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The Effect of the Quiet Eye Training on the Gaze Control in Pistol Shooters: Randomized Control Trial

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Original Article

Abstract

Introduction: The aim of this study was to investigate the effect of quiet eye training on gaze control in pistol shooters.

Materials and Methods: This study was a controlled clinical trial in which 20 shooters with an average age of 22 years and a record of 545-555 m were selected using the purposive and convenience sampling method and assignied to two groups of quiet eye and technical training (10 people in each group) using the ranked pre-test scores (ABBA method). The participants performed the pre-test, post-test, and retention tests. The quiet eye test of the training group was performed with the elite shooter pattern along with verbal instructions in eight sessions and six blocks of 10 consecutive shots. Data was analyzed through independent t-test, repeated measures analysis of variance (ANOVA), and Bonferroni post hoc test ($\alpha = 0.05$).

Results: The mixed ANOVA test results showed that for the variable of the total duration of quiet eye, the main effect of the stage, the main effect of the group, and the interactive effect of the stage and the group were significant (P = 0.001); Only the effect of group (P = 0.002) was significant for the variable of onset. Regarding the quiet eye offset variable, the main effects of the stage and the group and the interaction effect of the stage and the group (P = 0.001) were significant. Repeated measures ANOVA indicated that changes in quiet eye timing were significant for the quiet eye training group (P = 0.001). Given the result of the Bonferroni post hoc test, the quiet eye training group in the post-test (P = 0.001), retention (P = 0.003), and post-test and retention (P = 0.001) stages compared to that of the pre-tests had longer total duration and offset of quiet eye. The esults of the independent t-test of quiet eye training group in the post-test (P = 0.004) and retention (P = 0.002) and post-test and retention (P = 0.001) stages compared to the technical training group had better total duration and offset of quiet eye.

Conclusion: Quiet eye training may influence proper timing of quiet eye through external visual attention and improve the gaze control of pistol shooting skills.

Keywords: Quiet eye training; Gaze; Shooting

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Introduction

To perform movements accurately, the motor system needs accurate and timely information about the environment and the task. In fact, visual inputs provide the individual with the information needed to perform the movement in an environment with specific conditions (1). The eyes, as one of the most trusted sensory organs of the individual, are constantly active in daily activities and sports activities, especially in shooting. About 40% of visual energy is spent on the operation of the eye and the visual center (2). In many sports, skilled players need to focus only on necessary and relevant information resources and use a skilled search pattern (recognizing when and where to look) in order to improve and enhance performance (3). Thus, visual skills enable champions of any level of ability to quickly and accurately detect and process visual information, and this is the first step in preparing the

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body for a proper response during the competition and an important component of skills with a high perceptual-cognitive requirement like shooting (4,5). This ability is very important for shooters, especially in the sport of pistol shooting due to time constraints; Because the shooter, in addition to maintaining balance and the ability to hold the weapon with one hand, must use the visual system to maintain the targeting elements in the targeting space and to determine the trigger release time to function properly (6,7).

Reaching the elite stage in pistol shooting, like other areas that require temporal and spatial perception needs, requires the practice of a set of modified perceptual-cognitive skills (8) so that the athlete be efficient in both areas (9,10). Thus, practicing the cognitive and perceptual elements of a motor skill, just as much and even more than actually performing a motor pattern, can be effective in achieving high levels of skill (11). It is said that each of these performance indicators can have a different effect on visual skills (12).

