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THE IMPACT OF REFRACTIVE ERRORS AND THEIR CORRECTION ON VISUAL-MOTOR PERFORMANCE IN TEAM SPORT ATHLETES: A NARRATIVE REVIEW

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ABSTRACT

Efficient visual processing is crucial in team sports, where accurate spatial perception and quick reaction time directly affect the quality of performance. Even mild refractive errors (e.g., myopia, hyperopia, or astigmatism) can impair visuomotor skills and result in tactical errors, reduced precision, and delayed responses. This review aims to examine the impact of refractive defects and their correction on visual performance in athletes, highlighting the importance of proper vision management in competitive settings. Studies consistently show that uncorrected refractive errors negatively affect reaction time, depth perception, stereopsis, and spatial awareness, which are all essential for rapid decision-making during dynamic game situations. In contrast, proper correction improves visual acuity and contrast sensitivity, reduces neural load, and enhances visuomotor coordination, allowing athletes to process visual information more efficiently. Each correction technique, including spectacles, contact lenses, refractive surgery, and sports-specific protective eyewear, has particular advantages and limitations depending on the type and demands of the sport. Vision correction is therefore crucial for optimizing sports performance; however, standardized correction guidelines tailored to athletic requirements are still lacking. Further research using advanced tools such as VR, fMRI, and eye-tracking is needed, along with routine vision screening and individualized correction planning for athletes.

KEYWORDS

Refractive Errors, Team Sports, Reaction Time, Visual Performance, Contact Lenses, Orthokeratology, LASIK

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Introduction:

Visual function plays an important role in sports performance, particularly in team sports, where success depends on the quick processing of visual stimuli, accurate decision-making, and efficient visuomotor coordination. It is estimated that up to 80% of the information processed by the brain comes from the visual system, making it the primary tool for planning, controlling, and executing movement during athletic activity (Clark et al., 2020). In team sports, with high dynamics and unpredictable game scenarios, visual skills such as depth perception, tracking of moving objects, peripheral vision, and reaction speed are of critical importance (Ryu et al., 2013).

Multiple studies have shown that uncorrected refractive errors - including myopia, hyperopia, and astigmatism - can negatively affect reaction time, passing precision, judgment over distance, and overall decision-making ability on the field. Statistics suggest that up to 28% of athletes present with visual acuity below 20/25 never underwent a comprehensive eye examination (Beckerman & Hitzeman, 2001).

In football, dynamic vision and binocular function are especially crucial. Jorge and Fernandes (2019) showed that uncorrected refractive errors in footballers were associated with lowered visual acuity and slower responses to fast-changing game situations. In a follow-up study, Jorge, Diaz-Rey, and Lira (2021) observed that over 36% of players had at least one binocular vision defect, most commonly convergence insufficiency (CI) and accommodative insufficiency (AI). These impairments can significantly impact depth perception, passing accuracy, and the ability to quickly localize objects spatially. Of note was that 74% of affected athletes were unaware of their visual deficits.

Similarly, visual performance is crucial in volleyball, where athletes must instantly interpret ball rotation, opponent positions, and attack-timing. This requires not only high visual acuity but also efficient real-time visual processing. Agostini et al. (2013) conducted a study analyzing postural control in volleyball players under different sensory conditions - both with eyes open and closed. The results showed that, under open-eye conditions, athletes relied more heavily on visual information than non-athletes, showing superior postural stability and better adaptation to environmental changes. These findings suggest that volleyball players' sensorimotor systems adapt to the sport's specific demands - characterized by fast-paced, spatially complex scenarios that require precise integration of visual, proprioceptive, and vestibular inputs. Balance maintenance during serve reception, blocking, or directional changes requires rapid visual processing that consequently results in appropriate motor responses.

Another study by Schorer et al. (2013) demonstrated that skilled volleyball players can utilize both central (foveal) and peripheral fields of vision to anticipate the direction of an opponent's attack. Only athletes with advanced experience were able to successfully interpret the actions of opposing players using the full range of visual field. Restriction of either visual field greatly impaired response effectiveness, particularly among players with less expertise.

