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The Effect of Quiet Eye Training on the Gaze Behavior and Performance of Volleyball Service

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ABSTRACT

Background: Until now, many researches have shown the effect of quiet eye (QE) training on motor behaviors have been investigated. The aim of this study was to evaluate the effect of QE training on gaze behavior and performance improvement in volleyball service.

Methods: Eighteen male students of the University of Tehran with an age mean of 22±2 participated in this study and were randomly divided into two groups of QE and traditional training. This research was conducted in three stages: pre-test, post-test and retention test. At the beginning, a professional volleyball player was asked to perform a number of volleyball services, and the gaze points and their duration were obtained using eye-tracking glasses. In addition, he was filmed from a side view using a camera. In the next stage, at the pre-test, participants in both groups were told to send 10 simple services. At the same time, their gaze points were recorded using eye-tracking glasses. We also used the Russell Long service test (RLST) to evaluate the accuracy of the services. In the acquisition phase, in three sessions, the traditional training group practiced only the service, but the QE training group practiced QE training. In the post-test, their gaze points were recorded again using eye-tracking glasses, and the accuracy of their services was evaluated by RLST. 24 hours later, the same procedure was performed for the retention test.

Results: The results showed that QE training group to traditional training increased the duration of the fixation and improved performance in volleyball service at the retention.

Conclusion: The results showed that QE training has a positive effect on improving the performance and duration of stabilization period of beginner players and improve their performance in volleyball serve.

1. Introduction

Vision is one of the sources of sensory information in controlling movement and coordination, and humans use this sense more than all other sensory devices (Du Toit, 2011). In order to produce goal-based movements, the motor system needs accurate and timely visual information about the goals to perform the task (MF, 2009). While the timely acquisition of visual information is important in all daily tasks, it is critical in sports where one's precise performance must be achieved in very high time and spatial conditions and often under high levels of pressure(Lee, 2015).One of the training methods that improve performance and progress in sport skills is eye training , which includes special exercises that increase eye performance in control and coordination. (Wilson, 2005) believe that just as athletes use a variety of strength and endurance exercises to improve their physical abilities in order to participate in competitions, and these exercises put more pressure on different body systems based on the overload principle and they vision is also strengthened by introducing overload and more training, and some of its abilities are increased. They believe that some visual perceptual abilities are increased through special visual exercises. Also, performing special vision exercises that cause the eyes to move more in a wider range of motion strengthens the eye muscles and increases the desired range of motion (Wilson, 2005). Nowadays, researchers have used an eye tracking device and have shown that at a high level of motor skill execution, the gaze is directed towards prominent targets and objects in the executive-visual workspace (JN, 2007). Vision search behavior includes an alternation between fixations, it is saccades. Fixations are periods of time when the visual image on the eye cavity is kept constant to obtain the necessary information, and saccades are rapid eye movements that shift visual attention in less than 100 ms between different positions (Moeinirad et al., 2018). The last fixation of the eye to a specific point or object in visual-motor space with three degrees of central vision in less than 100 ms is called quiet eye (QE)(JN, 2007).The QE period is the last fixation of the eye before the start of the movement, which is a vital stage in the movement, which consists of three components: the beginning of the QE, the end of the QE, and the duration of QE . The beginning of the last fixation on the intended target is called the beginning of the QE. When the last fixation deviates from the desired target, it is known as the end of the QE. The time interval between the beginning and the end of the QE is called the duration of QE (JN, 2007). Many evidences and researches show the effectiveness of visual training on some movement functions. In a research,(Alessandro Piras, 2014) compared visual search in expert and beginner judo players under attack and defense conditions and

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concluded that expert judo players direct their gaze to collect more information at once, to points They stare more importantly and also acquire more information during the period of QEs(Alessandro Piras, 2014) . A research investigated the glare points and prediction of soccer penalty kicks in expert goalkeepers. the results in the post-test were that the training group performed better in predicting penalty kicks compared to the intervention group, and the QE exercises caused a change in the glare areas of the training group had been(Bahram, 2019). The study titled "QE training help long-term learning of throwing and receiving in children. After performing two post-test stages and receiving the results of the performances, they came to the conclusion that by performing QE training, the duration of target fixation and the follow-up period for throwing and receiving skills increased (Miles, 2017). On the other hand, some researchers conducted in the field of QE exercises have shown the ineffectiveness of these exercises on some movement skills. For example, Dan Witzner Hansen (2019) focused on target selection for a QE in biathlon and using 9 biathletes who were members of the German national biathlon team and had to shoot at targets at a distance of 50 meters, they came to the conclusion that the time Stabilization does not affect the number of correct hits. Sharafian et al by examining traditional exercises and QEs in the targeted reception of volleyball serve concluded that the performance of the QEs group was better than traditional exercises in the retention test. but there was no significant difference between the two groups during of QE (Sharafian, 2019).

