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CONTACT LENSES IN SPORTS: OCULAR ADVANTAGES, SAFETY RISKS, AND CLINICAL CONSIDERATIONS. A NARRATIVE REVIEW

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ABSTRACT

Background: There are several methods to achieve high visual acuity. One of them is contact lenses. Compared with glasses, they provide clear vision without spatial restrictions. Contact lenses do not block the field of view, work well with protective headgear, and do not fog, get wet, or collect sweat. On the other hand, physical exercise and specific sports environments create conditions that can influence the contact lens wearing experience.
Aim: The aim of this review was to evaluate ocular benefits, risks, and sports-related considerations of contact lens use in athletes.
Material and Methods: A narrative review was conducted using articles published in PubMed, Medline, EMBASE, Google Scholar, and the Cochrane Library, focusing on reviews, consensus statements, randomized trials and laboratory studies.
Results: Contact lens use is associated with both advantages and disadvantages. The benefits depend on different factors, such as blinking rate, tear film stability, lens fitting, material, types of exercises, meteorological conditions, water exposure, dehydration, and sweat.
Conclusion: To improve the experience of contact lens use, regular check-ups, a preference for daily disposable lenses, and the avoidance of water contact should be considered.

KEYWORDS
Contact Lenses, Athletes, Ocular Surface, Tear Film

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Introduction

The International Olympic Committee consensus statements on sports-related ophthalmology explicitly highlight that ocular health, functional vision monitoring and spatial visual testing should be seamlessly integrated into sports medicine screening protocols [1]. For athletes requiring vision correction choosing a method goes beyond convenience. Although regular glasses can provide adequate vision at rest, spectacle frames impose significant limitations, such as obstructing the field of view, fogging, and presenting a breakage risk [8]. Contact lenses eliminate these frame-related issues, providing an unobstructed view and allowing athletes to move unrestrictedly. Lens wear comfort depends on the lens material, surface wettability, the modulus of elasticity, fitting characteristics, and blinking rate [2, 3]. For athletes, these factors become even more critical. Athletes often face high aerodynamic stress, low humidity, air conditioning, dust, airborne debris, sweat, extreme temperatures, and prolonged visual attention that disrupts normal blinking [4, 10]. The use of contact lenses is a well-established risk factor for microbial eye infections [5]. Poor compliance behaviors - such as sleeping with lenses, inadequate hand hygiene, improper lens case care, and water exposure - greatly raise this risk [6]. The main challenge for optometrists and sports physicians is to determine which lens type and management strategy provide the optimal balance of clear vision, ocular homeostasis, and safety for a specific sport [1].

Beyond basic refractive compensation, athletic performance relies heavily on dynamic visual functions such as depth perception, binocular coordination, and peripheral awareness. Contact lenses maintain a consistent vertex distance and eliminate the minification or magnification effects commonly introduced by thick corrective spectacle lenses, thereby preserving natural spatial orientation [8, 9]. Furthermore, high-level sports frequently demand rapid shifts of gaze and intense tracking of fast-moving objects, tasks that can be severely hindered by the restricted frame boundaries or optical aberrations inherent in traditional eyewear [1].

The physiological interaction between the ocular surface and contact lens polymers is profoundly tested during rigorous physical exertion. Elevated core body temperatures and profuse facial sweating introduce hypertonic fluid and lipid debris directly to the periorbital region, which can easily migrate into the pre-lens tear film [10, 16]. This chemical alteration shifts tear osmolarity and accelerates lipid deposition on the lens

matrix, triggering localized irritation, inflammatory responses, and early visual degradation during prolonged competitive events [11, 17].

Environmental exposures further complicate the physiological equilibrium of contact lens wear in active populations. Outdoor disciplines subject the eye to continuous high-velocity airflow, ultraviolet radiation, and airborne particulates that exacerbate pre-lens tear film evaporation and induce mechanical micro-abrasions [4, 10]. Conversely, indoor athletic venues present microclimates governed by artificial climate control, low relative humidity, and thermal fluctuations that challenge corneal hydration and increase the overall risk of contact lens discomfort and wear discontinuation [3, 4].

In addition to environmental and physiological stressors, the neurological integration of visual feedback plays an essential role in athletic execution. Contact lenses eliminate the prismatic distortions and peripheral blind spots associated with heavy frames, allowing the central nervous system to process retinal images with greater spatial fidelity and shorter response latencies during high-speed motor coordination tasks [1, 9]. This seamless visual input directly supports elite athletes in maintaining superior hand-eye coordination and spatial positioning across unpredictable competitive fields.

Furthermore, recent breakthroughs in material science, such as biomimetic surface coatings, phosphorylcholine integration, and advanced wetting agents, have significantly transformed the interaction between modern polymers and the ocular surface [3, 11]. These molecular refinements help stabilize the tear film and mitigate friction under high airflow conditions, offering a more reliable wearing experience for endurance and outdoor athletes [14, 16]. Nevertheless, technological innovations must be paired with disciplined wearer habits to fully prevent adverse ocular events [6, 23].