One of the subsets of cognitive function is visual function, which can be assessed by measuring several visual skills, including the quiet eye skill, and a perceptual-cognitive benefit associated with peak performance in targeting tasks and scheduling in skilled performers which refers to a specific gaze behavior, i.e. the last fixation of the eye before the start of movement during exercise (9). Before the onset of moving in the quiet eye, a relatively long final fixation takes place on the related task target or spaces in the field of vision. This fixation is maintaining a fixed gaze in the range of one to three degrees from the viewing angle for 80 to 150 milliseconds, which allows for the information to be processed (8). The quiet eye consists of three components: “quiet eye onset, quiet eye offset, and quiet eye duration”. The beginning of the last fixation of vision on the target is called the quiet eye onset, and when the last fixation deviates from the target, it is known as the quiet eye offset. The time interval between the quiet eye onset and offset is called the quiet eye duration (9). During this period, sensory information is combined with the necessary mechanisms for the simultaneous scheduling and controlling in order to create an appropriate motor response. Findings of studies show that both factors of earlier onset and longer duration of quiet eye are associated with high levels of expertise and performance (9-12). The quiet eye represents the time required to organize neural networks and visual indicators responsible for directing and controlling visual attention in order to schedule the next response components (13). Thus, quiet eye is a perceptual-action variable (14) and with increasing the quiet eye duration, accuracy and expertise are improved; this organization takes place through gaze control and attention control (15).

In order to properly understand the environment, the images require to be placed in the center of vision through purposeful movements of the eyes, head, and body, which is called gaze control (9,12). Due to the suppression of information during saccades, the visual search strategy, the use of fewer and longer fixations, is more efficient (13) and by paying attention to the fixation points, leads to inhibition of the visual system of movement (decrease in the amplitude and acceleration of saccades) (12). Thus, quiet eye, as a key predictor of efficient performance in scheduling and targeting tasks, can be learned through the practice of optimal motor control and focusing on the target, thus contributing to better performance and accelerating learning in the targeting skills (15). The results of investigations have suggested that the duration of the quiet eye exercises based on the modeling of eye movements of a skilled person has a positive effect on learning and performance (15-18). Hence, it seems that the key to success in many skills, such as pistol shooting, in which time and space accuracy are of paramount importance, is to increase the gaze and quiet eye time. Studies using eye movement tracking systems in these types of skills (5,14,16) have shown that quiet eye exercises improve skills by controlling attention for proper planning for better response (19). This is especially important in sports such as archery and darts, which require optimal movement control and focus on the target (20).

Given the recent research, quiet eye can be considered as a sensitive period in which sensory information is combined with the necessary mechanisms to preschedule and control proper motor response (21). For example, in rifle shooting, in which the movement time is very short, the quiet eye duration can indicate the pre-planning of movement (22). In other words, the quiet eye, as part of a program, helps the person to focus on an object such as a ball before performing the movement; While in ball-hitting skills such as golf, the quiet eye offers both simultaneous pre-planning and control functions (23). Numerous studies have been performed to investigate the role of the quiet eye, which can include the following:

In a study, the quiet eye behavior in military rifle shooters was examined and the results indicated that in elite shooters compared to novice shooters, the quiet eye onset, quiet eye offset, and quiet eye duration were faster, later, and longer, respectively, and the shooter after matching visual elements, by

focusing on the foresight of the weapon, began to gaze earlier than the novice shooter, which was until the moment before the trigger of the weapon was released. In addition, the gaze duration from the time the trigger was released to the completion of the shooting operation, was longer in the elite military shooters (6). In fact, they matched the elements of vision, including the aperture, the foresight, and the black spot faster, and gained better time to aim and release the trigger. In another study, the quiet eye behavior was examined in basketball players' jump shots and it was found to be longer in successful attempts compared to unsuccessful attempts in basketball jump shots (14). These findings support the quiet eye role in responding to information planning and processing; So that in all studies, the task is targeting tasks, gaze function, and attention system, determining the position of the target in the environment, and controlling the targeting of the object in the target area (11,13,18,20).

Targeting tasks are divided into three sub-categories; "gaze controlling for fixed targets, abstract targets, and moving targets such as shooting at flying targets, in which an object is often thrown outward of the body with the hands or feet toward the target, in which accuracy and consistency of performance are the ultimate goal (24). In these tasks, the focus is on the most vital part of the goal and the information acquisition time is important, in addition, the optimal coordination between the gaze and targeting movements leads to optimal performance (25). In order for these tasks to be performed accurately, the visual space must be interpreted and translated, complex patterns must be identified, and an optimal sequence of the gaze behaviors must be formed in specific environments and goals before targeting. This optimal sequence of gaze behavior before targeting implies pre-programmed control of these tasks (24).