So far, the effect of QE training on improving performance in skills such as predicting the direction of a soccer penalty(Bahram, 2019), receiving a volleyball serve(Fatemeh Sharafian, 2019), throwing a dart (Norouzi, 2019) , predicting a hockey penalty shot(Ali AsghariTuiyeh M, 2017), and table tennis backhand (Taghizadeh, 2019) and badminton forehand (Parvizi, 2018) has been done. In addition to, in a number of researches, the effect of QE training on changing the gaze points on novice dart players (Norouzi, 2019) and the duration of QE in deceptive aiming actions (Greg Wood, 2017), the effect of anxiety on the duration of QE (KA-KR, 2018), the effect of the angle The presentation of the pattern on the QE, the difference between the QE in beginners and skilled people (Norouzi, 2019) and the effect of different training methods on the duration of QE have been mentioned. But until now, the effect of these exercises on the accuracy of the volleyball serve and the striking points of the server has not been studied.

Today's advanced volleyball has two characteristics: speed and variety in the game. The high level of the game and the performance on the net and the excellence and completeness in the techniques and skills to create speed and variety in the game. In order to create speed and variety in the game, many coaches focus on increasing the speed of the ball in the service and the spike. Nowadays, at least 4 of 6 players in the world and Olympic competitions use high-speed serves with high speed and low error. In addition, it seems that this increase in service speed will make 4-person receiving systems more popular in the coming years, that is, the player the diameter of the passer or behind the line in some rotations; especially when it is located in zone 4 or zone 1; In the face of the opponent's powerful fast serves, join the receiving group. Also, by hitting the service with precision and high speed, receiving the ball in the opponent's area will be less successful, and the opposing team will not be able to create a serious attack and danger due to its weak reception. For this reason, in this research, we are looking for whether it is possible to use QE training to improve performance in volleyball serve?

2. Materials and Methods

2.1. Subjects

The research was semi-experimental and practical in terms of purpose, and the design was carried out with repeated measures. The statistical population included all male students of the University of Tehran with perfect eyesight, in the age of 22 ± 2 , who were beginners in volleyball. 18 of them were selected by G-power software through formulanova repeated measure within-between interaction, with an effect size of0.5 and a power of 0. 95 by available sampling method, and in two groups of n=9, QE training and traditional training. ethic code of research in this section is IR.UT.SPORT.REC.1399.028

2.2. Apparatus and task

Russell Long's service test: The method of Russell Long's service test (RLST) is to divide the volleyball court into several parts and assign a certain point to each part, the subject serves ten serves from the area and according to the landing place of the ball, special points are given to him in that section, if the service is on the line, that is, between the two areas that we have for each We have considered a separate point, if it lands, the point of the zone will be awarded to it, and if the ball hits outside the volleyball court, it hits the net, and the player's feet touch the line, no points will be awarded to him. The scoring method is such that the highest score obtained from 10 services is recorded as individual score (.Darzabi T, . 2016). The validity of this test is 0.8 .

Eye tracking device: The tracking device used in the current research is a binocular vision tracking device made by the German pupil company. An eye tracker was used to check the eye movements of the participants. This device includes a pair of glasses that are placed on the eye and has three cameras, two of which record the movements of each eye and one camera records the position of the environment. The ability to record with a changeable frame rate (30, 60, 90, 120) frames per second in all three rounds. The ambient camera is also capable of recording images with dimensions of up to 1920*1080. The size of the eyepiece camera is 10*45*7mm. This device has the ability to record fixations, duration of fixations and saccadic eye movements with high sampling speed. This device has an LED tracking system based on infrared waves. A small projector shines infrared waves. The camera takes pictures of the eye in short intervals and by processing those images, details of the light reflection from the eye are obtained. With the help of these data and the pattern of mathematical rhythms, the points that the viewer looks at at any moment are calculated. This eye tracking device is able to measure eye activities and determine which point the person's eyes are focused on or how much the eyes move from one point to another. Another hardware part of the device is a laptop, which is used to record and extract the output data of the eye tracking device through Pupil Player and pupil chapter software (Parvizi, 2018)

2.3. Procedure

The test was conducted in three phases: pre-test, post-test, and retention test, with two groups of QE and traditional training. At the beginning, we asked a Skilled male volleyball player to send 10 serves, also we using eye tracking glasses, the gaze points and his duration were obtained. In addition, we also took a video of the skilled person's movement from the side view with a camera (sony, PAL HDR-CX210 Handycam) To start the research, all the participants were given a consent form and they all participated in this project with full consent.