Finally, navigating the balance between optimal athletic functionality and ocular safety requires a comprehensive understanding of risk management. While technological breakthroughs in silicone hydrogel chemistry and daily disposable modalities have greatly enhanced oxygen transmissibility and surface biocompatibility, patient compliance remains the single most critical determinant of long-term ocular health [14, 23]. Establishing evidence-based clinical guidelines and pre-season screening protocols is therefore paramount to mitigating sight-threatening complications while maximizing visual efficiency across diverse athletic disciplines [1, 5].

This review aims to synthesize clinical data regarding the properties of contact lenses, including their material composition, ocular surface interactions, and sports-related complications. Specifically, it addresses the risks of microbial infection, water exposure hazards, aerodynamic and environmental impacts, and the potential for ocular injury in athletes.

Methodology

To capture and critically evaluate the complex interplay between athletic environments, visual correction demands, ocular surface homeostasis, and contact lens performance, this article employed a multidisciplinary literature review across clinical ophthalmology, sports optometry, polymer chemistry, sports medicine, and environmental physiology. The investigative timeline was strategically bounded between 2016 and 2026 to ensure that synthesized empirical evidence captures the present generation of advanced silicone hydrogel materials, high-precision tear film analyzers, continuous telemetric monitoring systems, and contemporary guidelines in sports ophthalmology. Early foundational publications were selectively retained only when they provided essential theoretical frameworks necessary for interpreting corneal metabolism, microbial biofilm formation, and ocular viscoelasticity under physical exertion.

Search Strategy and Information Sources

Information retrieval was executed across major international biomedical databases: PubMed, MEDLINE, the Cochrane Database of Systematic Reviews, EMBASE, and Google Scholar. The electronic search strategy incorporated targeted, Boolean-linked keyword strings designed to capture the intersection of athletic visual demands, contact lens interactions, and environmental stress factors, including:

- ("contact lens" OR "contact lenses" OR "soft contact lenses") AND ("athlete" OR "athletes" OR "sports" OR "sports ophthalmology")
- ("contact lens discomfort" OR "ocular surface" OR "dry eye" OR "tear film stability") AND ("physical exertion" OR "exercise" OR "sports environment")

- ("microbial keratitis" OR "Pseudomonas aeruginosa" OR "Acanthamoeba" OR "biofilm formation") AND ("non-compliance" OR "lens hygiene" OR "water exposure")
- ("oxygen transmissibility" OR "corneal hypoxia" OR "silicone hydrogel" OR "hydrogel polymers") AND ("material composition" OR "dehydration" OR "surface wettability")
- ("environmental stress" OR "wind velocity" OR "low humidity" OR "altitude") AND ("visual performance" OR "protective eyewear" OR "ocular trauma")

Inclusion and Exclusion Criteria

o Retrieved articles were screened and deemed eligible for inclusion if they satisfied at least one of the following operational inclusion criteria:

- Evaluated contact lens use, visual performance, or refractive correction strategies specifically in elite or recreational athletes, sports training, or active physical exercise settings;
- Investigated the impact of physical activity, aerodynamic stress, or environmental variations (e.g., wind, dust, temperature fluctuations, and humidity) on the ocular surface, tear film stability, and contact lens wearer comfort;
- Analyzed cellular metabolism, oxygen transmissibility, hypoxia-related alterations, or material responses to different lens modalities, including conventional hydrogels, silicone hydrogels, and rigid gas-permeable lenses;
- Documented infectious risks, microbial keratitis, biofilm synthesis, or the impact of non-compliance, improper lens care, and water exposure (such as swimming or aquatic sports);
- Addressed sports-related ocular trauma, prevention protocols, or the integration of contact lenses with certified protective sports eyewear and headgear.

o Conversely, publications were systematically excluded if they met any of the following criteria:

- Did not directly address visual science, contact lenses, ocular surface physiology, sports medicine guidelines, or optometric evaluations;
- Evaluated non-lens-related general athletic vision training or surgical refractive corrections (e.g., LASIK or PRK) without addressing contact lens wear;
- Consisted of commercial product manuals, non-refereed fitness blogs, popular media articles, or opinion-based commentary lacking structured empirical metrics;
- Manuscripts without available full English text.

Finally, investigations focusing solely on geriatric populations, pathological dry eye syndromes unrelated to physical activity or lens wear, or systemic non-ophthalmic medical conditions were kept outside the scope of this review. The physiological tear film dynamics, environmental exposure levels, and physical demands of non-athletic cohorts lack the specific high-velocity airflow, sweat intrusion, and mechanical challenges typical of active sports and athletic training environments.

Results

The most frequently reported benefit of contact lenses in a sports setting is the complete elimination of the physical spectacle frame. This change provides the athlete with an unobstructed horizontal and vertical visual field, which is critical in team sports and combat sports where rapid horizontal eye movements, motion detection, and close contact with other players are needed [8]. Since a contact lens moves synchronously with the eye, it remains aligned with the line of sight, thereby removing peripheral distortions and areas where vision is blocked. This design also eliminates common spectacle-related complications, such as lens fogging, sweat accumulation, and frame displacement [8].

Additionally, contact lenses offer greater optical stability compared with glasses, which can move or slide down the nose during sports that involve high impact or rapid changes in speed. However, it is important to understand the distinction between visual correction and actual athletic performance enhancement. While contact lenses address mechanical issues associated with glasses, there is currently insufficient evidence to suggest they improve performance for individuals who already have good uncorrected vision [1].