One of the special tasks in targeting in pistol shooting is eyesight and visual skills in shooting, and the sense of sight is responsible for the correct guidance of the arm and hand towards the path; So that the foresight and the aperture are placed in the target space correctly (14). Therefore, time and focus are points to be able to do this for a longer period of time, and the eyes need to have a certain tolerance and try to divide the sharpness among the foresight, the aperture, and the black spot of the target, and this action will not be possible without gaze control (26). Therefore, it is necessary to improve the focus on targeting before firing, but given that the foresight is one of the middle components of the visual elements, which is clearly visible and reflects the position of the hand, it is considered as a clear point of view for pistol shooters (27) and it is very difficult to have a proper gaze control and sufficient focus to reduce visual error when aiming to improve performance for a long time. That is, focusing on the target for about 4 to 6 seconds, and for 50 to 90 shots at the target in practice, requires very sharp and diligent eyes (6) and during the execution of an accurate shot in each firing rhythm (3 to 20 seconds), the eyes not only should not change their adaptation, but they also have to change the focus at the same time and continuously so that they can monitor the elements of vision and their movements (27).

At this time, parts of the firing process that are fully recorded through the eyes are likely to cause the shooter to hesitate at the time of shooting (14). Therefore, the pistol shooter needs programmed exercises that can systematically and automatically optimize vision. Therefore, the present study was conducted according to the principles of quiet eye exercises (using patterning along with verbal instructions) used in previous studies (9,24) and with the aim of modifying these exercises based on the characteristics of pistol shooting skills. The present study sought to answer the question of what effect the designed quiet eye exercises have on the gaze control of pistol shooting?

Materials and Methods

This study was a controlled clinical trial performed as pre-test, post-test, and retention with two groups of quiet eye exercises and technical exercises and was cross-sectional and applied taking into account the length of time. Participants in the study consisted of 20 male and female shooters ranging in age from 18 to 26 years (mean age 22 years). After completing the consent form, among 60 male and female 10-meter pistol shooters present in the national competitions (Premier League, national championship, and freestyle), based on previous studies (2) and skill level, as well as the limited sample size, 20 people were selected using the purposive and convenience sampling method based on the pre-test scores (ABBA method) and were divided into two groups of quiet eye (n = 10) and technical exercises (n = 10). The study inclusion criteria included a record of 545-555 meters, normal vision, and aligned eyes and hands: dominant right. Irregular attendance at the training sessions and not practicing completely were also considered as the exclusion criteria that were examined by the researcher. All study participants used personal pistol shooting equipment that they always practiced with. The study was approved with

the ethics code IR.SSRI.REC.1398.132 in the research ethics committee of the Research Institute of Physical Education and Sports Sciences. Moreover, the study project was registered in the Iranian Registry of Clinical Trials (IRCT).

In the present study, all data related to the recording and the quiet eye were presented digitally and automatically through the SCATT USB system (ST4-12, SCATT, Russia) and the visual tracking device. Before performing the pre-test and in accordance with the previous coordination with the Islamic Republic of Iran Shooting Sports Federation (ISSF), first, the quiet eye performance of the elite pistol shooters was examined and recorded by the visual tracking system on the eyes of 5 pistol shooters, who were members of the national team. In the first session, in order to check the score, infrared light was sent and received by the receivers installed on the target using the SCATT system, and the data was recorded and stored in the computer via cable at the time of aiming through the optical sensor installed under the pistol barrel. Simultaneously, the subjects' gaze points during each attempt were assessed by the Pupil vision tracking system (Pupil Eye Tracking USB model, Pupil, Germany) at a speed of 60 frames per second, 1 degree visual acuity (VA), and a resolution of 1280 x 720 pixels per inch in Pupil Player software and using a reference plane, for each subject, the gaze points were recorded as three points on the pistol target in the shooting position and its information was recorded via cable and stored in the computer. Furthermore, at the same time with the vision tracking system, a SONY camera (DSC-HX200V, SONY, Japan) with a capability of 60 frames per second was used to record the quiet eye onset in each attempt, which in each test, 10 attempts were recorded separately for each shooter in coded files.

