Development of coordination abilities of athletes in bullet shooting as a basis for improving their technical skills

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Abstract

Background and purpose
Improving the technical training of athletes in shot put at the stage of specialized basic training using the targeted development of coordination abilities is an urgent task of modern scientific research.

The purpose of the study: to develop a methodology for the development of coordination abilities to increase the technical readiness of athletes in bullet shooting at the stage of basic training.

Material and methods
45 athletes in shot put shooting at the stage of specialized basic training of the sports school “Comunar” in Kharkov were involved in the study, of which 21 athletes made up the control group, 24 - the experimental group. To check the effectiveness of the author’s program, a pedagogical experiment was conducted, which had two repeated preparatory periods of training macrocycles during August 2022 - June 2023. The following tests were used as testing: 1 – the sum of points in the exercise “shooting while sitting on a chair”; 2 - the sum of points in the exercise “shooting while standing on the platform”; 3 – the sum of points in the “shooting with closed eyes” exercise. The following exercises were used to develop the shooters’ coordination abilities: clenching the left hand into a fist, touching the little finger of the left hand with the extended fingers of the right hand, simultaneously changing the positions of the hands; clap your hands in front and behind with each step; in walking, symmetrical hand movements for each step: sideways, up, down, forward, backward; balancing a gymnastic stick on the palm, raising and lowering the hand; catching a gymnastic stick after it rolls down the hands with and. p. horizontally on the shoulders and others. Special exercises were also used to develop shooters’ coordination abilities, such as shooting from different distances, with different target distances, with eyes closed, after performing non-specific movements (jumping, rolling, squatting, etc.). When processing the data obtained during the research, the methods of mathematical statistics were used. Standard statistical indicators were calculated - arithmetic mean, mean square deviation, error of the mean. Group mean values were compared using Student’s t-test for paired and unpaired samples.

Results
The developed program of technical training with an emphasis on the development of coordination abilities provides for an increase in the share of the volume of training loads aimed at improving the coordination abilities of qualified athletes in bullet shooting in general and special physical training, an increase in the share of training tools for the comprehensive development of various physical qualities in combined with coordination abilities, a reduction in the share of training tools for the development of maximum strength and speed-power endurance. The effectiveness of the application of the program for improving the technical training of athletes in bullet shooting at the stage of specialized basic training with the help of targeted development of their coordination abilities has been proven (p<0.01, p<0.001).

Conclusions
The developed method of development of coordination abilities of athletes in shot put contributes to increasing the level of technical preparation of athletes.

Keywords: athletes, coordination abilities, technical preparation, bullet shooting
Анотація

Жаннета Козіна, Андрій Пугач. Розвиток координаційних здібностей спортсменів в пульовій стрільбі як основа поліпшення їх технічної майстерності

Обґрунтування і мета

Вдосконалення технічної підготовленості спортсменів в пульовій стрільбі на етапі спеціалізованої базової підготовки з використанням спрямованого розвитку координаційних здібностей є актуальним завданням сучасних наукових досліджень.

Мета дослідження: розробити методику розвитку координаційних здібностей для підвищення технічної підготовленості спортсменів в пульовій стрільбі на етапі базової підготовки.