Contact lens discomfort remains a primary reason for lens wear discontinuation. Introducing a contact lens inherently disrupts ocular surface homeostasis by splitting the tear film into two layers, which causes the lipid layer to become unstable faster. This mechanism leads to increased tear evaporation and elevated friction [2, 11]. Moreover, physical activity can exacerbate these issues because aerodynamic stress during sports like

running or cycling accelerates tear film evaporation [10]. Furthermore, prolonged visual concentration is associated with a lower blinking rate, which can lead to greater ocular dryness [4]. An athlete during sports experiences accelerated dehydration, which can also adversely influence the ocular surface. Sweat intrusion into the eyes can alter tear osmolarity and cause mechanical irritation. That is why athletes with pre-existing ocular conditions need to be evaluated carefully before wearing contact lenses for long periods of athletic activity [1].

Traditional types of contact lenses rely mostly on their water content to transport oxygen; consequently, these lenses feature a higher water content and retain a large amount of unbound water within their matrix [3, 14]. This structure is associated with increased water loss [16], which forces the lens to draw fluid from the tear film, thereby drying out the eye and causing discomfort [16]. Newer lenses are composed of a silicone hydrogel matrix with specialized channels for oxygen transmissibility, meaning they dehydrate more slowly under windy conditions. However, the hydrophobic silicone phase can attract lipids from the tear film, which alters surface wettability and can also induce dryness during sports activities [3, 11].

Immediately upon insertion, the contact lens matrix adsorbs components from the tear film, establishing a deposition layer of proteins and lipids. Proteins like lysozyme, lactoferrin, and albumin adhere to the substrate, while lipids derived from the meibomian glands deposit onto the hydrophobic regions of the lens [3, 11]. When an athlete performs, core body temperature increases, and hypertonic sweat accumulates near the eyes. This process can cause the proteins on the lens surface to denature [3]. These denatured proteins can irritate the palpebral conjunctiva, manifesting as ocular erythema and visual degradation during competition [17].

The cornea is an avascular tissue that derives its oxygen supply primarily from the atmospheric oxygen dissolved in the tear film. The placement of a contact lens creates a physical barrier to this diffusion, necessitating material characteristics that facilitate adequate oxygen transmissibility. The elevated metabolic demands during athletic exertion, combined with the necessity for optimal visual acuity during competition, require precise lens selection to mitigate the risk of corneal hypoxia [18]. Modern silicone hydrogel matrices exhibit significantly higher oxygen transmissibility than traditional materials, effectively reducing hypoxia-related complications such as corneal edema and epithelial microcysts [14, 18]. However, superior oxygen permeability does not universally guarantee optimal performance for every athlete. Surface wettability, material modulus, and biocompatibility with multipurpose solutions are equally critical parameters. Indeed, robust clinical evidence indicates that silicone hydrogel lenses do not demonstrate a definitive advantage over conventional hydrogels regarding subjective comfort or the overall incidence of adverse events [14]. Consequently, lens selection for athletes should extend beyond material classification to consider wear modality, sport-specific demands, individual blinking dynamics, and patient compliance with maintenance protocols.

Contact lens wear is inherently associated with localized complications, including conjunctival hyperemia, inflammatory responses, and infectious keratitis [5]. These adverse events are frequently mediated by mechanical friction or immunologic reactions to lens care solutions [17, 21]. The physiological and environmental stressors encountered during sports can exacerbate these pathologies. Outdoor athletic environments introduce substantial quantities of dust, sand, and particulate matter, which can infiltrate the post-lens tear film [4]. During blinking or manual ocular manipulation, these foreign bodies can induce corneal epithelial abrasions [16]. Crucially, contact lenses do not provide mechanical ocular protection. In high-impact or contact sports, a contact lens offers no defense against blunt force trauma. Relying on contact lenses as a substitute for certified protective eyewear presents a severe risk and can lead to catastrophic ocular injuries [1].

Microbial keratitis represents the most severe and sight-threatening complication associated with contact lens wear. The primary driving factors for this risk include non-compliance with hygiene protocols, such as inadequate hand hygiene, improper lens case maintenance, and exposure of the lenses to non-sterile water [5, 6, 22]. *Pseudomonas aeruginosa* poses a critical threat due to its rapid proliferation and virulent capacity to induce extensive corneal destruction [15, 22]. Other prevalent pathogens encompass *Staphylococcus aureus* and various environmental opportunistic bacteria. Athletes are predisposed to elevated pathogen colonization due to handling lenses with sweat-contaminated hands, exposure to bioaerosols in outdoor settings, and extended wear durations without timely disinfection [6, 10, 23]. Strict adherence to prescribed lens care and replacement schedules remains the most effective preventive strategy against infectious keratitis [6, 22].

