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Evaluation of Visual Skills in Soccer Referees and Assistant Referees

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Abstract

Background: As a soccer referee or an assistant referee, having perfect visual skills is mandatory, which will help make quick and accurate decisions in the field of the play and during matches; however, this skill is not well studied among referrers. This study aimed to assess the visual skills of referees and assistant referees.

Methods: Men's professional referees and assistant referees working for the Iran football federation were investigated in 2019. The visual skill investigation consists of the evaluation of static visual acuity, color vision, stereoacuity, intraocular pressure, confrontation test, and eye anatomical assessment with slit lamp. The statistical analysis was performed using the SPSS software Version 18.

Results: In this study, 159 men's professional referees and assistant referees with a mean age of 35.52±5.39 were selected. The results of this study showed that 1.88% of the referees and assistant referees had color blindness dyschromatopsia) and 3.14% of them needed more follow-up examinations. The mean spherical equivalent of examined eyes was -0.42D in the right eye and -0.16 D in the left eye.

Conclusion: Our results showed that referees and assistant referees both had some kind of visual skill deficiencies. As visual skills are among the fundamental skills for success in referees in dynamic sports such as soccer, all of them must undergo visual skill assessments during the precompetition period to avoid any errors in judgment due to visual disturbances.

Keywords: Visual, Soccer, Sports

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Introduction

Soccer is one of the team sports that involve kicking a ball with the foot to score a goal (1). In this team sport, the referee is attentive for at least 90 minutes of the match, but sometimes the match lasts longer than 120 minutes. The referee sometimes receives an enormous amount of information from several senses (2). It is necessary for the referees to be physical, technically, psychologically, and visually skill-appropriate to have a good performance during the competition. In addition to their skill in mastering the rules of judgment and physical fitness, referees must have a good visual experience, which is highly dependent on the sense of sight. The ability of a referee to perceive fast-moving players, in consecutive or simultaneous movements, depends on the visual awareness, a factor that may affect the referee's decision in a variety of situations (3). According to previous studies, more accurate decisions are made by elite referees, and hence a significant difference was observed in their visual search behaviors (4). Additionally, referees should always locate themselves in the best position in the field to have the best ob-

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↑What is "already known" in this topic:
Previous studies have assessment visual skills of expert and novice athletes; referees' performance has not been addressed.

→What this article adds:
In this study, it was found that referees need a clear vision and color vision in addition to the appropriate professional judgment and acceptable physical fitness.

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servation of the play (5). Nowadays, it is known that suitable performances in this sport require skill in sensory and motor skills (6). Therefore, a referee needs a strong visual memory to make accurate decisions. The referee's judgment of the ball rotation relies on visual resolution ability, contrast sensitivity, dynamic visual acuity, and coulometer function to provide the best visual information for processing (7).

Depth perception is the most important anticipation skill in soccer. Besides, visual coincidence anticipation can provide helpful information in the evaluation of the soccer referee. Therefore, for an appropriate arbitration, the soccer referees need especial visual skills, such as focusing and tracking, anticipation timing, eye-hand-foot coordination, peripheral vision/awareness, and depth perception.

Depth perception is the most important predictive skill in soccer. Referees adjust the location of the ball during the match based on their anticipation and relocate themselves in the field to have the best sight on the match and the ball. Soccer is a dynamic sport, with 20 players moving, so the referee is exposed to a lot of information in one sight. Therefore, referees must have a strong visual memory to help them make the correct decision. This study was designed to evaluate the visual skills and abilities of the soccer referees and assistant referees. Therefore, the present study aimed to provide a comprehensive evaluation of visual function in a group of soccer referees and assistant referees who judge at a professional level. Currently, there is no vision standard for soccer referees, and the relationship between a referee's level of vision and performance is unclear (8).

Methods

This cross-sectional study was performed in collaboration with the Iran Football Federation with the Farabi Eye hospital in Tehran in 2019.

The study population included all the referees and assistant referees who were registered in the Football Federation of Iran for the upcoming soccer league. All of the referees were men performing at the professional level. One of the referees was a known case of diabetes and 14 mentioned they had previously underwent eye surgery.