Матеріал і методи

До дослідження було залучено 45 спортсменів в пульовій стрільбі на етапі спеціалізованої базової підготовки спортивної школи «Комунар» м. Харкова, з них 21 спортсмен склали контрольну групу, 24 – експериментальну. Для перевірки ефективності авторської програми проведено педагогічний експеримент, який мав два повторюваних підготовчих періоди макроциклів підготовки впродовж серпня 2022 – червня 2023 рр. В якості тестування були використані наступні тести: 1 – сума балів у вправі «стрільба сидячи на стільці»; 2 – сума балів у вправі «стрільба стоячи на платформі»; 3 – сума балів у вправі «стрільба зі закритими очима». Заострювалися наступні вправи для розвитку координаційних здібностей стрільців: стиснення в кулак лівої руки, одночасна зміна положень кистей рук; хлопки руками спереду і ззаду під кожен крок; у ходьбі на кожен крок симетричні рухи руками: вбік, вгору, вниз, назад; балансування гімнастичної палицею на долоні, піднімаючи і опускаючи руку; ловля гімнастичної палиці після її скочування по руках з і. п. горизонтально на плечах та інші. Заострювалися також спеціальні вправи для розвитку координаційних здібностей стрільців, такі, як виконання пострілів з різних дистанцій, з різною відстанню мішені, із закритими очима, після виконання неспецифічних рухів (стрибок, кубирок, присідання, тощо). При обробці отриманих в ході дослідження даних застосовувалися методи математичної статистики. Обчислювалися стандартні статистичні показники — середнє арифметичне, середнє квадратичне відхилення, помилка середнього. Середньогрупові значення порівнювалися за допомогою t-критерія Стьюдента для парних та непарних вибірк.

Результати

Розроблена програма технічної підготовки з акцентом на розвиток координаційних здібностей передбачає збільшення частки обсягу тренувальних навантажень, спрямованих на удосконалення координаційних здібностей спортоменів в пульовій стрільбі у загальній та спеціальній фізичній підготовці, збільшення частки тренувальних засобів комплексного розвитку різних фізичних якостей у поєднанні з координаційними здібностями, зменшення частки тренувальних засобів розвитку максимальної сили та швидкісно-силової витривалості. Доведено ефективність застосування програми удосконалення технічної підготовленості спортсменів в пульовій стрільбі на етапі спеціалізованої базової підготовки за допомогою спрямованого розвитку їхніх координаційних здібностей (р<0,01, р<0,001).

Висновки

Розроблена методика розвитку координаційних здібностей спортсменів в пульовій стрільбі сприяє підвищенню рівня технічної підготовленості атлетів.

Ключові слова: спортсмени, координаційні здібності, технічна підготовленість, пульова стрільба
Introduction

Bullet shooting has now turned from a military and hunting affair [1] into an Olympic sport [2–4]. Sports shooting has gained strong positions in many countries of the world, on all continents. The improvement of the shooting technique was accompanied by a struggle of coaches' views on the choice of one or another technique [2, 4].

According to the structure of competitive activity, bullet shooting belongs to the group of complex coordination sports. Scientific studies of the training of athletes in complex coordination sports with target accuracy reveal the problems of modeling the athlete's body movements, physiological mechanisms of motor skills, psychophysiological foundations of movement formation [5–7]. The results of research [8–11] partially solve the problems of technical training in sports that require target accuracy.

The areas of improvement of technical training in bullet shooting can be the development of special physical fitness of athletes, the use of training devices, the formation of the structure and content of training loads in accordance with the sports qualifications of athletes.

One of the physical qualities is dexterity, which is based on the level of development of coordination abilities [12–15]. In complex coordination sports, it is coordination abilities that are of primary importance for improving technical preparation [16–20]. And that is why improving the technical training of athletes in bullet shooting at the stage of specialized basic training using the targeted development of coordination abilities is an urgent task of modern scientific research.

The purpose of the study: to develop a methodology for the development of coordination abilities to increase the technical readiness of athletes in bullet shooting at the stage of basic training.

Material and methods

Participants

36 athletes in shot put shooting at the stage of specialized basic training of SDYUSHOR "Comunar" in Kharkov were involved in the study, of which 17 athletes made up the control group, 19 - the experimental group.

To check the effectiveness of the author's program, a pedagogical experiment was conducted, which had two repeated preparatory periods of training macrocycles during August 2022 - June 2023.

Intervention technology

The experiment substantiated the structure and content of the author's program for improving technical readiness using the targeted development of their coordination abilities at the stage of specialized basic training.

To check the effectiveness of the developed program, a pedagogical experiment was conducted, which had two repeated preparatory periods of training macrocycles during August 2012 - May 2013.