Recent advancements in high-throughput sequencing have elucidated how contact lens wear alters the ocular surface microbiome. Evidence demonstrates that lens wear significantly modulates the commensal bacterial community, reducing microbial diversity and shifting the profile toward a composition resembling skin flora, characterized by an increased abundance of *Pseudomonas*, *Acinetobacter*, *Methylobacterium*, and

Staphylococcus species [24]. Pathogenic bacteria adhere to the lens matrix by binding to the adsorbed tear pellicle of proteins and lipids [25]. Once attached, these microorganisms synthesize an extracellular polymeric substance matrix composed of polysaccharides, proteins, and extracellular DNA, establishing a structured biofilm [26]. In athletes utilizing reusable lens modalities, these biofilms can develop within lens cases or on the lens substrate itself, shielding the incorporated bacteria from the antimicrobial action of disinfection systems [21, 26]. Furthermore, bacteria within the biofilm utilize quorum sensing to coordinate phenotypic shifts and upregulate virulence factors, exacerbating ocular tissue damage, particularly if the corneal epithelium has been compromised by mechanical friction or dryness [26].

Systematic medical consensus evaluating water-lens interactions establishes a definitive causal link between water exposure and severe corneal pathologies, strongly emphasizing that water contact during lens wear must be absolutely avoided [12, 19]. Both hydrogel and silicone hydrogel polymers are highly porous materials that absorb environmental pathogens from aqueous environments [25]. *Acanthamoeba* keratitis is a devastating corneal infection linked almost exclusively to water exposure in contact lens wearers. This protozoan exists in two distinct morphological stages: an active trophozoite form and a highly resilient, dormant cyst form that exhibits extreme resistance to standard chemical disinfection systems and municipal tap water chlorination [28, 29]. Following corneal epithelial infiltration, *Acanthamoeba* induces severe pain, perineural infiltrates, and progressive stromal ulceration [28]. Athletes must be educated to never rinse or store lenses and cases in tap water, and to avoid handling lens modalities with wet hands [12, 19].

The microenvironment surrounding an athlete fundamentally modulates lens performance and visual comfort. Low ambient humidity accelerates pre-lens tear film evaporation, causing rapid lens dehydration, which alters parameters, increases fitting tightness, restricts tear exchange, and induces ocular discomfort [4]. Concurrent high aerodynamic stress drastically compounds this evaporative dehydration [10]. Disciplines such as cycling, long-distance running, downhill skiing, and speed skating subject the ocular surface to continuous, high-velocity airflow [4]. Conversely, indoor sports facilities frequently feature controlled microclimates - governed by air conditioning, refrigeration units, or indoor heating - that generate localized low-humidity environments. Thermal extremes also impose physiological challenges; winter sports expose lenses to freezing ambient winds, which can accelerate lipid deposition and increase the elastic modulus of the polymer matrix [3, 11]. Arid, high-temperature environments induce severe evaporative stress, destabilizing the tear film. Additionally, athletes training or competing at high altitudes face a triad of environmental challenges: extreme low humidity, high wind velocities, and reduced atmospheric oxygen tension [1, 18]. The optimal clinical approach is not the discontinuation of lens wear, but rather the strategic selection of lens modalities engineered to withstand environmental stress, combined with the use of protective wrap-around sports eyewear [4].

Although silicone hydrogel lenses offer superior oxygen transmissibility, material selection cannot be based on a single characteristic. Modern hydrogel lenses incorporating materials such as phosphorylcholine or hyaluronic acid demonstrate significantly improved surface wettability, lower friction coefficients, and enhanced resistance to dehydration. These properties are particularly advantageous for athletes exposed to high wind velocities [3, 11]. Daily disposable lenses represent a highly practical and clinically sound option for athletic populations, effectively eliminating the compliance challenges and microbiological hazards associated with lens reuse [1, 23]. Adherence to prescribed replacement schedules is paramount; wearing a lens beyond its indicated duration simply because it remains comfortable is strictly counterindicated [7, 13, 20]**.** For athletes utilizing reusable modalities, rigorous disinfection protocols are mandatory, including the use of hydrogen peroxide systems alongside meticulous lens case cleaning and air-drying [7, 21, 22]. The rate of lens dehydration is heavily mediated by ambient humidity and temperature [4, 10]. In high-water-content hydrogel lenses, rapid airflow accelerates water loss, which draws fluid away from the pre-lens tear film and induces corneal dryness [16]. Conversely, silicone hydrogel matrices feature lower water content and utilize specialized silicone channels for oxygen transport, thereby demonstrating a slower dehydration rate under dynamic air movement [14, 16]. However, their hydrophobic silicone phase remains highly susceptible to lipid deposition, which can alter surface characteristics and induce dryness during prolonged athletic performance [3, 11].

Discussion

The integration of contact lenses into competitive and recreational sports represents a complex intersection of visual optics, ocular surface physiology, and environmental ergonomics. While standard spectacles have historically served as the default refractive correction method, their structural and mechanical limitations—such as peripheral obstruction, frame displacement, fogging, and vulnerability to impact damage—render them suboptimal for dynamic athletic environments [1, 8]. Contact lenses successfully eliminate these frame-related barriers, offering an unobstructed visual field, stable vertex distance, and uninhibited freedom of movement [1, 9]. However, placing a synthetic polymer directly onto the living cornea introduces a cascade of physiological, biomechanical, and microbiological challenges that are significantly magnified by the unique stressors of physical exertion [2, 10].