The test was conducted for 5 sessions in the volleyball hall of the Faculty of Sports silences and Health, University of Tehran. In the pre-test, the participants of both groups executed 10 serves, and their gaze points and gaze duration were recorded in each serve using eye tracking glasses. Also, using the RLST, they were scored according to the landing place of the serves. The acquisition phase lasted for three sessions. During this time, the group of QE did QE training such a way that at the beginning of each session, participants did 5 trials services to warm up, then the video of the skilled person's performance (3 times at the original speed, 3 times at a slow speed and finally 3 times at the original speed) along with his glancing points and QE were observed. While watching the video, they were listened to the necessary explanations and feedback about the place

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to look at the ball and the field, which was done by the expert, and then they were asked to make 20 trials according to the method of execution, the points of the gaze and the QE of the expert(M. Mohseni). The traditional training group practiced the serve twenty times in each session without seeing the video of the expert(Fatemeh Sharafian, 2019) . At the end of the third session, a post-test was taken from the subjects, which was again measured with eye tracking glasses, the location and duration of gaze, and the accuracy of subjects' services was measured with the RLST. After 24 hours, a retention test, which was similar to the post-test, was taken from the participants of both groups and the results obtained in these three stages were compared.

2.4. Data analysis

Due to the non-existence of the assumptions of repeated analysis of variance between groups, to compare the average performance between the two groups in the pre-test, post-test and retention phases, Independent t-test was used. All statistical calculations were done by SPSS 16 statistical software. The level of significance in all statistical tests was $P \leq 0.05$.

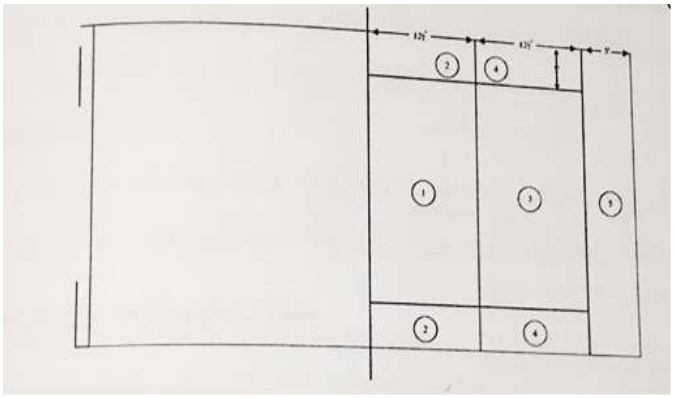

Figure 1: *Russell Long service test execution area*

3. Results

In order to check the normality of the data distribution, the Shapiro-Wilk test was used, the results of which showed that all the dependent variables at the levels of the independent variable had a normal distribution in all stages of the research ($P > 0.05$). The results of independent t-test showed that there is no significant difference in the accuracy of the players' performance between the group of traditional and QE training in the pre-test ($t_{(16)} = 0.27$, $P = 0.78$) and post-test ($t_{(16)} = 2.07$, $P = 0.055$). However, there is a significant difference between groups in in the retention ($t_{(16)} = 2.46$, $P = 0.025$) (**Figure 2**).

Also, the results of independent t-test showed showed that there is no significant difference between the duration of gaze in volleyball serve between the QE and traditional groups in the pre-test ($t_{(16)} = 0.03$, $P = 0.977$), post-test ($t_{(16)} = 1.79$, $P = 0.09$). However, there is a significant difference between groups in in the retention ($t_{(16)} = 2.00$, $P = 0.04$) (**Figure 3**).