The main components of the experiment were as follows:

- increasing the share of the volume of training loads aimed at improving the coordination abilities of athletes in bullet shooting to 35% and 45% in general and special physical training;
- increasing the share of training tools for the complex development of various physical qualities in combination with coordination abilities from 60 to 80%;
- reduction of the share of training means for the development of maximum strength and speed-power endurance from 20 to 5% and from 25 to 20%.

Exercises for the development of coordination abilities in the general physical training of shooters

1. Clenching the left hand into a fist, touching the little finger of the left hand with the extended fingers of the right hand, simultaneously changing the positions of the hands.
2. Various complex coordination of movement with hands: clap hands in front and behind with each step.
3. When walking, symmetric hand movements are used for each step: sideways, up, down, forward, backward.
4. Balancing a gymnastic stick on the palm, raising and lowering the hand; catching a gymnastic stick after it rolls down the hands with and. p. horizontally on the shoulders.
5. Acrobatic flips forward, backward, right, left, over the shoulder, after walking, running, jumping over an obstacle.
6. Balancing on a stuffed ball, maintaining balance on a moving platform lying on a log, a
stuffed ball.

7. Jumps through the hoop on two legs, alternately on the right and left leg.

Special exercises were also used to develop shooters’ coordination abilities, such as shooting from different distances, with different target distances, with eyes closed, after performing non-specific movements (jumping, rolling, squatting, etc.).

In the structure and content of the program for the development of coordination abilities of athletes, the total time of educational and training work, the duration and number of training sessions, the ratio of time of parts of a training session, the direction of technical training, the amount of technical and physical training, the proportion of training forms of competitive exercise were left unchanged.

To check the effectiveness of the author’s program, an experiment was conducted that lasted from August 2022 to June 2023.

Testing methods

The following tests were used as testing:
1 – the sum of points in the exercise "shooting while sitting on a chair";
2 - the sum of points in the exercise "shooting while standing on the platform";
3 – the sum of points in the exercise "shooting and with closed eyes"

Statistical analysis

When processing the data obtained during the research, the methods of mathematical statistics were used. Standard statistical indicators were calculated - arithmetic mean, mean square deviation, error of the mean. Group mean values were compared using Student's t-test for paired and unpaired samples.

Methods of correlation analysis were also used. The data were processed using computer programs "EXEL" and "SPSS".

Results

According to the results of the study, reliable differences were established between the indicators of the control and experimental groups, which indicated the predominant focus and effectiveness of the developed program of technical training of qualified athletes in bullet shooting.

Considering the gains in individual groups, it is possible to ascertain the positive effects of both training programs on the level of preparedness of qualified athletes in bullet shooting with the advantage of the experimental program (Table 1).

Most of the changes that occurred in the special physical fitness of the athletes of the experimental group were expected (p<0.05, p<0.01).

Both the traditional and author’s training programs turned out to be quite effective, but the main results of using the traditional program were the development of the strength qualities of qualified athletes, and the author’s program - the development of coordination abilities and strength endurance.

As a result of the formative pedagogical experiment, positive dynamics of complex indicators of the technical preparedness of athletes in bullet shooting were revealed (Table 1).

According to the results of the experiment, pronounced differences were formed in all comprehensive indicators of technical readiness between the athletes of the control and experimental groups. The dominance of athletes of the experimental group was established (p<0.05).

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<td>128.38±8.91*</td>
<td>110.52±10.23</td>
<td>142.29±16.45*</td>
<td>112.29±16.42</td>
</tr>
</tbody>
</table>

Notes: * - reliability of differences between groups; Exp. Group - experimental group, Contr. Group - control group, 1 - results of the exercise "shooting sitting on a chair, points"; 2 - results of the exercise "shooting while standing on the platform, sum of points"; 3 – results of the exercise “shooting with closed eyes, sum of points"
Discussion

To analyze the obtained results, we will consider them from the point of view of the laws of ballistics. Internal ballistics is a science that studies the processes occurring at the moment of a shot. A shot is the ejection of a bullet from the bore of a weapon by the energy of gases produced during the combustion of a powder charge [21]. The following phenomena occur when a small-arms shot is fired. As a result of the impact of the firing pin on the capsule of the combat cartridge sent into the magazine, the impact composition of the capsule explodes and a flame is formed, which occupies the powder charge. When the charge burns, a lot of highly heated gases are formed. As a result of the gas pressure on the bottom of the ball, it is displaced and hits the grooves, rotating along them, moves along the barrel channel with a continuously increasing speed, and is ejected outwards in the direction of the axis of the barrel channel.