Basketball, relies heavily on visual perception and rapid information processing. Players continuously monitor the positions of teammates, opponents, and the ball while responding to changing in-game scenarios. Of particular importance is "global perception" - the ability to comprehend the overall structure of the visual scene and react quickly to stimuli. Studies analyzing cognitive-visual strategies in basketball confirm that athletes with better Visual Tracking Speed (VTS) perform better when it comes to assists, steals, and fewer turnovers, underscoring the crucial role of visual proficiency in performance outcomes (Mangine et al., 2014). In team sports like basketball, reaction time and rapid interpretation of visual cues are directly linked to visual clarity and processing efficiency. Research further demonstrates that higher-level athletes are better at responding to changes in opponents' movement direction and develop superior perception skills through targeted visual training (Fujii et al., 2014; Ryu et al., 2016). While these studies do not directly address refractive errors, they highlight the fundamental role of intact visual function in quick and accurate decision-making - an ability that may be severely compromised with uncorrected vision errors.

It is worth noting that the problem of uncorrected refractive defects also extends to athletes in individual sports such as baseball and tennis. Laby and Kirschen (2017) conducted a study on 608 Major League Baseball (MLB) players and found that around 20% had improperly corrected vision, which could potentially impair their performance. Similarly, Chang et al. (2015) observed that young tennis players with uncorrected refractive errors demonstrated poorer peripheral vision and worse depth perception - skills that are essential for effective serving and ball return. Importantly, even after optical correction using glasses, not all visual functions were fully restored, pointing out the need for an individualized approach to vision correction.

This narrative review aims to assess the impact of refractive errors and various correction methods on precision and reaction time in team sport athletes. The analysis encompasses both the physiological aspects of the visual system and the outcomes of studies evaluating the efficacy of different correction techniques - including glasses, contact lenses, orthokeratology, and refractive surgery - in the context of variables such as spatial assessment, decision-making, and real-time responsiveness to dynamic stimuli.

Special emphasis is given to the comparison between corrected versus uncorrected vision and identifying the limitations of certain correction techniques in dynamic conditions demanding quick visual adaptation. This review also seeks to provide practical recommendations for coaches, sports medicine professionals, and athletes, highlighting the importance of individualized correction strategies and routine visual examinations as essential components in supporting athletic performance.

Materials and Methods

A comprehensive literature review was conducted using the databases PubMed, Google Scholar, ResearchGate, and Scopus to examine the effects of various types of refractive errors - including myopia, hyperopia, and astigmatism - as well as their correction methods (eyeglasses, contact lenses, refractive surgery, orthokeratology) on visual function and reaction time in a sports performance context.

The review consists of experimental and observational studies, as well as systematic reviews and meta-analyses, covering:

- Experimental studies involving reaction time tests and motor tasks;
- Studies employing neuroimaging techniques (fMRI, EEG) and virtual reality (VR) environments;
- Observational studies involving both general and athletic populations;
- Systematic reviews and narrative review articles.

Publications not available in English or lacking full-text access were excluded. The selection process involved an analysis of titles and abstracts, followed by full-text assessment based on methodology and relevance to the topic.

Refractive Errors - Definitions and Epidemiology

Refractive errors are among the most common visual defects and include: myopia (when the image is focused in front of the retina), hyperopia (when the image is focused behind the retina), astigmatism (caused by irregular curvature of the cornea or lens, resulting in image distortion), and presbyopia (an age-related decline in accommodative ability, typically appearing after the age of 40).

The prevalence of refractive errors varies depending on geographic region and age group. In Europe, according to a meta-analysis involving over 61,000 adults aged 25-90 years, myopia was present in 30.6% of participants, hyperopia in 25.2%, and astigmatism in 23.9%. The highest prevalence of myopia - up to 47.2% - was observed in young adults aged 25–29 years (Williams et al., 2015).

In the United States, data from the NHANES study of over 12,000 individuals over the age of 20 showed that the prevalence of myopia was 33.1%, astigmatism 36.2%, and hyperopia (≥+3.0 D) 3.6%. Age-specific trends revealed that myopia was more common in younger adults, while hyperopia and astigmatism were more prevalent in older individuals (Vitale et al., 2008).