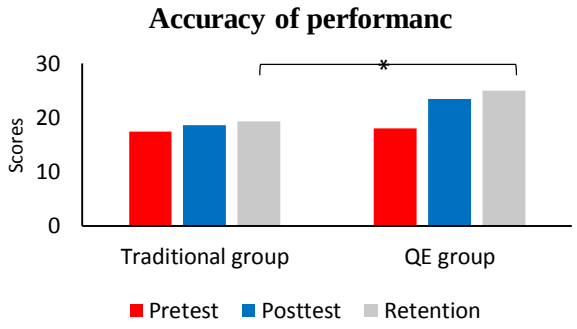

Figure 2. *Comparison of serve accuracy performance*

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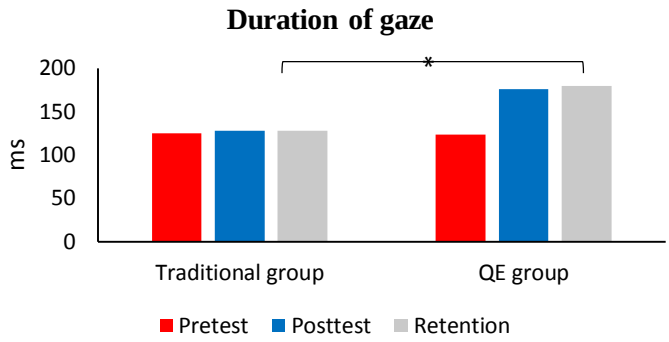

Figure 3. *Comparison of duration of gaze*

Discussion and Conclusion

The results of this study showed that QE training to traditional training increased the duration of the fixation period, the duration of the last stabilization and improved performance in volleyball service. This conclusion is consistent with the research of (Ali AsghariTuiyeh M, 2017), (Miles, 2017), (Vine SJ) and (Fahimeh Taghizadeh, 2019). In the research of Taghizadeh et al., under the title of the effect of QE training on learning table tennis skills, they concluded that QE training speed up the acquisition of skills in beginners compared to common exercises. These studies have concluded that when a high level of skill is achieved, not only is the gaze directed directly to more important locations and targets, but vital signs and the infrastructure for optimal performance are received in a precise and timely manner. that this accurate and timely timing can justify the increase in the performance of the participants by using QE training. In addition to that, QE training can affect the number of perceptual-cognitive workspaces, the number and type of places and goals in a visual-motor space, the location of vital signs, the focus of attention, and the optimal timing of gaze. Also, the theories of conscious processing and the theory of limited action by Wolff et al (G., 2007) state that external attention during performance is effective to help improve learning and maintain performance. A QE leads to a kind of external attention. 15 years of research has shown that focusing on external attention facilitates motor performance and learning. Focusing on external attention allows motor control to be executed automatically and lead to the best possible results. The QE may provide the "external focus of attention" described by Wolff (G., 2007). In addition, Singer's five-step strategy has shown that in some laboratory and field studies, facilitation of learning and performance has been observed, and the focus has been on creating situations for the performance mode (just do it). These points emphasize that optimal focused attention is achieved by selecting the appropriate external cue. QEs may be part of a pre-performance routine to help the performer focus on something they can control a relevant external cue. with performance(Wilson MR, 2011). QE training are a practical technique to guide the external focus of visual attention and also guide its timing in relation to important movements (Causer J, 2012). Another result obtained from the research is that researchers have stated that QE training is a means of implicit motor learning. QE training can create a form of implicit learning; When the learner partially protects the explicit rules by focusing on external goals and no longer focuses on motor control (Poolton JM, 2006). QE training by directing attention to the external cue during learning, commit to explicit knowledge about the rules that They control and limit the execution of movement skills (Poolton JM, 2006). These results were in line with the findings of Mayel et al.'s research on the effect of QE training on the components of QEs in healthy children. In their research, Miles et al(Miles, 2017) investigated the effect of traditional and QE training on the throwing and receiving performance of 16 10-year-old children and reported a significant increase during the QE duration of the group with QE exercises compared to the group with traditional exercises. which caused a significant improvement in throwing and receiving performance from pre-test to post-test. Kasser et al. (Causer J, 2012) believe that the early start of the eye rest causes better processing of information and attention to the relevant signs in the assignments, and as a result, it causes the correct answer to begin (Causer J, 2010). Other results showed that the end of QEs and the duration of QEs have a significant positive relationship with motor performance. That is, the longer the QE period is and the later this period ends, the motor performance increases. Longer period of QE and a later completion of this period is related to a high level of expertise and performance, which justifies the difference in performance and is in accordance with the results of the present research (Wilson MR, 2015.). . Likewise, a longer QE develops critical planning time during movement parameterization (direction and force) and also precisely scales the timing of limb coordination. Therefore, the longer duration of the QE provides the motor control system with information about the target position and makes the movement kinematics and muscle activity pattern effective for the successful execution of the skill. The coupling between gaze behavior and opponent kinematics during anticipation. of badminton shots(Alder D, 2014). The QE duration shows the time needed to organize the neural networks and visual parameterization that is responsible for controlling precise movements. It is suitable for combination (JN, 2007). The long-term duration of QE and its function can be explained using the neurocognitive model of optimal attention control by Kurita et al. This model implies the importance of attention control in aiming and skill tasks and the balance between the goal direction and the two paths. It is sensitive from top to bottom (dorsal) and bottom to top (ventral). In the top-down direction, the attention system is goal oriented and its center is the dorsal part of the dorsal root and the frontal cortex. On the other hand, the stimulus-oriented attention system (ventral attention), whose center is the parietal cortex and the ventral part of the frontal cortex, is involved during the detection of salient and unwanted stimuli and breaks the loops of top-down attention (Corbetta M, 2008). Accordingly, Vickers stated that a long duration of QE may allow the performer to extend the duration of response planning. While the least disturbance is caused by other symptoms. In other words, according to Courbet's opinion, the QE helps to maintain the effective control of goal-oriented attention, while reducing the effect of the attention-oriented control system (Wilson MR, 2013). Of course, in another study, Moore et al. investigated the effect of QE