Due to the pressure of gases on the walls of the sleeve and barrel, their stretching occurs - elastic deformation, and the sleeve, tightly pressed against the chamber, prevents the breakthrough of powder gases towards the bolt. At the same time, when a shot is fired, an oscillating movement (vibration) of the barrel occurs and its heating occurs. Hot gases and particles of unburnt gunpowder flowing out of the barrel channel following the bullet, when meeting with air, generate a flame and a shock wave; the latter is the source of sound during the shot. The shot takes place in a very short period of time, approximately 0.001-0.06 s.

When a shot is fired, four successive periods are distinguished: preliminary, first (or main), second, third (or the period of the effects of gases). The preliminary period lasts from the beginning of the burning of the powder charge until the bullet is completely embedded in the barrel grooves. During this period, gas pressure is created in the barrel channel, which is necessary to move the ball from its place and overcome the resistance 16 of its insertion into the barrel grooves. This pressure is called forcing pressure; it reaches 25-50 MPa depending on the arrangement of the grooves, the weight of the bullet and the hardness of its shell. It is assumed that the combustion of the powder charge during this period occurs in a constant volume, the bullet hits the rifling instantly, and the movement begins immediately when the forcing pressure is reached in the barrel channel.

The first (or main) period lasts from the beginning of the movement of the bullet to the moment of complete combustion of the powder charge, it occurs in a rapidly changing volume. At the beginning of the period, when the velocity of the bullet through the barrel channel is still small, the amount of gases increases faster than the volume of the bullet space (the space between the bottom of the bullet and the bottom of the casing), the pressure of the gases rises quickly and reaches its maximum value. This pressure is called the maximum pressure. It is created in small arms when the bullet travels 4-6 cm. Then, due to the rapid increase in the speed of the bullet, the volume of the bullet space increases faster than the influx of new gases, and the pressure begins to fall, until the end of the period it is equal to about 2/3 of the maximum pressure. The speed of the ball constantly increases and by the end of the period reaches approximately 3/4 of the initial speed [21].

The theoretical-methodical approaches to training and improving technique in bullet shooting are determined by the features of competitive activity and the focus on achieving the maximum result. The effectiveness of the technique is ensured by the ability of athletes in bullet shooting to reproduce and preserve the rhythmic, dynamic and kinematic characteristics of motor actions during the execution of the shot in general and in all its phases. One of the main factors that ensure the optimal formation and observance of the rhythm-tempo structure of the technique of competitive exercise in bullet shooting at various stages of long-term training are qualitative manifestations of coordination abilities against the background of the optimal development of strength qualities of athletes.

The effectiveness of the program to improve the technical training of athletes in shot put at the stage of specialized basic training with the help of targeted development of their coordination abilities is reliable (p<0.01−0.001). This is evidenced by a significant increase in performance in exercises to control complex indicators of technical readiness (results in exercises with changed performance conditions) by 1.41-24.49% at p<0.05-0.01 and optimization of shooting technique characteristics.

Conclusion

The developed program of technical training with an emphasis on the development of coordination abilities provides for an increase in the share of the volume of training loads aimed at improving the coordination abilities of qualified athletes in bullet shooting to 35% and 45% in general and special
physical training, an increase in the share of training tools for the comprehensive development of various physical qualities in combined with coordination abilities, reducing the share of training means for the development of maximum strength and speed-strength endurance from 19 to 4% and from 18 to 16%, respectively.

The effectiveness of the application of the program for improving the technical training of athletes in bullet shooting at the stage of specialized basic training with the help of targeted development of their coordination abilities has been proven (p<0.01, p<0.001).

Conflict of interest

The authors declare that they have no conflict of interest.

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