East Asia reports the highest rates of myopia. In Singapore, among adults over 40 years old, myopia was present in 38.9%, hyperopia in 31.5%, and astigmatism in 58.8%, with the highest figures observed in the Chinese population (Pan et al., 2013). In South Korea, myopia affected 51.9% of the population, and astigmatism 31.2%, with the highest prevalence among those aged 19-29 years (Rim et al., 2016).

Even though athletes are often seen as physically superior individuals, refractive errors occur in this population just as frequently as in the public - and could even be more common in certain sports. In a study conducted by Hashemi and colleagues (2018), 49% of Iranian sports science students had at least one refractive error. Myopia was observed in 42.7% of participants, astigmatism in 29.5%, and hyperopia in 3.8% (Hashemi et al., 2018).

Refractive errors in athletes may occur more frequently than commonly believed, and routine vision screenings often prove insufficient. In a study by Weise et al. (2021) involving 58 NCAA American football players, 60% reported never undergoing a comprehensive eye exam or having had their last exam more than 10 years prior. After thorough testing, visual acuity improved in 58% of study participants with proper correction. Moreover, 81% were found to meet conditions for visual improvement that could potentially affect safety and performance. Alarmingly, typically employed screening methods successfully identified only 7.5% of athletes with actual visual deficits (Weise et al., 2021).

Methods of Refractive Error Correction in Athletes

Selecting an appropriate method for refractive defect correction in athletes should take into consideration not only visual acuity but also safety during physical activity, the durability of the corrective effect, and its impact on spatial perception and reaction time. In team sports, where movement precision, rapid decision-making, and accurate distance estimation are of essence, proper vision correction can greatly enhance athletic performance.

Corrective eyeglasses, while being the simplest and most widely used solution, come with several limitations in the context of physical activity. Their use in contact or high-intensity sports poses a risk of mechanical injury, slippage of the frames, or damage during collisions. Additionally, glasses may restrict the visual field, introduce optical distortions -particularly in cases of high refractive power - and fog up during intense sweating or fluctuating temperatures, which can negatively affect spatial perception and athlete comfort (Queirós et al., 2012).

Contact lenses - especially silicone hydrogel soft lenses - offer an advantegous alternative in sports that require a wide visual field and dynamic movement. Their benefits include an improved field of view, optical stability, and the absence of peripheral image distortion which is commonly associated with glasses. However, lens use comes with specific complications, such as dry eye syndrome, corneal microtrauma, and increased risk of infection, especially with improper hygiene or prolonged wear (González-Pérez et al., 2019). Therefore, individual fitting and proper handling are of critical importance.

Many athletes choose surgical correction in order to improve vision quality without the need for glasses or contact lenses. The most commonly used techniques are LASIK (Laser-Assisted In Situ Keratomileusis) and PRK (Photorefractive Keratectomy), both of which enable permanent improvement in visual acuity. LASIK offers a faster recovery and reduced postoperative discomfort but carries a risk of corneal flap displacement in the event of ocular injury - an important consideration in contact sports. PRK, while associated with a longer recovery time, does not come with such a risk and is therefore considered safer for athletes involved in disciplines with a high risk of facial injuries (Karadağ, 2022), (Wagoner et al., 2010).

For individuals with high myopia, hyperopia, thin corneas, or contraindications to laser ablation, phakic intraocular lenses (ICLs) offer another viable option. These lenses are implanted while preserving the natural lens, allowing for high-quality vision without intervention into the cornea. Toric versions of ICLs are also available, effectively correcting concurrent astigmatism, making this a suitable option for athletes with complex refractive errors (Horáková et al., 2007), (Huang, 2009), (Alshamrani & Alharbi, 2019).

Orthokeratology (Ortho-K) is a non-surgical correction method involving wearing specially designed gas-permeable rigid lenses overnight to temporarily reshape the corneal surface. It results in clear daytime vision with no need for glasses or contact lenses. Ortho-K is recommended for individuals with mild to moderate myopia (up to approximately −6.00 D), low astigmatism (up to ~1.75 D), and for children or adolescents in order to slow myopia progression. For athletes, this method proves beneficial in contact, aquatic, or highly mobile sports where employing other methods may cause problems. Studies demonstrate that Ortho-K can provide functionally stable daytime vision after a few nights of use. Some users may experience a slight decrease in acuity toward evening. Contrast sensitivity is not significantly affected, and subjective visual quality is rated as good (Johnson et al., 2007).