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training on the performance and impact kinematics of beginner golfers. As expected, the group with QE exercises showed longer QE duration and better golf swing efficiency. However, additional analyzes showed that only stroke acceleration could mediate the difference between the performance of the control groups and the QE training. The difference between the groups in the duration of QEs could not mediate the difference in the performance of the groups. Therefore, they argued that their study failed to provide strong support for a possible role of the resting eye in enhancing performance and suggested that a threshold of resting eye duration might explain the lack of association between performance and resting eye duration (Vine SJ, 2014). Finally, regarding the duration of the gaze, the present study showed that the relaxation eye exercises did not have a significant effect on the duration of the gaze of the subjects in the two groups of relaxation and traditional eye exercises, and there was no difference between the two groups in the pre-test, post-test and observation stages. It didn't happen. This result is in line with the research of Henrich et al. In this research, they asked 9 biathletes who were members of the German national biathlon team to shoot targets that were 50 meters away and concluded that the duration of fixation does not affect the number of correct shots. In this research, the cause of this phenomenon was attributed to the dynamic characteristics of eye-hand coordination, dry eyes and blinking (Dan Witzner Hansen, 2019). In a research, Moini Rad and his colleagues compared the visual search behaviors of skilled and semi-skilled people in basketball pair shots and they also obtained the same results as the present study, that no significant difference was observed between the duration of the gaze of the two groups(Moeinirad et al., 2018). Since the service skill has a high speed and the person has to hit the ball at a specific point, it is expected that eye training cannot have a significant effect on this component. In addition to that, in this research, the participants had to look at the opponent's court and a point of the court that they wanted to direct the service to, in addition to the ball, and this difference in glare made them unable to focus on the ball for a long time. Of course, Kazer et al investigated the duration of eye rest and gun movement in skilled and semi-skilled shooters. For this purpose, they examined gaze control and movement kinematics among 42 skilled shooters and 42 non-skilled shooters. In all shooting situations, skilled shooters showed an earlier and longer onset than semi-skilled (Vine SJ). This research is inconsistent with the result of our research about the duration of staring. Due to the fact that QE training affects both the duration of fixations and QE and the accuracy of performance, it is suggested to the trainers to show the video of the skilled people and also the state of their gaze to the novices during the training of the hammer service skill. Show them and give them feedback while watching the movie. Also, it is better to investigate the effect of this type of training on other types of serve in future research, and since this research was successful on the volleyball serve, it is suggested to carry out this method on the serve of other disciplines, such as Badminton or tennis can also be played.

Author's contribution

Conception and design of study: F.Z, E.A; data collection: F.Z; Data analysis and/or interpretation: F.Z, M.SH; Drafting of manuscript and/or critical revision: F.Z, E.A, M.Sh; Approval of final version of manuscript: F.Z, E.A, M.Sh.

Conflict of interest

The authors declare that there is no conflict of interest.

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