As outlined in **Table 1**, the physiological demands, environmental stressors, and corrective strategies vary significantly across diverse athletic disciplines—ranging from wind-driven desiccation in endurance running and cycling to severe microbial contamination hazards in aquatic sports.

Table 1. Comprehensive Sport-Specific Contact Lens Fit Matrix and Stress Tolerances.

Sport Category	Functional Advantages	Ocular Concerns & Hazards	Practical Recommendations
Running / Track	No frame slippage or bounce; wide horizontal peripheral awareness lanes.	Continuous wind-driven pre-lens desiccation, dust micro-particulates, heavy sweat entry [4, 10].	Assess dynamic tear-film breakup times; prioritize biomimetic daily disposable polymers [1,23].
Cycling (Road/MTB)	Absolute helmet alignment stability; frame-free gaze lines.	High-velocity laminar airflow, flying insect collisions, soil or sand grain tracking [4,10].	Mandate high-wrap impact-resistant polycarbonate sunglasses or shields over daily lenses [1,7].
Football / Soccer	Eliminates mud streaks or sudden spectacle displacement.	Sweat osmolarity shifts, grass/lime dust micro-abrasions, conjunctival dirt ingress [4,10].	Utilize single-use daily disposable modalities; immediate disposal post-competition [1,23].
Racket Sports	Optimal spatial binocular vision tracking; no blind spot tracking.	High orbital trauma index from balls/rackets, heavy facial perspiration accumulation [1].	Optimize sphere/cylinder corrections; utilize polycarbonate sports goggles over lenses [1,7].
Basketball / Court	Expands horizontal visual scanning fields for tactical execution.	Forced climate air conditioning desiccation, physical finger strikes from opponents [1,4].	Monitor for corneal abrasions; advocate external ASTM-certified face shields [1,7].
Winter Sports	Total elimination of spectacle lens fogging inside thermal hoods.	Severe cold, dry mountain air desiccation, elevated high-altitude hypoxia risks [3,11,18].	Integrate UV-blocking polymers combined with fully sealed thermal snow goggles [1].
Swimming / Aquatic	Gross orientation and navigational field preservation between legs.	Extreme risk of bacterial (Pseudomonas) and protozoan (Acanthamoeba) keratitis [19,22,28].	Strictly remove lenses prior to water entry; substitute with watertight custom prescription goggles [12,19,27].
Combat Arts	Preserves basic spatial positioning metrics without dangerous hardware.	Severe direct blunt force trauma, high globe rupture index, lens displacement [1].	Lenses offer zero protective value; mandate instant removal and ophthalmic screening post-bout [1,7].
Precision Sports	Perfect pupillary alignment stability; avoids frame prism distortions.	Severe blink suppression desiccation, microscopic focus fluctuations during aiming [4,9].	Perform specialized sport-specific custom trials; choose low-dehydration polymers [14,18].

A primary theme emerging from the literature is the profound disruption of ocular surface homeostasis induced by contact lens wear during athletic activity. Under resting conditions, the pre-lens tear film is maintained through a delicate balance of blink dynamics, lipid layer secretion, and aqueous tear production [2, 11]. During intense physical training, this equilibrium is heavily compromised. Endurance athletes, cyclists, and runners experience high aerodynamic stress from continuous high-velocity airflow, which drastically accelerates pre-lens tear film evaporation [4, 10]. Furthermore, intense athletic concentration and fast-paced visual tracking are frequently associated with a compensatory reduction in spontaneous blink rates, leading to localized dry spots, increased friction, and accelerated lens dehydration [4, 9]. Our analysis indicates that the rate of dehydration is fundamentally governed by the material composition of the lens. Traditional high-water hydrogel lenses rely heavily on unbound water within their matrix; under windy or arid conditions, these lenses rapidly lose moisture, drawing fluid directly from the pre-lens tear film and inducing significant corneal desiccation and discomfort [3, 14].

In contrast, modern silicone hydrogel polymers incorporate specialized silicone channels that facilitate superior oxygen transmissibility while featuring a lower initial water content, thereby mitigating rapid evaporative water loss during dynamic physical exertion [14, 18]. However, the hydrophobic nature of the silicone phase introduces a distinct clinical trade-off: it exhibits a high affinity for tear-film lipids and proteins [3, 11]. When athletes experience elevated core body temperatures and heavy facial sweating, hypertonic sweat and denatured organic deposits accumulate on the lens surface [10, 17]. This deposition layer alters surface wettability, increases friction coefficients, and can trigger localized palpebral conjunctivitis and visual blurring during peak athletic performance [3, 16]. Consequently, material selection must be carefully tailored to the specific environmental and physiological profile of the sport, balancing oxygen permeability against surface wettability and deposit resistance [1, 14].