The participants in the morning time attended the Olympic Shooting Hall of Isfahan Province, Iran, and each shooter performed 10 attempts for 10 minutes as a pre-test. This number was chosen based on the number of shots in the rounds defined by the International Shooting Sport Federation (ISSF) (10 shots per round). The method of participating in the quiet eye exercises was explained and performed on one of the participants in the quiet eye group. In the quiet eye group, while the shooters were asked not to participate in any shooting exercises other than the quiet eye training, each shooter performed the quiet eye training in accordance with the pattern obtained from the elite shooter pattern through watching the video with verbal instructions in 8 consecutive sessions in 6 blocks of 10 minutes; so that in each block, the participant was present at the previously specified time at the training site and performed 10 attempts for 10 minutes in each block and similar to the test conditions under the supervision of the researcher (24), which in total, each shooter performed 480 attempts. The technical training group also performed their usual training, including dry training (without bullets) and training on training targets, based on the amount of time and sessions similar to those of the quiet eye training group under the supervision of their coach and in a separate time from that of the quiet eye training group. Immediately after the training, a shooting post-test was taken as an acquisition test and after 24 hours, a retention test was taken (20).

Descriptive and inferential statistics were used to examine the raw information, which included the mean and standard deviation (SD) indicators, tables, and graphs to express descriptive information related to the study variables. In the inferential statistics section, the compliance of the data distribution with the normal distribution was examined by the Shapiro-Wilk test. Independent t-test, combined analysis of variance (ANOVA), and repeated measures ANOVA and Bonferroni post-hoc tests were employed to analyze the study hypotheses. The quiet eye variable is a type of visual fixation and consists of the two parts onset and offset, as well as the duration. The onset and offset include from the moment of gazing to before movement and from the beginning of movement to the end of staring, respectively. The sum of these two variables includes the gazing duration (16). The effect size was displayed with Cohen's D. All statistical calculations were analyzed in SPSS software (version 20, IBM Corporation, Armonk, NY, USA) and $P < 0.05$ was considered as the significant level.

Results

All participants completed the steps and their records were finally analyzed. Therefore, the adherence rate of the participants in the present study was 100% and there was no decline, thus, the Intention-to-treat (ITT) test was not performed. Demographic information such as age, shooting history, and gender of the subjects are presented in table 1.

Table 1. Demographic information of the subjects

Variable	Group	Mean ± SD	P
Age (year)	Quiet eye training	21.00 ± 2.35	0.070
	Technical training	22.90 ± 2.18	
Shooting history (year)	Quiet eye training	4.50 ± 1.50	0.640
	Technical training	4.80 ± 1.31	
Gender	Quiet eye training	6 men and 4 women	0.630
	Technical training	7 men and 3 women	

SD: Standard deviation

Table 2. Average quiet-eye performance of pistol shooters

Variable	Group	Pre-test	Post-test	Retention
Total quiet eye duration	Quiet eye training	1779.80 ± 256.77	3702.50 ± 1137.50	3562.40 ± 1004.29
	Technical training	2018.88 ± 418.44	2394.23 ± 567.63	2081.30 ± 752.31
Quiet eye onset	Quiet eye training	1358.94 ± 191.01	1182.15 ± 155.61	1485.17 ± 122.34
	Technical training	1513.39 ± 260.09	1665.32 ± 375.97	1566.71 ± 511.77
Quiet eye offset	Quiet eye training	420.88 ± 142.32	2520.35 ± 1093.24	2077.22 ± 975.81
	Technical training	505.44 ± 225.07	728.91 ± 274.42	524.55 ± 288.70

Data are reported based on the mean ± standard deviation (SD).

The normal distribution of data was examined using the Shapiro-Wilk test and the results showed that the data distribution followed the normal distribution ($P < 0.05$). The mean values of the quiet eye variables in the pre-test, post-test, and retention stages is presented in table 2.