The inclusion criteria were referees and assistant referees with at least 3 years of judging experience who were aged 26 to 42 years. A total 159 male soccer referees and assistant referees 100 referees and 59 assistant referees) participated in the study. We selected the sample based on the census. All tests were performed in a single day and then evaluated by an ophthalmologist and an optometrist; all tests were also performed in the same day. Informed consent was obtained from all participants before participating in this study. This study was approved by the ethical committee of Tehran University of Medical Sciences 6).

Visual Test

Definitions and Characteristics of the Visual Tests: All definitions and characteristics of the visual tests are based on the study by Mohammadi (9). In this study, a range of visual functions that are considered important in sports performance, such as color vision, stereoacuity, visual acuity, and refraction, were evaluated.

Static Visual Acuity: Static visual acuity SVA) is "the ability to see a static aim at a fix distance." (10) We measured the SVA with the Snellen chart, it is a Quantitative variable. The fraction result obtained is the reciprocal of the minimum angle of resolution (11). The evaluation of the SVA is an essential factor in any vision assessment because a degraded visual acuity can have a detrimental effect on many other parts of the visual performance. Reduced visual acuity has been shown to affect dynamic visual acuity, depth perception, and accommodative accuracy. The SVA is defined as the resolving power of the eye, or the ability to discriminate 2 objects as being separate when these objects are both static (12). This protocol offers the following advantages including: 1) maximum distinction of visual acuity through alphabet-based scoring; 2) increased measurement scope to the highest theoretical level i.e., supervision); and 3) application of diverse English letters instead of E that decreases the impact of the responding chance (9).

Color Vision: Ability to detect colors based on the wavelength of light emitted or passing through the object.

Color vision is the ability to distinguish different colors and is due to the photoreceptors in the retina of the eye, which is known as cones. The light-sensitive pigments in these cones enable us to recognize colors (13).

The referees' color vision was tested with the Farnsworth D-15 color vision test. The test is made up of 15 color samples. The light conditions in this test, which according to the International Commission on Illumination are equal to 30 feet / candles, equivalent to 323 Lux. The lighting conditions are adjusted with the help of a photometer.

There was no time limit for people to take this test. Evaluation of color vision for each person was done binocularly and in a distance of 50 cm from the person. First, the correct arrangement of the beads was shown to the person and after randomly moving all the beads except the first bead guide bead), he was asked to place the beads in the box in order according to the color similarity.

Finally, the test results were reported quantitatively based on the color distortion coefficient criterion (14).

Intraocular Pressure: The fluid pressure inside the eye is called intraocular pressure IOP). The Goldmann equation can be used to theoretically determine the IOP. Goldmann applanation tonometry is currently used as the clinical gold standard for assessing IOP 11).

Stereopsis: Stereopsis is traditionally considered to be the threshold measure of how well an individual can interpret binocular disparity as perceived depth by determining the spatial correlation of points projected onto the retina (15). This test provides valuable information about the alignment of both eyes and their ability to perceive spatial depth; it is a binocular faculty that is achieved through horizontally disparate images for the right and left eyes of the same person. Stereo acuity was assessed using the TNOstereo test with a standard procedure. This test measures the stereopsis vision from 15-480 s/arc (9).

The Confrontation Test: The confrontation test is an eye

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examination that can detect dysfunction in peripheral vision (16). Participants were asked to cover their right eye with their right hand vice versa when testing the opposite eye). While the examiner was sitting directly in front of the participants, they turned their gaze toward the eye of the examiner.

The normal visual field reaches 180º, 160º, and 135º for the horizontal plan, monocular vision and the vertical plan, respectively. A moving target should start outside the usual 180º visual field, and then move slowly to a more central position until the participant confirms visualization of the target (17).

Refractive Errors: Optical power deviation of the eye to create a sharp image on the retina). This measurement was performed with and without cycloplegia. Measuring was conducted using an i-Trace with Scale Spherical and cylindrical error with axis Diopter) (11).

Statistical Analysis

Statistical analysis was performed using SPSS software Version 18 SPSS Inc). Data are presented as mean and standard deviation.