Beyond material interactions, the microbiological and infectious risks associated with athletic contact lens wear demand rigorous clinical vigilance. The ocular surface microbiome undergoes a distinct compositional shift during contact lens wear, characterized by reduced microbial diversity and an increased relative abundance of opportunistic pathogens such as Staphylococcus, Acinetobacter, and Pseudomonas species [24]. In athletic settings, the probability of contamination is significantly compounded by environmental factors and behavioral non-compliance [5, 6]. Athletes frequently handle lenses with sweat-contaminated hands, store them in poorly maintained cases, or expose them to bioaerosols and particulate matter during outdoor training [10, 23]. Once pathogenic bacteria adhere to the adsorbed tear pellicle on the lens matrix, they synthesize an extracellular polymeric substance, establishing a robust biofilm that shields the microorganisms from the antimicrobial action of multi-purpose disinfection solutions [25, 26].

Among infectious complications, microbial keratitis remains the most sight-threatening hazard, with virulent organisms capable of inducing rapid and catastrophic corneal destruction [15, 22]. Furthermore, water exposure represents a critical and often underestimated risk factor across aquatic and outdoor disciplines [12, 19]. Both hydrogel and silicone hydrogel lenses act as porous sponges capable of absorbing environmental microorganisms from non-sterile water sources [25]. The association between water exposure and Acanthamoeba keratitis is particularly devastating; the resilient cyst form of this protozoan exhibits extreme resistance to standard chemical disinfection systems and municipal water treatment, leading to agonizing stromal infiltration and permanent visual impairment [28, 29]. Given these severe risks, international consensus guidelines firmly dictate that contact lenses must never be worn during swimming, water sports, or exposure to untreated water, and that daily disposable modalities should be strongly prioritized to eliminate the breeding grounds associated with reusable lens cases [1, 19, 23].

It is also vital to address the persistent misconception regarding the mechanical protection afforded by contact lenses. Unlike certified polycarbonate sports eyewear or custom protective face shields, soft and rigid contact lenses provide zero defense against blunt force trauma, high-velocity projectiles, or accidental digital strikes from opposing players [1, 7]. In high-impact team sports, combat arts, and racquet disciplines, relying on contact lenses as a substitute for certified protective gear introduces an unacceptable risk of globe rupture and severe ocular trauma [1]. Sports physicians and optometrists must therefore educate athletes that contact lenses serve strictly to optimize visual acuity and spatial awareness, and must be worn in conjunction with appropriate external protective equipment rather than in place of it [1, 7].

Furthermore, contact lens compliance requires an individualized approach that accounts for environmental extremes and mechanical trauma risks. To address these discipline-specific challenges, Table 2 provides a comprehensive matrix of functional advantages, ocular hazards, and practical recommendations for various sports, ranging from endurance running to aquatic and combat disciplines.

Table 2. Summary of Practical Clinical Guidelines and Behavioral Prioritization for Athletes.

Clinical Guideline / Recommendation	Scientific & Physiological Rationale
Individual sport-specific fitting	Mechanical stability and spatial visual parameters vary between disciplines [1, 9].
Absolute avoidance of water contact	Blocks environmental pathogens from binding to the lens [19, 25, 26].
Rigorous hand hygiene protocols	Minimizes bacterial cross-contamination during insertion and removal [6, 22].
Zero overnight wear (no sleeping)	Eliminates prolonged corneal hypoxia and drops infection rates dramatically [14, 18].
Strict adherence to replacement timelines	Prevents surface organic deposit layer build-up and biofilm initiation [3, 26].
Prioritize daily disposable modalities	Eliminates contaminated storage cases and solution toxicity vectors [21, 23].
Pre-season ocular surface optimization	Identifies and treats dry eye or MGD to ensure long-term wear tolerance [2, 11].
Mandatory external polycarbonate protection	Contact lenses offer zero mechanical protection against high-velocity trauma [7].
Carry alternative backup correction	Ensures immediate visual restoration if a lens is lost or dislodged [8].
In-field environmental wear trials	Clinic testing cannot replicate extreme wind, humidity, or altitude conditions [4, 10].

Finally, the translation of these clinical findings into practical sports medicine protocols requires a proactive, individualized approach. Pre-season screening must evaluate baseline tear film stability, meibomian gland function, and individual refractive demands to tailor the optimal lens modality for each athlete [1, 2]. Incorporating field-based environmental trials allows clinicians to assess how a specific lens performs under extreme wind, humidity, or altitude conditions that cannot be fully replicated in a clinical exam room [4, 10]. By enforcing strict hygiene compliance, eliminating overnight wear, advocating for daily disposable options, and mandating appropriate external eye protection, sports practitioners can successfully harmonize visual optimization with uncompromising ocular safety [1, 6, 14].

Conclusion: Contact lenses provide a practical and effective method for refractive correction in athletes, particularly when spectacles are contraindicated due to displacement, fogging, or compatibility issues with protective gear. Daily disposable lenses represent a highly advantageous modality for athletic populations, eliminating maintenance challenges and reducing the incidence of infection. Modern silicone hydrogel matrices offer superior oxygen transmissibility compared with traditional hydrogels, thereby mitigating the risk of corneal hypoxia. However, ocular dryness, inflammatory responses, and severe corneal infections can occur if compliance protocols are neglected. Furthermore, contact lenses provide no mechanical protection. Water exposure represents a critical hazard for serious ocular infections, including *Acanthamoeba* keratitis, which is of paramount importance in swimming and aquatic sports. When managed with strict adherence to safety protocols, contact lenses offer an optimal balance of optimal vision and ocular safety for athletes.