The Impact of Vision Correction on Visual Function and Athletic Performance - A Review of Scientific Studies

Efficient function of the visual system - including movement precision, distance estimation, and rapid reaction time - is essential in team sports, where athletes must constantly respond to changing stimuli and dynamic game situations. Multiple studies indicate that even mild uncorrected refractive errors, such as myopia or astigmatism, can significantly impair visual perception and performance.

Chang et al. (2015) demonstrated that young tennis players with uncorrected myopia performed significantly worse on tests that measured depth perception and peripheral vision, which directly affected their trajectory tracking and overall game effectiveness. Impaired spatial awareness led to errors in decision-making and response time was slowed. Jorge et al. (2024) confirmed these findings in team sport athletes - those with full visual acuity performed better in tests evaluating reaction speed, object tracking, and tactical decision-making in game-like environments. This highlights the importance of effective refractive correction for optimizing cognitive performance in sports.

Experimental research also supports the notion that uncorrected visual impairments - particularly myopia - result in prolonged reaction times to visual stimuli. Mohanraj and Karthikeyan (2017) evaluated visual reaction times in three groups: emmetropic participants, individuals with uncorrected myopia, and those with optically corrected myopia. Results demonstrated that the uncorrected group had the longest reaction times, while the corrected myopia group still performed worse than the emmetropic control group. Although optical correction significantly improved visual function, it did not fully restore visuomotor efficiency.

This finding may be attributed to neuroadaptation to blurred or distorted input, which results in more complex and slower integration of visual stimuli with motor responses. In competitive sports, where milliseconds can determine the success, even slight delays in reaction time may reduce performance. Importantly, athletes presenting such deficits may be unaware of their impairments, particularly if the condition develops slowly over time. These findings highlight the need for regular assessment not only of visual acuity but also of spatiotemporal visual functions as a standard component of diagnostics for athletes, especially those involved in fast-paced, spatially demanding sports (Mohanraj & Karthikeyan, 2017).

In the context of adaptive changes, the findings of Wen et al. (2013) are particularly noteworthy. The authors compared neural activity in athletes and non-athletes during visual tracking tasks. EEG recordings showed that athletes exhibited significantly greater activity in cerebral regions responsible for visual perception and visuomotor integration - especially in the superior parietal lobule and visual cortex - and increased power in theta (4–7 Hz) and beta (13–30 Hz) frequencies, associated with attentional focus, sensory processing, and motor coordination. It suggests enhanced neuroplasticity and a greater readiness of the nervous system for dynamic sensory processing. In practical terms, this means that perceptual performance in athletes depends not only on visual acuity but also on efficiency in visual information processing and interpretation. These results may also explain why individuals with no prior adaptation to rapid sensory processing - such as recreational athletes - do not achieve the same performance outcomes even after vision correction; their neural systems are not tuned for high-efficiency sensory integration.

Further insights into functional asymmetries in vision depending on player position were provided by Barreto et al. (2023), who examined visual behaviors and cognitive load in football players during live 11-a-side games. Using mobile eye-tracking and pupil diameter measurements as indicators of attentional effort, the study revealed significant differences in gaze fixation patterns between players in different field positions. Pupil diameter also varied depending on position, suggesting different cognitive demands. This study highlights that athletes' visual fields and perceptual strategies are not only determined by visual correction but are also shaped by plastic adaptations and spatial orientation specific to their role on the field. These findings may help explain the incomplete restoration of perceptual performance following refractive correction, as the visual system is shaped also by long-term adaptation to environmental demands and functional roles in the game.

Reaction simulators and specialized sensory training tools, like Senaptec Sensory Station, are providing evidence that effective vision correction directly influences visuomotor performance in athletes. These tools can measure and train key functions like reaction time, multiple object tracking, visuomotor coordination, peripheral vision, and rapid visual information processing - crucial in team sports where players must simultaneously control the ball, track teammates and opponents, and make split-second decisions.

