

Optimizing the methods of biathlete shooting training by means of «aiming-off» with usage of «SCATT» marksmanship trainer

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Purpose: the improvement of algorithm of biathlete shooting training by means of «aiming-off» during changing wind conditions that had been earlier developed by the authors.

Material & Methods: theoretical methods of scientific cognition and practical experimental training with utilization of marksmanship trainers were used.

Results: correction tables of hold-off during shooting under the conditions of different strength and direction of wind were developed. Elaborated algorithm of biathlete shooting training during changing wind conditions by means of «aiming-off» was optimized and divided into four stages: the objective of the first stage was to make the athlete determine the direction of hit deviation (target impact point) from the target centre at the given mutually arranged aiming devices; that of the second stage consisted in shooting training with aiming at the given target points; that of the third stage was to teach shooting at voluntary target points in playing form, and that of the fourth stage was to neutralize the interference of conventional wind. The complex of preliminary exercises providing accelerated training of «aiming-off» was presented.

Conclusions: suggested algorithm of training with usage of marksmanship trainer permits to reduce the cartridge expenditure significantly and accelerates mastering the shooting technique by biathletes under the real conditions.

Keywords: biathlon, shooting technique, training, method of «aiming-off», marksmanship trainer.

Introduction

Shooting in biathlon is carried out in the conditions of open shooting ranges therefore the set of the external forcing-down factors (the direction and wind force, temperature and humidity of air, atmospheric pressure) influences on a trajectory of a flight of a bullet [1; 2]. Temperature, humidity of air and atmospheric pressure interfere slightly when firing in biathlon as they are successfully corrected on adjustment fire before competitions or training [3]. The greatest influence on flight of a bullet from the listed above factors when shooting on a distance of 50 meters (standard conditions of biathlon) is exerted by force and the direction of wind [3; 4]. Directly the process of training in technique of shooting in the conditions of open shooting ranges is difficult because of inconstancy of wind on force and the direction [3].

The great number of authors was engaged in studying of influence of wind on demolition of a bullet when shooting from the small-caliber weapon on open shooting ranges. In particular, questions of calculation of amendments at wind, different in force and the direction, were considered in the first works on biathlon of N. G. Bezmelnitsyn [5], and later in the works of Ya. I. Savitsky [6] and V. A. Kinl [7]. W. C. Pullum and F. T. Hanenkrat [8] in shooting sport, and A. I. Kudelin [9] in biathlon were engaged in definition of the main (defining) wind site in a practical method with the use of wind installations.

And the Ukrainian experts on shooting sport came to the same conclusions theoretically with the use of mathematical calculations [10]. A. V. Pilin with coauthors studied a behavior of wind (redistribution of air streams) on a shooting range depending on force and the direction of it on an entrance to a shooting range [4]. A. I. Kudelin and P. A. Rostovtsev [11], and also T. Boyer [12] were engaged in calculations of size of carrying out of an aiming mark at different in force and the direction wind.

Traditionally shooting in biathlon is carried out with amending a sight at change of a wind situation [5–7]. And rather recently the second way when shooting during wind – «anticipation» or method of «aiming-off» began to use in biathlon [3; 11; 13; 14]. Amending a sight, in case of change of the direction and wind force, is carried out practically before each shooting, and sometimes and more than once during one shooting session. It not only increases the time spent of a sportsman for a distance, but also can lead to mistakes when amending that significantly reduces sports result of a sportsman. A number of authors consider that shooting with carrying out in practice is more effective, than preliminary amending a sight [3; 13]. In particular, according to A. I. Kudelin [15], a set of examples from practice exists when biathlons, shooting at the wind changing on force and the direction, made amendments to a sight incorrectly. Long-term practice of sports bullet shooting in field conditions from the small-caliber weapon confirms

expediency of use of shooting in the method of «aiming-off» when shooting during wind [12; 16]. Especially it concerns high-speed exercises and final series of separate types of sports bullet shooting [17].

And though shooting with «aiming-off» is widespread among «practitioners» now in biathlon, directly described a technique of training in «aiming-off» - doesn't exist. We didn't reveal it in scientific and methodical literature on biathlon and shooting sport [3; 6–8; 11; 12; 16–20] that confirms the relevance of our researches.