REFERENCES

1. Moe, M. C., Özmert, E., Baudouin, C., Binadra, A., Crafoord, S., Jo, Y., & International Olympic Committee. (2023). International Olympic Committee (IOC) consensus paper on sports-related ophthalmology issues in elite sports. *BMJ Open Sport & Exercise Medicine, 9*(3), Article e001644. https://doi.org/10.1136/bmjsem-2023-001644
2. Jones, L., Efron, N., Bandamwar, K., Barnett, M., Jacobs, D. S., Jalbert, I., Pult, H., Robertson, D. M., & Woods, C. (2023). TFOS Lifestyle: Impact of contact lenses on the ocular surface. *The Ocular Surface, 29*, 175–219. https://doi.org/10.1016/j.jtos.2023.04.010
3. Jones, L., Brennan, N. A., González-Méijome, J., Lally, J., Maldonado-Codina, C., Schmidt, T. A., Subbaraman, L., Young, G., & Nichols, J. J. (2013). The TFOS International Workshop on Contact Lens Discomfort: Report of the Contact Lens Materials, Design, and Care Subcommittee. *Investigative Ophthalmology & Visual Science, 54*(11), TFOS37–TFOS70. https://doi.org/10.1167/iovs.13-13215
4. López-de la Rosa, A., Martín-Montañez, V., López-Miguel, A., Fernández, I., Calonge, M., González-Méijome, J. M., & González-García, M. J. (2017). Ocular response to environmental variations in contact lens wearers. *Ophthalmic and Physiological Optics, 37*(1), 60–70. https://doi.org/10.1111/opo.12338
5. Lim, C. H. L., Stapleton, F., & Mehta, J. S. (2018). Review of contact lens-related complications. *Eye & Contact Lens: Science & Clinical Practice, 44*(Suppl 2), S1–S10. https://doi.org/10.1097/ICL.0000000000000481
6. Stellwagen, A., MacGregor, C., Kung, R., Konstantopoulos, A., & Hossain, P. (2020). Personal hygiene risk factors for contact lens-related microbial keratitis. *BMJ Open Ophthalmology, 5*(1), Article e000476. https://doi.org/10.1136/bmjophth-2020-000476
7. Sindt, C., Bennett, E., Szczotka-Flynn, L., Sclafani, L., Barnett, M., American Academy of Optometry Section on Cornea, Contact Lenses & Refractive Technologies, & American Optometric Association Contact Lens and Cornea Section. (2020). Technical report: Guidelines for handling of multipatient contact lenses in the clinical setting. *Optometry and Vision Science, 97*(8), 544–548. https://doi.org/10.1097/OPX.0000000000001547
8. Spinell, M. R. (1993). Contact lenses for athletes. *Optometry Clinics, 3*(1), 57–76.
9. Jorge, J., & Fernandes, P. (2019). Static and dynamic visual acuity and refractive errors in elite football players. *Clinical and Experimental Optometry, 102*(1), 51–56. https://doi.org/10.1111/cxo.12812
10. Strózik, A., Syguda, A., Szcześniak, A., Matyja, W., & Tarnawska, K. (2026). Dry eye disease and ocular surface disorders in endurance athletes - A narrative review of current evidence and prevention strategies. *Quality in Sport, 68*, Article 74355. https://doi.org/10.12775/QS.2026.68.74355
11. Papas, E. B., Ciolino, J. B., Jacobs, D., Miller, W. L., Pult, H., Sahin, A., Srinivasan, S., Tauber, J., Wolffsohn, J. S., & Nelson, J. D. (2013). The TFOS International Workshop on Contact Lens Discomfort: Report of the Management and Therapy Subcommittee. *Investigative Ophthalmology & Visual Science, 54*(11), TFOS183–TFOS203. https://doi.org/10.1167/iovs.13-13166
12. Zimmerman, A. B., Richdale, K., Mitchell, G. L., Kinoshita, B. T., Lam, D. Y., Wagner, H., Sorbara, L., Chalmers, R. L., Collier, S. A., Cope, J. R., Rao, M. M., Beach, M. J., & Yoder, J. S. (2017). Water exposure is a common risk behavior among soft and gas-permeable contact lens wearers. *Cornea, 36*(8), 995–1001. https://doi.org/10.1097/ICO.0000000000001204
13. Nichols, J. J., Willcox, M. D., Bron, A. J., Belmonte, C., Ciolino, J. B., Craig, J. P., Dogru, M., Foulks, G. N., Jones, L., Nelson, J. D., Nichols, K. K., Purslow, C., Schaumberg, D. A., Stapleton, F., & Sullivan, D. A. (2013). The TFOS International Workshop on Contact Lens Discomfort: Executive summary. *Investigative Ophthalmology & Visual Science, 54*(11), TFOS7–TFOS13. https://doi.org/10.1167/iovs.13-13212
14. Haworth, K., Travis, D., Leslie, L., Fuller, D., & Pucker, A. D. (2023). Silicone hydrogel versus hydrogel soft contact lenses for differences in patient-reported eye comfort and safety. *Cochrane Database of Systematic Reviews, 2023*(9), Article CD014791. https://doi.org/10.1002/14651858.CD014791.pub2
15. Linaburg, T. J., & Hammersmith, K. M. (2024). Contact lens-related corneal infections. *Infectious Disease Clinics of North America, 38*(4), 795–811. https://doi.org/10.1016/j.idc.2024.07.010
16. Phan, C. M., Wy Chan, V., Drolle, E., Hui, A., Ngo, W., Bose, S., Shows, A., Liang, S., Sharma, V., Subbaraman, L., Zheng, Y., Shi, X., Wu, J., & Jones, L. (2024). Evaluating the in vitro wettability and coefficient of friction of a novel and contemporary reusable silicone hydrogel contact lens materials using an in vitro blink model. *Contact Lens and Anterior Eye, 47*(2), Article 102129. https://doi.org/10.1016/j.clae.2024.102129
17. Abdelaziz, O., Ghalibafan, S., Ruiz-Lozano, R. E., Peterson, J. C., Gallo, R. A., & Djalilian, A. R. (2026). Contact lens-associated ocular surface and corneal disorders. *Methods and Protocols, 9*(3), Article 95. https://doi.org/10.3390/mps9030095
18. Schnell, D., & Khaireddin, R. (2013). Hornhautstoffwechsel unter Kontaktlinsen im Sport [Corneal metabolism with contact lenses in competitive sports]. *Der Ophthalmologe, 110*(6), 502–510. https://doi.org/10.1007/s00347-012-2770-1
19. Arshad, M., Carnt, N., Tan, J., Ekkeshis, I., & Stapleton, F. (2019). Water exposure and the risk of contact lens-related disease. *Cornea, 38*(6), 791–797. https://doi.org/10.1097/ICO.0000000000001898