For the quiet eye duration variable, the results of the combined ANOVA test with acceptance of the Mauchly's test of sphericity ($P < 0.050$) in table 3 indicated that the main effect of the stage, the main effect of the group, and the interaction effect of the stage and group were significant. For the quiet eye onset variable, only the group effect was significant ($P = 0.001$), but the effects of the stage and the stage and group interaction were not significant. For the quiet eye offset variable, all three main effects of the stage and the main effect of the group and the interactive effect of the stage and the group were significant (Table 3).

The results of the Bonferroni post hoc test to determine the inter-group differences in the quiet eye onset variable showed that the technical training group had significantly higher quiet eye onset than the quiet eye training group (mean difference = 236.38, $P = 0.020$).

Given the significance of the interactive effect in the two variables of the total quiet eye duration and the quiet eye offset, the main effects were omitted and the post hoc tests were performed for the interactive effect by adjusting the level of significance to prevent type I error. Thus, for each of these variables, the two tests of repeated measures ANOVA (Table 4) and Bonferroni test (Table 5) to observe the trend of changes in each group in the study steps and also, the three Independent t-tests (Table 6) to see the differences between the two groups were performed in each step (the Bonferroni post hoc test showed only the main effects of the differences, not the interactive effect, and therefore it was necessary to perform a t-test based on the study design with α modulation). The adjusted significance level was considered 0.010. By performing an additional post hoc test, α is adjusted to prevent type I error; For example, for 5 additional tests, α is divide by 5, and this is a principle in statistics.

The results of the repeated measures ANOVA test assuming the Mauchly's sphericity ($P > 0.050$) to observe changes in the quiet eye duration and offset of the study groups from the pre-test to retention revealed that these changes were significant for the quiet eye training group, but not significant for the technical training group (Table 4).

The Bonferroni post hoc test results indicated that in the post-test and retention stages, the quiet eye training group had significantly longer quiet eye duration and offset compared to the pre-test stage. No significant difference was observed between the post-test and retention stages (Table 5).

Table 3. Results of combined analysis of variance (ANOVA) test to investigate the main and interactive effects of the stage and group of onset, offset, and duration of quiet eye of shooters

Variable (milliseconds)	Source of changes	Degrees of freedom	F statistic	P	Effect size (Cohen's D)
Total quiet eye duration	Effect of stage	2	15.23	*0.001	0.45
	Effect of group	1	14.58	*0.001	0.44
	Interactive effect of stage × group	2	9.22	*0.001	0.33
Quiet eye onset	Effect of stage	2	0.77	0.470	0.04
	Effect of group	1	6.55	*0.020	0.26
	Interactive effect of stage × group	2	3.25	0.060	0.15
Quiet eye offset	Effect of stage	2	19.83	*0.001	0.52
	Effect of group	1	38.15	*0.001	0.67
	Interactive effect of stage × group	2	14.39	*0.001	0.44

*Significance at the level of $P \leq 0.050$

Table 4. Results of repeated measures analysis of variance (ANOVA) test to examine the intra-group differences of quiet eye duration and offset in different stages

Quiet eye scheduling (milliseconds)	Group	Indicators	Degrees of freedom	F statistic	P	Effect size
Quiet eye duration	Quiet eye training	Conditions	2	15.28	*0.001	0.62
		Error	18	-	-	-
	Technical training	Conditions	2	1.83	0.180	0.16
		Error	18	-	-	-
Quiet eye offset	Quiet eye training	Conditions	2	17.73	*0.001	0.66
		Error	18	-	-	-
	Technical training	Conditions	2	4.55	0.020	0.33
		Error	18	-	-	-

*Significance at the level of $P \leq 0.010$

Additionally, the Independent t test results for the two variables of the quiet eye duration and offset showed that there was no significant difference between the groups of quiet eye and technical training in the pre-test stage, however in the post-test and retention stages there was a significant difference between the two groups; Thus, the quiet eye training group showed a higher quiet eye duration and offset than the technical training group (Table 6).