The findings of Jorge et al. (2024) further highlight this view. Using the Senaptec Sensory Station, they assessed visuomotor function in team sport athletes. Their study showed that athletes with properly corrected vision - whether via contact lenses or refractive surgery - achieved significantly better results in reaction time, multiple object tracking, and peripheral perception tests compared to those with uncorrected or suboptimally corrected vision. The most significant differences appeared in tasks requiring simultaneous tracking of multiple stimuli and rapid response to changing conditions. This shows that vision correction not only enhances static visual parameters such as acuity but also has an impact on complex cognitive-motor functions that are essential for high-level sports competition. Choosing the most appropriate correction method - tailored to the specific sport and competitive environment - can offer athletes a significant competitive advantage.

Study by Oliveira et al. (2025) assessed the impact of visual acuity on postural stability in elite football players. Objective balance tests were conducted under controlled conditions and with restricted visual input. The results showed that athletes with full visual acuity had significantly better postural stability with less fluctuation in balance, even under visually limited conditions. This suggests that precise visual input supports decision-making and reactive capabilities during play, as well as body biomechanics - particularly in disciplines requiring quick position shifts, rotations, and balance control, such as football, volleyball, and basketball. From a practical standpoint, this shows that uncorrected refractive errors may increase the risk of motor errors and injury.

Modern research regarding the topic offers new insights by employing novel techniques such as functional magnetic resonance imaging (fMRI) and virtual reality (VR) technology. An example is the experiment by Limanowski et al. (2017), in which participants, equipped with VR headsets, were instructed to track moving objects with their hand. In some trials, a deliberate delay was introduced between the actual hand movement and its visual representation in the VR environment, creating a sensory mismatch between perception and motor execution.

Functional MRI signal analysis showed that such sensory incongruence strongly activated brain regions responsible for error detection and action correction in the temporo-occipital gyrus and the posterior parietal cortex. Notably, the intensity of this activation increased proportionally with the visual delay. Task performance - measured by tracking accuracy - was significantly correlated with activation in previously mentioned brain areas, indicating that the nervous system dynamically adjusts motor control mechanisms based on the quality and reliability of visual input.

The findings of this study are critical for understanding the role of vision correction in athletic performance. Even minor disruptions in visual acuity, contrast sensitivity, or processing speed - potentially caused by uncorrected or improperly corrected refractive errors - can be a significant burden on the central nervous system. In other words, an athlete with suboptimal vision does not respond more slowly due to muscular or motor limitations, but because the brain must allocate more time and energy resources to interpret an imprecise visual image.

In the context of team sports - where milliseconds matter and players must simultaneously respond to multiple stimuli - any such cognitive deficit may result in decision-making errors, delayed reactions, and reduced tactical effectiveness. This study shows that effective vision correction is a key factor in optimizing visuomotor integration processes and minimizing the neurological cost of executing complex sports tasks.

Valuable insights into modern strategies for enhancing visuomotor functions in athletes are to be found in the study by Alwashmi et al. (2023), which employed perceptual training in virtual reality (VR) environments in order to stimulate integrated visual and auditory processing and evaluate its effects on motor responses and brain activity. Participants completed tasks requiring rapid responses to visual and auditory stimuli appearing in various spatial locations, designed to simulate dynamic and unpredictable conditions similar to real-life team gameplay.

Analysis showed that participation in VR training led to a significant reduction in reaction time and improved accuracy, suggesting enhanced visuomotor coordination. Additionally, fMRI scans revealed increased activation in key brain structures involved in multisensory processing and motor planning, which are not only crucial to visual and auditory perception but also for integrating sensory information and rapidly translating it into appropriate motor responses.

Although this study did not focus specifically on athletes with refractive errors, its findings hold significant implications for sports practice. Improving sensory integration - through both perceptual training and properly fitted vision correction - can enhance decision-making mechanisms and reaction times. This is especially critical in team sports, where players must instantly process visual cues and auditory signals, and even a slight delay can compromise performance.

The use of virtual technologies as a training tool may serve as a valuable addition to athletic preparation - both for individuals with normal vision and those who have undergone refractive correction. The application of VR appears to be particularly beneficial in the context of neuroplasticity, serving as a method for enhancing the nervous system's adaptation to new visual conditions - such as after surgery, a change in correction method, or recovery from ocular trauma.