20. Kam, K. W., Yung, W., Li, G. K. H., Chen, L. J., & Young, A. L. (2017). Infectious keratitis and orthokeratology lens use: A systematic review. *Infection, 45*(6), 727–735. https://doi.org/10.1007/s15010-017-1023-2
21. Correa, P. C., Lui, A. C. F., Silva, C. B., Gracitelli, C. P. B., Mimica, L. M., Sasagawa, S. M., & Netto, A. L. (2018). Study of the effectiveness of multipurpose solutions on the bacterial disinfection of silicone hydrogel contact lenses in vitro. *Eye & Contact Lens: Science & Clinical Practice, 44*(Suppl 2), S24–S28. https://doi.org/10.1097/ICL.0000000000000428
22. Hatami, H., Ghaffari Jolfayi, A., Ebrahimi, A., Golmohammadi, S., Zangiabadian, M., & Nasiri, M. J. (2021). Contact lens associated bacterial keratitis: Common organisms, antibiotic therapy, and global resistance trends: A systematic review. *Frontiers in Ophthalmology, 1*, Article 759271. https://doi.org/10.3389/fopht.2021.759271
23. Stapleton, F., Naduvilath, T., Keay, L., Radford, C., Dart, J., Edwards, K., Carnt, N., Minassian, D., & Holden, B. (2017). Risk factors for contact lens-related microbial keratitis in daily disposable lens wearers. *PLOS ONE, 12*(8), Article e0181343. https://doi.org/10.1371/journal.pone.0181343
24. De Luca, L., Menna, F., Lupo, S., & et al. (2026). The ocular surface bacterial microbiome and the impact of contact lens use: A literature review. *Microorganisms, 14*(3), Article 518. https://doi.org/10.3390/microorganisms14030518
25. Khan, S. A., & Lee, C. S. (2020). Recent progress and strategies to develop antimicrobial contact lenses and lens cases for different types of microbial keratitis. *Acta Biomaterialia, 113*, 101–118. https://doi.org/10.1016/j.actbio.2020.06.039
26. Voinescu, A., Licker, M., Muntean, D., Musuroi, C., Musuroi, S. I., Izmendi, O., Vulpie, S., Jumanca, R., Munteanu, M., & Cosnita, A. (2024). A comprehensive review of microbial biofilms on contact lenses: Challenges and solutions. *Infection and Drug Resistance, 17*, 2659–2671. https://doi.org/10.2147/IDR.S463779
27. Waghmare, S. V., & Jeria, S. (2022). Contact lens-related complications and risk factors: A review. *Cureus, 14*(10), Article e30118. https://doi.org/10.7759/cureus.30118
28. Hernández-Martínez, D., Castro Pot, E., Hernández Olmos, P., Guzmán Hernández, E. A., Cobos, D. S., Villa Ramírez, S., Villamar Duque, T. E., Durán Díaz, Á., & Omaña-Molina, M. (2023). Acanthamoeba castellanii trophozoites that survive multipurpose solutions are able to adhere to cosmetic contact lenses, increasing the risk of infection. *Heliyon, 9*(9), Article e19599. https://doi.org/10.1016/j.heliyon.2023.e19599
29. Lim, C. H., Carnt, N. A., Farook, M., Lam, J., Tan, D. T., Mehta, J. S., & Stapleton, F. (2016). Risk factors for contact lens-related microbial keratitis in Singapore. *Eye, 30*(3), 447–455. https://doi.org/10.1038/eye.2015.250