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CONTACT LENS WEAR COMPLICATIONS: A COMPREHENSIVE ANALYSIS OF RISK FACTORS AND PREVENTION

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Abstract

Background:
Contact lenses (CLs) are widely used for both therapeutic and refractive correction purposes. Despite their benefits, improper use can lead to complications ranging from mild discomfort to severe ocular infections.

Methodology:
A systematic literature search was conducted across PubMed, Scopus, Web of Science, and Google Scholar databases for studies published between 2015 and 2025. Eligible articles included observational studies, reviews, and clinical trials discussing complications of contact lens wear. Data were extracted on the types of complications, their prevalence, associated risk factors, and preventive strategies. PRISMA guidelines were followed during screening and selection.

Results:
Out of 320 identified articles, 35 met the inclusion criteria. The most common complications reported were microbial keratitis, dry eye, corneal abrasions, giant papillary conjunctivitis, and corneal neovascularization. Key risk factors included poor hygiene, overnight or extended wear, low oxygen-permeable lenses, and water exposure. Studies consistently highlighted that patient noncompliance was a major contributor to adverse outcomes. Preventive measures such as proper hygiene education, appropriate lens selection, and regular follow-up significantly reduced complication rates.

Conclusion:
While contact lens wear is generally safe, adherence to preventive guidelines is crucial to minimize risks. Patient education, regular monitoring, and advancements in lens materials such as antimicrobial coatings and daily disposable lenses can further enhance safety. Continued research should focus on improving compliance strategies and developing smarter lens technologies for long-term ocular health.

Keywords: ocular health, risk factors, microbial keratitis, contact lenses, complications, and prevention

Introduction

Contact lenses are now a necessary tool for ocular therapy and vision correction. More than 125 million people use contact lenses globally, according to recent estimates [1]. Wearing contact lenses can increase a person's risk of developing ocular surface disruptions, infections, and long-term corneal

changes. Complications may be influenced by lens type, wearing schedule, hygiene practices, and individual ocular physiology [2].

The purpose of this review is to systematically analyse published evidence on complications of contact lens wear, identify associated risk factors, and summarize prevention strategies to reduce adverse outcomes.

Methods

This review follows a systematic literature search approach:

- **Databases searched:** PubMed, Scopus, Web of Science, Google Scholar
- **Inclusion criteria:** English-language articles published between 2015 and 2025 that discuss contact lens-related complications through observational studies, reviews, and clinical trials
- **Exclusion criteria:** case reports lacking a systematic analysis focus, letters to editors, and non-human research
- Relevant studies were screened, and data on types of complications, prevalence, associated risk factors, and preventive measures were extracted.

PRISMA Statement

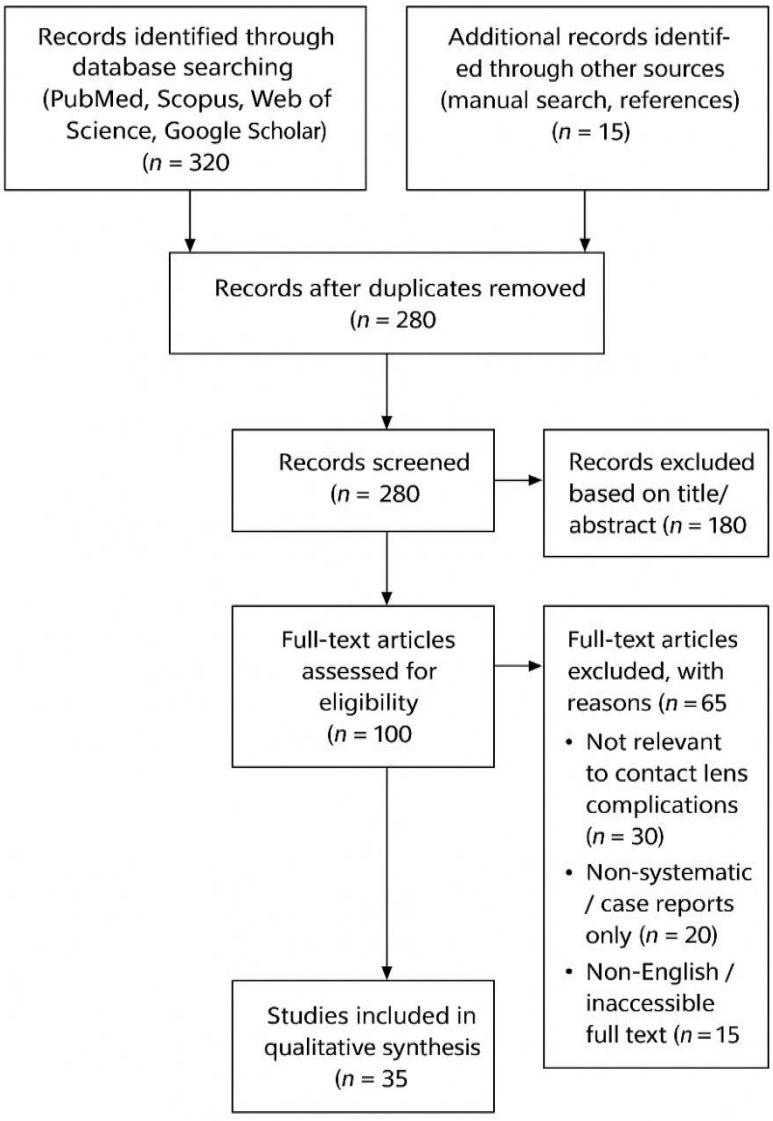

Figure1: Prisma

Types of Complications

Infectious Complications

- **Microbial keratitis (MK):** The most serious complication; can lead to permanent vision loss if untreated[3].
- **Common pathogens:** Pseudomonas, Staphylococcus aureus, Acanthamoeba spp.
- **Risk factors:** Overnight wear, extended wear, poor hygiene, swimming with lenses, and noncompliance with disinfection protocols.