Research hypothesis

Training of biathlons in shooting is very problematic at constantly changing wind situation in the conditions of shooting ranges in the method of «aiming-off» as wind isn't predictable that complicates to maintain sequence of grade levels, and it is unprofitable to create especially for it the shooting ranges which are equipped with carminative installations in the financial plan. In this regard we assume that it is expedient to begin training with the use of the marksmanship trainer «SCATT», thanks to its specific properties [19; 21]. And only after training of biathlons in technique of shooting with the method of «aiming-off» on the marksmanship trainer «SCATT» it is necessary to pass to fixing of skills of shooting at wind on an open shooting range. The offered by us algorithm of training allows a sportsman and a coach to obtain quickly information which he can't quickly receive when carrying out this sort trainings on a shooting range. A sportsman copes with skill of shooting at wind in the method of «aiming-off» quicker by means of the marksmanship trainer «SCATT» and the expense of cartridges on training is reduced.

Communication of the research with scientific programs, plans, subjects

The choice of a subject of the research is carried out according to a scientific subject “2.5. Improvement of the training process in winter sports” in the specialty “24.00.01. – Olympic and professional sport” of the Consolidating plan of the research works in the sphere of physical culture and sport for 2011–2015 of the Ministry of youth and sport of Ukraine.

The purpose of the research

The improvement of the developed by authors of article earlier algorithm of training in technique of shooting of biathlons in the method of «aiming-off» at the changing wind situation.

Research problems:

1. To develop adjustment tables for shooting at wind of various direction and force.
2. To optimize algorithm of training of biathlons in shooting at the changing wind situation in the method of «aiming-off» with the use of the marksmanship trainer.
3. To improve and approve the complex of the bringing exercises providing the accelerated process of training of «aiming-off».

Material and Methods of the research

The research methods: the theoretical methods of scientific knowledge, such as supervision, generalization, the analysis and synthesis and practical trainings – experiments on marksmanship trainers. The used equipment: personal weapon of biathlons; the marksmanship trainer «SCATT» (50 m, a small-caliber rifle (5,6 mm), range to a target – 5 m, ballistic coefficient ($F=0$) were chosen in the program SCATT, in this case the hole settles is down in a point where a rifle is at the time of operation of the shock and trigger mechanism).

Results of the research and their discussion

In the previous researches [22] we made an attempt to describe the algorithm of training in methods of shooting with «aiming-off» in ideal conditions for shooting – in the absence of wind and on the marksmanship trainer «SCATT», excluding influences of the forcing-down factors on demolition of a bullet. However errors and inaccuracies were noticed in the described algorithm at its approbation in the training process that induced authors to improve the offered by us algorithm of training in technique of shooting with «aiming-off». In particular, authors considered initially that from two ways of targeting: «interpositions of aim devices and the target» and «aiming-off» it is expedient to use only the second option [22]. But practice showed that preliminary training in interposition of aim devices and the targets accelerates the process of training due to faster understanding by sportsmen where the hole on a target at different problems of a point of carrying out of an aiming deviates. The gradation of wind on counter, side and passing was the second mistake of authors. While side-diagonal wind in practice meets considerably more often, and its intervention in demolition of a bullet significantly differs both from side, and from a head or fair wind. The same mistakes are present also at the work of Ya. Romanova [14].

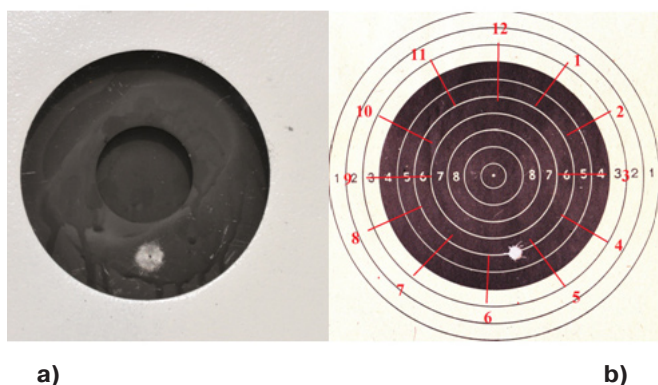
On our supervision and experiments in practice it is expediently to break all process of use of the marksmanship trainer «SCATT» into four grade levels.

The first – basic. The purpose – to teach a sportsman to define at what mutually located aim devices, in what direction a hole (a meeting point) will deviate from the center of a target. This stage is very individual as the size of a dioptrical sight, internal diameter of a ring front sight and length of the target line at athletes are very different that leads at identical statement by a coach of a task to various results of an arrangement of holes for targets. Testing of sportsmen is held on the computer training program «The mark of a shot – s dioptrical sight» at the beginning at this grade level [23]. This testing gives the answer to a question that a sportsman has acquired from a subject: «targeting».