Considering these findings, it can be assumed that effective vision correction combined with visuomotor training in realistic, simulation-based environments restores visual function and also significantly enhances athletes' perceptual-motor readiness for competition in dynamic, high-stimulus sports contexts.

Neuroimaging studies conducted on individuals with refractive visual impairments show that even during low-complexity motor tasks - such as saccades, the rapid, jerky eye movements used to shift visual attention - there is significantly increased brain activation. Specifically, research by Nelles et al. (2010) showed that individuals with even mildly reduced visual acuity demonstrated greater use of the fronto-parietal network and cortical areas responsible for visual information processing (both primary and secondary), compared to participants with normal vision. The authors interpreted these results as evidence of increased so-called"neurological cost, " associated with the need to compensate for imprecise visual data during movement planning and execution.

From an athlete's perspective, this means that an individual with uncorrected refractive error must use more cognitive and energetic resources to achieve the same level of functional performance as athletes with optimal visual acuity. Such compensation may lead to faster neural fatigue, slower reaction times, and decreased motor precision - particularly under dynamic and complex conditions characteristic of team sports. In situations requiring rapid visual attention shifts between teammates, opponents, the ball, and the environment, any inefficiency can compromise performance. These findings underscore that effective refractive correction enhances visual perception and reduces neural load, improving visuomotor efficiency and allowing athletes to focus more fully on executing tactical tasks during gameplay.

Practical Implications for Coaches, Sports Physicians, and Athletes

Findings from numerous studies clearly indicate that visual performance plays a fundamental role in achieving victory in team sports. Therefore, regular, specialized eye examinations and functional visual examinations should be an integral part of athletic preparation. Unfortunately, in practice, refractive errors often remain undiagnosed or are corrected inadequately for the demands of physical activity. Such shortcomings can significantly impair an athlete's performance - affecting spatial perception, distance judgment, motor accuracy, and reaction time. In professional sports, where outcomes are determined by fractions of a second, failing to account for visual deficits may severely limit an athlete's potential.

The selection of an appropriate vision correction method should be precisely tailored to the specific requirements of the sport. In contact sports (e.g., football, basketball, rugby), the use of eyeglasses may pose injury risks. Contact lenses, orthokeratology, or refractive surgery are preferred alternatives. Conversely, in disciplines requiring extreme precision and rapid response (e.g., volleyball, hockey), it is crucial to ensure maximum acuity, a wide field of vision, and correction stability even under fatigue or variable lighting conditions. Such personalized solutions optimize visual performance and minimize the risk of injuries caused by misjudgments.

In sports practice, it is essential to integrate visual system considerations into both training planning and athlete evaluation. Coaches should account for visual fitness when making decisions about player positioning, tactical roles, and the intensity of perceptual stimuli during training. Simple diagnostic tools - such as reaction time testing, peripheral vision assessment, or dynamic object tracking - can be highly effective in identifying hidden deficits that standard evaluations might overlook. Close collaboration between coaching staff, ophthalmologists, and optometrists enables precise optical correction and can result in the implementation of preventive and educational measures that enhance overall training effectiveness.

Sports physicians and optometrists should go beyond standard acuity measurements and include advanced functional tests - such as dynamic vision, stereopsis, visuomotor coordination, and accommodative-vergence functioning. The method of correction must be selected individually: high oxygen-permeable contact lenses are recommended for high-intensity sports, orthokeratology may suit younger athletes with progressive myopia, and surgical options (e.g., LASIK, ICL) may be optimal for athletes seeking permanent correction without daily lens wear. Monitoring visual fatigue is advised, as it can impair perception, decision speed, and response accuracy.

Educating athletes is also a critical component of visual performance strategy. Athletes should be informed that even seemingly minor refractive errors - such as myopia of –0.50 D - can adversely affect pass accuracy, distance judgment, and decision-making speed. Recognizing subtle signs of declining visual performance, such as delayed reactions, difficulty tracking a ball, or trouble adapting to light changes, enables early diagnostic and corrective intervention. It is also valuable to incorporate perceptual training into athletic programs - using modern technologies such as virtual reality (VR), augmented reality (AR), or reaction simulators - which support the development of visuomotor integration and can enhance performance in both corrected and visually healthy athletes.