Mechanical or Structural Complications

- **Corneal abrasions and erosions:** Due to poor lens fit or trauma[4].
- **Giant papillary conjunctivitis (GPC):** Often caused by soft lenses; associated with lens deposits and immune response[4,5]
- **Corneal neovascularization:** Linked with hypoxia from low-oxygen transmissible lenses.

Physiological or Functional Complications

- **Dry eye and discomfort:** Dehydration of lenses, altered tear film, lens material properties[6].
- **Contact lens-induced acute red eye (CLARE):** Inflammatory response related to overnight wear[7].

Risk Factors

Table 1: List of risk factors in contact lenses

Risk Factor	Mechanism / Evidence
Poor hygiene	Lens case contamination, improper cleaning
Overnight/extended wear	Reduced tear exchange, hypoxia, and increased bacterial adhesion
Lens type	Low oxygen-permeable lenses → hypoxia, silicone hydrogel → better but still risk with misuse
Swimming/water exposure	Acanthamoeba keratitis risk
Noncompliance	Skipping follow-ups, using expired solutions
Pre-existing ocular surface disease	Dry eye, blepharitis increases infection susceptibility

Prevention Strategies

1. **Patient Education**
   - Proper lens cleaning, case hygiene, and handwashing.
   - Avoiding overnight or extended wear unless prescribed.
2. **Lens Selection and Fitting**
   - Choosing lenses with higher oxygen permeability (e.g., silicone hydrogel).
   - Ensuring proper lens fit to minimize mechanical trauma.
3. **Follow-up and Monitoring**
   - Regular check-ups for early detection of complications.
   - Monitoring for signs of GPC, neovascularization, or keratitis.
4. **Disinfection and Care Solutions**
   - Multipurpose or hydrogen peroxide-based solutions as per lens type.
   - Avoiding tap water and homemade saline solutions.
5. **Lifestyle Modifications**
   - Avoid swimming or showering with lenses.
   - Encourage lens removal at first sign of discomfort or redness.

Results

A total of 35 studies met the inclusion criteria after screening from an initial pool of 320 identified records. The findings revealed that microbial keratitis (MK) was the most frequent and severe complication associated with contact lens wear, followed by dry eye, corneal abrasions, giant papillary conjunctivitis (GPC), and corneal neovascularization.

1. Infectious Complications

Microbial keratitis remains the most serious condition and a leading cause of vision loss in contact lens users.

- Common pathogens: Pseudomonas aeruginosa, Staphylococcus aureus, and Acanthamoeba spp.
- Key risk factors: Overnight or extended wear, poor lens hygiene, swimming or showering with lenses, and noncompliance with cleaning protocols.

2. Mechanical or Structural Complications

Mechanical issues included corneal abrasions, epithelial erosions, and GPC.

- Poor lens fit and lens deposits were the primary contributors.
- Corneal neovascularization was linked with prolonged use of low oxygen-permeable lenses, reflecting hypoxic stress.

3. Physiological or Functional Complications

Functional disturbances such as dryness, discomfort, and Contact Lens-Induced Acute Red Eye (CLARE) were frequently reported.

- These were attributed to dehydration of lenses, reduced tear film stability, and hypoxia during extended wear.

4. Risk Factors

The most significant modifiable risk factors identified were:

- Poor hygiene and contaminated lens cases
- Overnight/extended wear causing reduced oxygen transmission and tear exchange
- Low oxygen-permeable lenses increasing corneal stress
- Swimming/water exposure leading to *Acanthamoeba* infections
- Noncompliance with replacement schedules and follow-up visits
- Pre-existing ocular conditions like dry eye and blepharitis

5. Prevention Strategies

Preventive interventions emphasized across studies included:

- Patient education on hygiene, disinfection, and avoiding overnight wear
- Lens selection with higher oxygen permeability (silicone hydrogel, daily disposables)
- Regular follow-ups for early detection of complications
- Use of proper care solutions (multipurpose or hydrogen peroxide-based)
- Lifestyle modifications such as avoiding water exposure and promptly removing lenses when symptomatic

Discussion

Contact lens complications are multifactorial, include patient behaviour, lens material, ocular physiology, and environmental factors. Among these, poor hygiene and extended wear are the most consistently reported modifiable risk factors[8,9]. The literature emphasizes the importance of education, proper lens selection, and monitoring to reduce adverse events. Advanced lens technologies, such as antimicrobial coatings and daily disposable lenses, show promise in reducing risk[10]. Despite advances, challenges remain in ensuring compliance, managing high-risk populations, and mitigating rare but severe complications like Acanthamoeba keratitis.

Conclusion

Wearing contact lenses is usually safe as long as the right safety measures are followed. Awareness of risk factors and preventive measures is essential to minimize complications[11]. Follow-up care, lens hygiene, and patient education should be prioritised by eye care providers. Further research is warranted to optimize lens materials, develop antimicrobial strategies, and improve real-world compliance monitoring.

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