Further it is necessary to start trainings on the marksmanship trainer at the following mutually located aim devices and a target: the front sight is pressed, but doesn't concern a target, the front sight concerns a target, the front sight «crashes» into a target on 1/2 part. A reference point – at the left-on the right, from above-from below. At the same time we try to obtain that a sportsman, «playing» by the distance «target- front sight», didn't distort an external visual ring «dioptrical sight- front sight».

When a sportsman mastered, without distorting aim devices, to aim in different points of a target and approximately began to represent where the bullet at these or those interpositions will leave «target front sight», we start *the second grade level* – shooting with an aiming in the set target points. The purpose – is to train in an aiming in the set target points with preservation of an equal «front sight» (the control of a gleam «dioptrical sight-front sight»). I.e. we change a way of targeting from the description of a relative positioning of aim devices and the target for aiming mark coordinates. The size of advantage and the direction of a hole on a target are used as coordinates.

A shooting target No. 7 is used mentally in biathlon for orientation and determination of advantage of holes on a target (it is used during the work on the marksmanship trainer and the choice of rifle exercise on 50 meters) and also the dial of a mechanical clock is imposed on it mentally. The phrase «the six on half past six» says that the bullet got to a zone of «the six» of a target number 7 from below (pic. 1a, b).



Pic. 1. Rules of the determination of advantage and the direction of a hole in biathlon:
a – the real place of blow of a bullet to a metal target; b – the visualization of a target No. 7 with the dial of hours imposed from above [3]

At the indication of an aiming mark the first figure defines a range of removal of an aiming mark from the center of a target, the second – the direction of removal from the center of a target. In the beginning we recommend to study various aiming marks across as more natural to sportsmen who got used to shoot with horizontal transfer of a weapon. The following points are chosen: four on nine (4 on 9) is a dimension of black and white on the left side of a target; eight on nine (8 on 9) is a dimension targets for shooting from situation at the left «lying»; center; eight on three (8 on 3); a dimension of black on the right (4 on 3).

The similar set of exercises with movement of aiming marks down across is carried out after the development of the set of exercises which are described above with movements of aiming marks.

For training of biathlonists in shooting «aiming-off», having high shooting qualification, it is expedient to use for targeting training tables with differentiation of aiming marks in one dimension (tab. 1).

In all exercises for high-quality performance of tasks it is necessary to control after each shot result of a shot on the screen

of the monitor of the marksmanship trainer «SCATT» – is to provide a constant feedback. For this purpose it is necessary to install the monitor so that the shooter to the monitor the cheek didn't come off a butt at transfer of a look. Besides, the control of each shot via the monitor of the marksmanship trainer «SCATT» will allow revealing a possible asymmetry of visual perception of a biathlonist.

Training in shooting at a target with a diagonal arrangement of holes from 10 till 4 hours is carried out after the development of shooting with the method of «aiming-off» at «horizontal» and «vertical». The main reason for «aiming-off» on diagonal – is the derivation phenomenon [1; 2]. At a side wind a bullet is not only taken down aside, but also lowers down (at the wind blowing in the direction «from the left») or, on the contrary, rises (at the wind blowing in the direction «on the right»). A ratio of demolition of a bullet is about three to one [3; 12]. Therefore it is expedient to study diagonal exercises in sequence: a dimension black at a target for 10 hours, a dimension of the eight for 10 hours, the center, and a dimension the eight for four hours, a dimension black at a target for four hours or in the opposite direction.

Further (*the third grade level*) various combinations of marksmanship trainer depending on the «estimated» force and the direction of wind are offered a sportsman in playful way. The criterion of quality of performance of exercises on the marksmanship trainer «SCATT» is the measure of coincidence of holes to the set aiming marks.

It is necessary to consider specifics of feature of visual perception of force and the direction of wind at a task of characteristics of «conditional» wind.

When shooting from situation «lying» the winds blowing from the directions 11, 12 and 1 of hours are perceived by a sportsman as passers, and the winds blowing from the directions 5, 6, 7 of hours are perceived as passing. In this regard winds with the directions from 11, 12, 1 hours are united in one group in tasks of sets of exercises – «passers», and winds with the directions from 5, 6, 7 hours are united in one group – «passing». Winds with the directions 2, 3, 4 of hour are perceived as «wind on the right». Winds with the directions 8, 9, 10 of hours are perceived as «wind at the left». Dependence of demolition of a bullet under the influence of different in force, but wind, identical in the direction, is presented in the works of A. A. Yuryev [16] (tab. 2).

