathological, and in case of passive physical efforts aimed towards bone structures of the pelvis and hip joint due to their insufficient formation, may lead to injuries and degenerative and dystrophic changes in the joints and spine. Morphological location of the cotyloid cavities influence the natural inversion. If the cavities are placed toward the front and head of the femur is deeply seated, the movement amplitude in the hip joints will be limited [5]. If the cavities are turned sideways, even if head of the femur is deeply seated, one can develop sufficient inversion. Moreover, elastic ligaments will help to achieve good hip rotation and mobility of the hip joint. Subclinical weakness of soft tissues is able to help gymnasts to achieve extreme movement range values, however there is a growing risk of their instability [1]. The aforementioned facts demonstrate relevance of using the justified approaches to choose methods of

developing inversion among young gymnasts, as well as the search of ways and forms of therapeutic and preventive measures aimed towards strengthening ligaments of the hip joint and excluding their damage.

Objective of the study – to substantiate use of special exercises in the prevention of injuries in the hip joint of young rhythmic gymnasts.

Methods and organization. The study was conducted with students of the “Severnaya Zvezda” rhythmic gymnastics sports club, February 2023 to June 2023. It included 16 gymnasts aged 7 ± 0.5 years at the beginner training level according to the sports improvement program. All gymnasts had approximately similar levels of physical qualities and physical fitness.

Main tasks of the study were: to identify the natural mobility and plasticity of the hip joints of athletes; to find morphological data contributing to performance of maximum movement volume in the joints; determining limitations of mobility and instability in the joints; evaluate effectiveness of the used therapeutic gymnastics methods on the formation of the hip joint's stability.

The study consisted of three stages: this stage included initial testing of functional capabilities defining movement volume in the hip joint. The capabilities were assessed with goniometry in an initial position of lying on the back/stomach. The following parameters were identified: maximum physiological mobility (flexion, extension, abduction, rotation), physiological abduction and rotation of the hip joint (maximum hip extension in deep squat). Functional tests that identify the hip joint's plasticity were carried out in the initial positions of standing – Trendelenburg Sign (identifying muscle ability to stabilize the pelvis), lying on the back – Patrick's (FABER) test (identification of possible dysfunction of the hip joint), lying on the stomach – Craig's Test (measurement of femoral anteversion or forward torsion of the femoral neck). At the second stage we developed and tested a set of isometric exercises aimed towards improvement of ligaments that form the hip joint.

The proposed set of exercises was performed daily, after the main training session. Isometric exercises were used when the hip joint was stationary: contraction of the muscles of the inner surface of the hip and hip abductor muscles; hip extensor and hip flexor muscles in static contraction. Dynamic exercises were also applied: hip extension in the position of lying on the stomach; hip extension in the initial position of standing on all fours; hip adduction in the position of lying on the side.

At the final stage we conducted a repeated study of functional indices of gymnasts of the studied group, and made a comparative analysis of the results before and after treatment and preventive measures.

The results of the study were processed with the math-and-stats methods: the mean values of the studied parameters, standard deviation were identified, the level of significance of the results was calculated with the Wilcoxon signed rank test if $p \leq 0.05$.

Results and discussion. Results of the study are presented in the table below.

The analysis of functional indices of young athletes revealed, that the right HJ flexion index improved by 1.7° , index of the left HJ – by 1.2° ($p \leq 0.05$). There was also an improvement in the HJ extension index: by 2° for the right and by 2.2° for the left. The HJ abduction index also improved by 0.3° for the right joint and 0.8° for the left. Values of the external HJ rotation increased by 0.8° for the right joint and 0.2° for the left. The Craig's test results revealed a significant improvement by 0.2° for the right joint and 0.7° for the left, which indicated an improved stability of the studied joints. The physiological pelvis abduction index demonstrated positive changes by 3.7° , which reflects an improved elastic ability of the hip joint's muscle and ligament system. Effectiveness of using the isometric exercises for the muscle ability of pelvic stabilization (Trendelenburg sign) is presented in a form of positive changes. The left and right HJ stabilization index improved by 0.2 cm. Identification of a possible hip joint dysfunction showed a change of initial values by 0.3 cm for the right joint and 0.8 cm for the left one, reflecting effectiveness of applied methods.

Table

Dynamics of the functional indices of studied gymnasts, $X_{\text{mean}} \pm \sigma$

Method/indices		Hip joint (HJ)		P
		right	left	
Goniometry, °				
Flexion, °	before	141.3±6.6	138.6±5.5	≤0.05
	after	143.0±5.1	139.8±6.1	
Extension, °	before	34.8±7.2	33.8±5.7	≤0.05
	after	36.8±6.1	36.0±4.5	
Abduction, °	before	58.4±7.7	56.1±5.7	≤0.05
	after	58.7±7.0	56.9±6.7	
Rotation, °	before	39.6±6.4	39.7±4.0	≤0.05
	after	40.2±4.0	39.9±3.4	
Craig's test, °	before	15.9±3.3	14.8 ±1.8	≥0.05
	after	15.7±2.8	14.1±1.4	
Deep squat, °	before	152.9±5.7		≤0.05
	after	156.6±5.6		
Plasticity tests, cm				
Trendelenburg sign, cm	before	3.4±0.8	3.1±0.6	≥0.05
	after	3.2±0.7	2.9±0.5	
Patrick's test, cm	before	8.9±2.5	8.3±2.5	≥0.05
	after	8.6±3.1	7.5±1.6	

Conclusion. Leg inversion of young gymnasts depends explicitly on morphological construction of hip joints and defines their functional capabilities. Application of therapeutic and preventive measures during training may contribute to the stabilization of hip joint,

reduce injury rate, develop functional capabilities to achieve extreme values in the joint's movement range. The use of isometric exercises is able to strengthen ligaments and enhance elasticity of the hip joint's muscle and ligament system.

Conflict of interest. The authors declare no conflict of interest.

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For citation: Kostyaeva V.V. Evaluation of the use of isometric exercises in the prevention of pathological in-stability of the hip joint in young athletes engaged in rhythmic gymnastics. *Russian Journal of Sports Science: Medicine, Physiology, Training*, 2023, vol. 2, no. 4. DOI: 10.24412/2782-6570-2023_02_04_3