Discussion

The aim of the present study was to investigate the effect of quiet eye training on gaze control in pistol shooters. The quiet eye can be used as an educational tool to improve gaze control in various targeting sports, which shows a clear correlation between quiet eye and gaze control (16). Findings regarding the effect of quiet eye training on gaze control of pistol shooters suggested that quiet eye training decreased the quiet eye onset and also increased the quiet eye offset and the total quiet eye duration. The results were consistent with the findings of previous studies (17,20,24,29). Before discussing the effect of quiet eye exercises, it is necessary to explain the role of quiet eye duration scheduling on performance. Accordingly, not only is the quiet eye duration important for performance, but the ratio of its functional aspects (onset and offset) is also important in relation to performance (6,23,30). The optimal quiet eye onset and offset has a greater effect on performance than the longer quiet eye duration (21), but the length of the long quiet eye duration is effective when it has a faster onset compared to a later offset (31); This means that in a given quiet eye, when the offset part is longer than the onset, it has a greater effect on performance. In this context, Vickers considered five perceptual-motor characteristics for the quiet eye, including the quiet eye location (related to spatial awareness), the quiet eye onset (related to selective prediction and attention), the quiet eye motor stage (related to perceptual-motor coordination), and the quiet eye offset (related to the use of feedback), and the quiet eye duration (attention and concentration) (9); how the change of each of these components is very important on motor behavior (25).

There is a strong association between eye movement and programming networks, and it may be important in the quiet eye duration (32) and the importance of understanding quiet eye mechanisms provides more knowledge of behavioral and neural mechanisms and productivity enhancement strategies by skilled athletes. Moreover, the formulation of more efficient training protocols to improve the direction of movement not only in exercise, but also in other cases such as surgery and among the population of clinical patients such as children, will facilitate with coordination the development of disorders and stroke survivors with coordination (9,33).

As the study by Miles et al. showed, the quiet eye training is effective on the performance and learning of throwing and receiving in young children (34).

Table 5. Results of Bonferroni post hoc test to evaluate the differences in total quiet eye duration and offset between the study steps of the quiet eye training group

Quiet eye scheduling (milliseconds)	Step (i)	Step (j)	Mean difference	P
Total quiet eye duration	Pre-test	Post-test	-1922.68	*-0.003
		Retention	-1782.57	*-0.001
	Post-test	Retention	140.11	0.990
Quiet eye offset	Pre-test	Post-test	-2099.47	*-0.001
		Retention	-1656.34	*-0.001
	Post-test	Retention	443.12	0.970

*Significance at the level of $P \leq 0.010$

Table 6. Independent t test results to examine the differences between total duration and offset of the quiet eye between the two quiet eye and technical training groups

Quiet eye scheduling (milliseconds)	Step	Degrees of freedom	Mean difference	T	P
Quiet eye duration	Pre-test	18	-239.01	-1.54	0.140
	Post-test	18	1308.27	3.25	*0.004
	Retention	18	1481.12	3.73	*0.002
Quiet eye offset	Pre-test	18	-84.56	-1.00	0.320
	Post-test	18	1791.44	5.02	*0.001
	Retention	18	1552.67	4.82	*0.001

*Significance at the level of $P \leq 0.010$

Therefore, it can indicate the effect of quiet eye exercises on proper and timely scheduling and performance of the quiet eye (31); as the duration of the quiet eye increases, accuracy and expertise improve (2). Furthermore, increasing the quiet eye duration in successful attempts rather than more unsuccessful attempts, can be one of the factors required for an athlete who wants to achieve a higher level of skill (2,23). Besides, it has been shown that allocating attention to fixation points leads to inhibition of the visual-motor system (reduction in amplitude and acceleration of the saccades). Thus, active fixation on points leads to the allocation of attention to that point and disregard for environmental situations (9); So that the fixation time before performing a movement as one of the quiet eye strategies, expresses the difference between motor skills, specialization, and execution in precise motor tasks (24). However, optimal gaze control in the selection of accurate cues, optimal timing, and the ability to focus attention for a long time are among the requirements of shooting skills that confirm the results of the present study and their consistency with previous studies (16). Another argument in support of the present study findings is that the quiet eye may be part of a pre-performance routine to help the performer focus on what they can control (a performance-related external cue) (29). Therefore, quiet eye training is a practical technique to guide the external focus of visual attention and guide its timing in relation to important movements (motor vision control) (18); So that the quiet eye affects motor performance by facilitating information processing and can lead to increased accuracy and performance in a targeting task. Thus, it seems that quiet eye training causes the person to focus on important stimuli that underlie optimal performance (12).