Discussion and Future Research Perspectives

A review of the available literature clearly confirms that refractive errors significantly affect key perceptual–motor parameters in team sports, including reaction time, decision-making accuracy, depth perception, and spatial orientation. Uncorrected deficits - particularly myopia, hyperopia, and astigmatism - can lead to image distortion, restricted visual fields, and delayed reactions. These factors reduce tactical effectiveness and increase the risk of perceptual errors, which may lead to failed plays or injury (Chang et al., 2015). Various vision correction methods, such as contact lenses, orthokeratology, or refractive surgery, improve visual quality; however, research findings suggest that they do not always fully restore visuomotor efficiency. This may be due to long-standing alterations in perceptual–motor integration and adaptive changes in the central nervous system (Mohanraj & Karthikeyan, 2017).

These findings are supported by Jorge et al. (2024), who showed that athletes with properly corrected vision performed significantly better in tests of depth perception, dynamic object tracking, and rapid decision-making - abilities directly tied to sports performance. Furthermore, neuroimaging studies reveal that even minor visual deficits result in heightened activation in brain areas involved in motor control and visual processing, leading to a higher"neurological cost" of motor execution (Limanowski et al., 2017; Nelles et al., 2010; Alwashmi et al., 2023). In the context of team sports, which require instant reactions and decisions under time pressure and environmental variability, this increased cognitive load may contribute to earlier mental fatigue and decreased performance toward the end of a match.

Despite growing interest in this field, many areas remain underexplored. Current studies focus predominantly on visual acuity, often omitting more complex functions such as stereopsis, dynamic perception, or adaptation to changing play conditions (Weise et al., 2021). These skills determine effectiveness in team sports, where athletes must simultaneously track the ball, monitor their surroundings, assess opponents' positions, and make split-second decisions.

Moreover, most studies are conducted on general populations or focus on individual sports, whereas team sports involve higher dynamics and demand multitasking and interpersonal coordination (Fujii et al., 2014). Clinical guidelines for choosing appropriate vision correction based on sport-specific demands, environmental conditions, and individual characteristics are still lacking. Many athletes do not undergo regular specialized eye examinations, and decisions regarding correction are often made intuitively or for aesthetic reasons, without proper ophthalmic consultation or consideration of sport-specific needs (Beckerman & Hitzeman, 2001; Weise et al., 2021).

Given these limitations, further prospective studies involving athletes of different levels and disciplines are needed, especially those utilizing objective tools such as reaction simulators, multitasking tests, eye-tracking, and neuroimaging techniques (e.g., fMRI). Research evaluating the effects of various correction methods on perceptual–motor performance over time - and their correlation with sports outcomes - would be particularly valuable. Simultaneously, standardized vision screening should be implemented as part of athletic performance assessment, and coaches, physicians, and athletes should be informed about the impact of visual function on game effectiveness.

Conclusions

Refractive errors can significantly impair perceptual abilities, reaction time, and decision-making efficiency in team sports, where success often hinges on rapid situational analysis and precise execution. Although modern correction methods - optical (eyeglasses, contact lenses), surgical (LASIK, PRK, phakic intraocular lenses), and orthokeratology - offer real improvements in visual quality, their effectiveness depends on the athlete's individual profile and the specific demands of the sport.

Neglecting ophthalmic diagnostics, delaying correction implementation, or selecting a method unsuited to the playing conditions (e.g., physical contact, variable lighting) reduces athletic performance and increases the risk of injuries and tactical errors. Unfortunately, studies show that many athletes still do not undergo regular, comprehensive visual examinations, and decisions regarding correction are often made without professional consultation or awareness of their potential impact on performance.

Therefore, further interdisciplinary research is needed to include athletes across various sports and performance levels. Such studies should extend beyond standard acuity measurements to encompass more complex visuomotor functions - such as stereopsis, fatigue-related adaptation, and dynamic perception - and employ tools like reaction simulators, eye-tracking systems, and neuroimaging techniques. Standardized clinical and coaching guidelines should be developed to help coaches, sports physicians, and athletes manage vision correction as an integral component of motor preparation and overall sports performance optimization.

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