Results

In this study, 195 professional referees and assistant referees were registered. The mean age of participants was 35.52 ± 5.39 years range, 26-42 years and the mean uncorrected visual acuity of the right and left eye was 0.97 and 0.98, respectively. Moreover, the visual acuity of at least one of the eyes was <0.8 in 20 participants. The minimum visual acuity of the right and left eye was 0.3. The results of color vision testing showed that there were 3 1.88%) patients with color blindness. Similar to elite athletes, 85.2% of the referees did not have a color deficiency and only 1 referee or 3.7%) required immediate attention. The slit-lamp examination by the ophthalmologist did not reveal any pathology affecting the cornea of participating referees. The mean IOP measured by the Goldman tonometer was obtained to be 15.01 for the right eye and 14.98 for the left eye. The examination of the crystalline lens did not reveal any participant having the cataract. Examination of stereopsis by the TNO Stereo test showed that 156 participants had stereopsis of 40 seconds of arc, while the stereopsis of 1 referee was revealed to be 50 seconds of arc and 2 of them to be 60 seconds of arc. As mentioned earlier, refraction was performed for all participants. The mean spherical equivalent of examined eyes was –0.42 in the right eye and –0.16 in the left eye. Of the 318 eyes examined, 163 51%) were found to be emmetropic, 79 24%) were myopic, and 76 23%) were hyperopic.

Discussion

Basic visual skills play a key role in determining success. The visual skill for a referee is an essential skill, even a more critical skill to be conserved as referees are frequently required to make judgments. This study aimed to assess the visual skills of professional soccer referees and assistant referees. The results revealed that 3 of the referees and assistant referees were suffering from color blindness Dyschromatopsia) and 5 people needed to do further follow- up and more detailed eye examination.

Ghasemi et al reported that expert referees are able to make more relevant decision information from the same visual field than the novice referees (18). It seems that paying more attention to the soccer referees' visual skills is crucial in improving their level (19).

According to Mallo J et al study, the error percentage for the referees was 14% (20). Moreover, the risk of making incorrect decisions was decreased whenever the assistant referees observed the offside situations from an angle between 46° and 60° (7). No considerable effect was observed on the correct and incorrect decisions in the distance of the assistant referee to the offside line (21, 22). The results of the SVA test showed that most of the referees performed average according to the norms.

The results of color vision testing showed that there were 31.88%) participants with color blindness.

Previous studies have shown that 8% of men and 0.64% of women have a color anomaly with red-green abnormalities, which is the most common problem (23). To decide whether a lack of color discrimination may impede the athlete's performance or not, the nature of sport should be taken into account (24). Soccer is a visually demanding sport that requires a high degree of visuomotor skills (25, 26). Soccer referees and assistant referees with abnormal color vision may be at a disadvantage because of diminished color contrast between the player clothes and green grass. Because of the importance of color vision in referees, given the fact that the soccer field is green, and in the case of red or green jerseys, it can lead to arbitrary mistakes(18) (27, 28). The study by Buys and Ferreira indicated that most of the athletes 79.9%) did not have a color deficiency (24).

Judgments of depth and distance are visual demands of virtually all sports that involve target or competitor movement. More than half of the athletes 52.5%) achieved the maximum score for stereopsis, which indicates that elite athletes do have excellent stereopsis (24, 29). Stereopsis is an important area of visual ability for referees, as it makes positioning and identification of player's positions to each other more accurately (30). A debate, however, is continuing regarding stereopsis and whether it can be improved through training; stereopsis will not improve by training, only depth perception may improve (31). However, there is debate about the role of training on the improvement of stereopsis. It has been reported that the depth perception can be improved through practice.

Examination and evaluation of the refractive state of referees is an important part of assessing their visual acuity. Refractive errors may lead to an error in the decision of the referees (9, 26). It seems that this finding cannot be extended to soccer referees, in which distance vision is of high importance. Correction of minor refractive errors is important in the correction of blurred vision at distances and achievement of maximum visual acuity (32). The detection of movement is considered as one of the main functions of the ambient system (33). Therefore, in refereeing, a referee must have a broad environmental vision to monitor all the elements in the field, such as players, balls,

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and assistants. For instance, in the scene of a corner kick, for detecting fouls), the ball for tracking it to the goal), and an assistant for detecting off-sides). It can be found that a higher level of visual perception in athletes is highly associated with the recognition of speed and responsiveness to stimuli than the functioning of the visual system in the peripheral field. However, some studies reported that sport disciplines that require multiple stimuli involvement of visual perception can improve peripheral vision (34). Different color lights were used for determining peripheral sensitivity. The results showed that these elite athletes had a significantly wider field of vision than novice athletes with regard to white and yellow color (35).