The results of the study by Moore et al. on the effect of quiet eye training on the performance and kinematics of novice golfers' stroke suggested that the group with quiet eye training had longer and more efficient quiet eye duration in golf stroke (lower acceleration). Further analysis also indicated that only the stroke acceleration could explain the difference between the control group and quiet eye training performances, which is also the case in weapon kinematics and aiming. Therefore, they argued that a threshold of the quiet eye duration may explain the relationship between function and quiet eye duration (18); Although there is a significant difference between motor maneuvers leading to golf throws and pistol shooting, in their view, a quiet eye threshold may explain the lack of correlation between performance and quiet eye duration (18). Therefore, if the quiet eye does not have the desired threshold, it may not be able to increase the duration of the quiet eye and consequently improve performance. It seems that the quiet eye in the present study has reached the desired threshold, which has been able to significantly increase the record.

Limitations

Lack of control of sleep and nutrition of the subjects was one of the most important limitations of the present study. The subjects' sleep timing could not be controlled as each subject had a unique sleep time. One of the factors affecting performance is the nutrition that in the present study, the type of nutrition of the subjects could not be controlled.

Recommendations

Given the results of the present study, which showed that quiet eye training can have a positive effect on the gaze control of shooters and, consequently, have more appropriate control on the weapon at the moment of targeting, it is suggested that trainers use this type of vision training and this perceptual feature in the preparation of training protocols as well as talent identification in targeting skills.

Conclusion

The outcomes of the current study revealed that quiet eye training can have a positive effect on improving the gaze control of shooters, and since quiet eye is an influential factor in better performance in most

aiming sports and with lower dynamic conditions such as pistol shooting, it helps the shooter to perform movements more efficiently in the fixed aiming task and, consequently, to have better control at the targeting moment.

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Authors' Contribution

Jaleh Bahramian-Dehkordi: study design and ideation, attracting financial resources for the study, data collection, providing study equipment and samples, analysis and interpretation of results, specialized statistics services, manuscript preparation, specialized manuscript evaluation in terms of scientific concepts, final manuscript approval to be submitted to the journal office, responsibility of maintaining the integrity of the study process from the beginning to the publication, and responding to the referees' comments; Saleh Rafiee: study design and ideation, study support, executive, and scientific services, manuscript preparation, specialized evaluation of the manuscript in terms of scientific concepts, final manuscript approval to be submitted to the journal office, responsibility of maintaining the integrity of the study process from the beginning to the publication, and responding to the referees' comments: Jaleh Bagherli: study support, executive, and scientific services, manuscript preparation, specialized evaluation of the manuscript in terms of scientific concepts, final manuscript approval to be submitted to the journal office, responsibility of maintaining the integrity of the study process from the beginning to the publication, and responding to the referees' comments; Seyed Mohammadkazem Vaezmousavi: study design and idea generation, manuscript preparation, specialized evaluation of manuscript in terms of scientific concepts, final manuscript approval to be submitted to the journal office, responsibility of maintaining the integrity of the study process from the beginning to the publication, and responding to the referees' comments.

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Conflict of Interest

The authors do not have a conflict of interest. Jaleh Bahramian-Dehkordi personally funded the basic studies related to this study and has been studying as a PhD student in motor behavior (motor learning branch) at the Central Tehran Branch, Islamic Azad University since 2016.

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