At the same time it is considered that diagonal wind (from 2, 4, 10 and 8 hours) takes down a bullet twice smaller, than side (from 9 and 3 hours), and the fair and head wind takes down a bullet three-four times smaller [3; 12]. At this grade level the reference value F coefficients from 25 to 35 is established on the marksmanship trainer «SCATT». The table of approximate «aiming-off» is presented in tab. 3.

The criteria for evaluation of performance of each task (a series of shots) is the measure of compliance of average points of hit to the set aiming marks and an accuracy of hits («shooting diameter» – an indicator which is used in the program of marksmanship trainer «SCATT») as well as when performing exercises of shooting with movement of aiming marks at diagonal.

And at the last *fourth grade level*, the weapon of a sportsman

Table 1

Diameters and radiuses of dimensions, distances in dimensions from the center of a target No. 7

Indicators	The serial number of dimension of a target No. 7									
	10	9	8	7	6	5	4	3	2	1
Dimension	10	9	8	7	6	5	4	3	2	1
Diameter of dimension, mm	10,4	26,4	42,4	58,4	74,4	90,4	106	122,4	138,4	154,4
Radius of dimension, mm	5,2	13,2	21,2	29,2	37,2	45,2	53,2	61,2	69,2	77,2
Distance from the center, in dimensions	0,7	1,7	2,7	3,7	4,7	5,7	6,7	7,7	8,7	9,7

Table 2

Deviation of bullets when shooting from a small-caliber rifle under the influence of a side wind (according to A. A. Yuryev, 1962)

Range of shooting, m	Deviation of bullets, mm		
	Weak wind (2 m·s ⁻¹)	Mild wind (4 m·s ⁻¹)	Strong wind (8 m·s ⁻¹)
50	15	30	60

Table 3

The table of «aiming-off» under a condition «adjustment fire in calm (calm) – shooting at wind of various direction and force»

Force and direction of wind	«Aiming-off» at various wind					
	Passer (from half past 12 till half past 1)	Side from the right (c from half past 3 till half past 4)	Side-diagonal from the right (from half past 1 till half past 3 and from half past 4 till half past 5)	Passing (с 5 до 7 часов)	Side from the left (from half past 9 till half past 10)	Side-diagonal from the left (from half past 7 till half past 9 and from half past 10 till half past 12)
Weak, 2 m·s ⁻¹	–	9 on 3	–	–	9 on 9	–
Mild, 4 m·s ⁻¹	9 on 12	7 on 4	9 on 3	9 on 6	7 on 10	9 on 9
Strong, 8 m·s ⁻¹	8 on 12	4 on 4	7 on 4	8 on 6	4 on 10	7 on 9

is brought to the center of a target «SCATT» (adjust on the center) and, imitating different in the direction and wind force of a condition, make amendments to aim devices, as if wind takes down a bullet. A task of a sportsman to carry out when shooting the «aiming-off» so what, counteracting amendments, the center of a target was struck.

After the coping of exercises by a sportsman on the marksmanship trainer it is recommended to repeat the second or fourth grade level in field conditions in windless weather.

Conclusions

1. The developed by us earlier [22] algorithm of training of biathlonists in shooting is optimized at the changing wind situation by the method of «aiming-off» with the use of the marksmanship trainer. Methodical mistakes on targeting and technical mistakes are considered in new algorithm at interpretation of size and the direction of wind. The new algorithm of training is successfully approved by us in a training practice.

2. The presented set of exercises on the marksmanship trainer accelerates the process of training of biathlonists in shooting in the method of «aiming-off» in actual practice.

3. At all grade levels it is expedient to use the marksmanship trainer not only as a supportive application of training, but also as means of an operating control of formation of skill of shooting in the method of «aiming-off».

4. It is offered to use the developed tables of «aiming-off» for simplification of process of training of biathlonists in shooting at wind of various direction and force.

5. It is necessary to pass to fixing of skills of shooting at wind on an open shooting range after training of biathlonists in rules of shooting with «aiming-off» on the marksmanship trainer.

The offered by us technique allows creating a representation at biathlonists at what mutually located aim devices in what direction the hole will deviate the center of a target, and to teach a sportsman to neutralize wind influence in the method of «aiming-off».

Prospects of further researches in this direction. Further the development of a technique of improvement of technique of shooting with «aiming-off» is supposed which is including special shooting trainings in field conditions and correction of mistakes with use of the marksmanship trainer «SCATT».

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