Time is considered as the most limiting factor in soccer refereeing. In this regard, time management is very important in all situations because of the fact that the referee must make decisions within seconds. For this reason, high skill plays a key role in the speed of recognition, and hence may help them make a suitable decision in subtle scenes (35). It seems that paying more attention to the performance of soccer referees' visual skills is crucial in improving their level.

Therefore, establishing clinically proven norms for the several skills is considered as an critical factor in the visual improvement discussion (36). These evolutions have both influenced the player's involved helped expert referees who are under stress to perform and make the correct judgments. Soccer requires the referees to move efficiently at a suitable distance from the action for 90 minutes and to be able to make smart calculated decisions based on the rules of the game. It is also vital to identify which skills are more important in the overall performance of these referees. In this regard, any abnormality could affect vision performance, leading to incorrect decisions. Elite referees have learned to recognize relevant from less-relevant information. Findings have implications for the development of perceptual training programs for sports officials.

The limitation of this study was attributed to the design, which does not allow us to determine the focusing, and tracking, anticipation timing, eye-hand-foot coordination, peripheral vision/awareness, and depth perception.

Conclusion

Referees need a clear vision and color vision in addition to the appropriate professional judgment and acceptable physical fitness. Therefore, considering the importance of vision in referees, the importance of periodic visual examinations, and visual behaviors of soccer referees during the assessment of foul play situations is recommended.

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Ethical approval: ERC.95.2.26.2

Conflict of Interests

The authors declare that they have no competing interests.

References

1. Reilly T, Gilbourne D. Science and football: a review of applied research in the football codes. J Sports Sci. 2003;21(9):693-705.
2. Pietraszewski P, Maszczyk A, Roczniok R, Gołaś A, Stanula A. Differentiation of perceptual processes in elite and assistant soccer referees. Proced Soc Behav Sci. 2014;117:469-474.
3. Sanabria J, Cenjor C, Márquez F, Gutierrez R, Martinez D, Prados-García JL. Oculomotor movements and football's law 11. Lancet. 1998;351(9098):268.
4. Spitz J, Put K, Wagemans J, Williams AM, Helsen WF. Visual search behaviors of association football referees during assessment of foul play situations. Cogn Res Princ Implic. 2016;1(1):1-11.
5. Reilly T. Motion analysis and physiological demands. In: Science and soccer. edn.: Routledge; 2003: 67-80.
6. Ghasemi A, Momeni M, Jafarzadehpur E, Rezaee M, Taheri H. Visual skills involved in decision making by expert referees. Percept Motor Skills 2011;112(1):161-171.
7. Oudejans RR, Verheijen R, Bakker FC, Gerrits JC, Steinbrückner M, Beek PJ. Errors in judging 'offside'in football. Nature. 2000;404(6773):33.
8. Baptista AMG, Serra PM, McAlinden C, Barrett BT: Vision in high-level football officials. PloS One. 2017;12(11):e0188463.
9. Mohammadi SF, Amiri MA, Naderifar H, Rakhshi E, Vakilian B, Ashrafi E, et al. Vision Examination Protocol for Archery Athletes Along with an introduction to sports visión. Asian J Sports Med. 2016;7(1).
10. Marshall BD. Sports Vision: Vision Care for the Enhancement of Sports Performance. Med Sci Sports Exerc. 2009;41(7):1531.
11. Jorge J, Fernandes P.: Static and dynamic visual acuity and refractive errors in elite football players. Clin Experim Optom. 2019;102(1):51-56.
12. Grosvenor TP. Primary care optometry: anomalies of refraction and binocular vision: Butterworth-Heinemann Boston, MA; 1996.
13. Ng JS, Liem SC. Can the Farnsworth D15 Color Vision Test Be Defeated through Practice? Optom Vis Sci. 2018;95(5):452-456.
14. Fattahi Bafghi F, Jafarzadehpour E, Mirzajani A, Yekta A. Evaluation of the Relationship between Color Vision and Blood Lead Concentration at Koushk Lead and Zinc Mine Employees in Bafgh City. J Paramed Sci Rehabil. 2018;7(3):54-60.
15. O'connor AR, Tidbury LP. Stereopsis: are we assessing it in enough depth? Clin Experim Optom. 2018;101(4):485-494.
16. Erickson GB. Sports vision: vision care for the enhancement of sports performance: Elsevier Health Sciences; 2007.
17. Elliott DB, North I, Flanagan J. Confrontation visual field tests. Ophthalm Physiol Opt. 1997;17:S17-S24.
18. Ghasemi A, Momeni M, Rezaee M, Gholami A. The difference in visual skills between expert versus novice soccer referees. J Hum Kinet. 2009;22(1):15-20.
19. Afshar M, Rostami R, Chahardah CM. Comparison of Visual Skills in Soccer Referees with Fewer and More Mistakes1. Motor Behav. 2019;10(34):75-90.
20. Mallo J, Frutos PG, Juárez D, Navarro E. Effect of positioning on the accuracy of decision making of association football top-class referees and assistant referees during competitive matches. J Sports Sci. 2012;30(13):1437-1445.
21. Helsen W, Gilis B, Weston M. Errors in judging "offside" in association football: Test of the optical error versus the perceptual flash-lag hypothesis. J Sports Sci. 2006;24(05):521-528.
22. Gilis B, Helsen W, Catteeuw P, Wagemans J. Offside decisions by expert assistant referees in association football: Perception and recall of spatial positions in complex dynamic events. J Experim Psychol Appl. 2008;14(1):21.
23. Voke J. Mechanisms of Colour Vision: Selected Papers, by WS Stiles. Academic, New York, 1978. Color Res Appl. 1980;5(4):232-233.
24. Buys J, Ferreira J. The development of protocols and norms for sports vision evaluations. Afr Vis Eye Health. 2008;67(3):106-117.
25. Ali A. Measuring soccer skill performance: a review. Scand J Med Sci Sports. 2011;21(2):170-183.
26. Minoonejad H, Barati AH, Naderifar H, Heidari B, Kazemi AS, Lashay A. Effect of four weeks of ocular-motor exercises on dynamic

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visual acuity and stability limit of female basketball players. Gait Posture. 2019;73:286-290.
27. Martir J. The influence of jersey colour on decision making of the referee. Master thesis, Psychology (MSc). 2017.
28. Baptista AM, Serra PM, Faisal M, Barrett BT. Association between Clinical Vision Measures and Visual Perception and Soccer Referees' On-field Performance. Optom Vis Sci. 2021;98(7):789-801.
29. Bahdur K, Ferreira J, Lategan L, Ludeke A. The effects of a visual intervention programme on the visual skills of professional football players: sport vision. Afr J Physic Act Health Sci. 2016;22(Issue-32):920-931.
30. Paulus J, Tong J, Hornegger J, Schmidt M, Eskofier B, Michelson G. Extended stereopsis evaluation of professional and amateur soccer players and subjects without soccer background. Front Psychol. 2014;5:1186.
31. Wood JM, Abernethy B. An assessment of the efficacy of sports vision training programs. Optom Vis Sci. 1997;74(8):646-659.
32. Ferreira J. The application of sports vision in cricket. Eyesight. 2003:41 citation_lastpage= 43.
33. Rooney KK, Condia RJ, Loschky LC. Focal and ambient processing of built environments: Intellectual and atmospheric experiences of architecture. Front Psychol. 2017;8:326.
34. Zwierko T. Differences in peripheral perception between athletes and nonathletes. J Hum Kinet. 2008;19:53-62.
35. Ghasemi A, Momeni M, Rezaee M, Gholami A. The difference in visual skills between expert versus novice soccer referees. J Hum Kinet. 2009;22:15-20.
36. Toornstra A, Hurks P, Van der Elst W, Kok G, Curfs L. Measuring Visual, Spatial, and Visual Spatial Short-Term Memory in Schoolchildren: Studying the Influence of Demographic Factors and Regression-Based Normative Data. J Pediatr Neuropsychol. 2019;5(3):119-131.

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