

# Keratitis

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## Keratitis

**Primary Disciplinary Field(s):** Ophthalmology, Infectious Diseases

### 1. Core Definition

Keratitis is a medical condition characterized by the inflammation of the cornea, which is the transparent, dome-shaped outer layer that covers the front of the eye. This vital structure plays a crucial role in focusing light onto the retina, contributing significantly to the eye's refractive power, and also serves as a protective barrier against external elements. When inflammation occurs, the cornea's clarity can be compromised, leading to a range of ocular symptoms and potentially significant visual impairment. The inflammatory response can involve various layers of the cornea, from the superficial epithelium to the deeper stroma and endothelium, depending on the etiology and severity of the condition.

The cornea's unique avascular nature, relying on tears and the aqueous humor for nutrients and oxygen, makes it particularly susceptible to damage when its integrity is breached or its metabolic processes are disrupted. Inflammation can result in corneal edema, cellular infiltration, and the deposition of inflammatory byproducts, all of which contribute to the loss of transparency and the symptomatic presentation of keratitis. This disruption not only affects vision but can also lead to considerable pain due to the cornea's rich innervation. Understanding the core definition of keratitis is fundamental to appreciating the diverse range of its causes, clinical manifestations, and the critical importance of timely and appropriate therapeutic interventions to preserve ocular health and visual function.

### 2. Etymology and Historical Development

The term "keratitis" is derived from the Ancient Greek word "keras" (κέρας), meaning "horn," which evolved into "keratos" (κερατός), referring to the cornea due to its horn-like texture and appearance, combined with the suffix "-itis," indicating inflammation. Thus, keratitis literally translates to "inflammation of the cornea." The understanding and treatment of corneal diseases, including keratitis, have evolved considerably throughout medical history, paralleling advancements in general medicine, microscopy, and microbiology. Early civilizations recognized eye diseases, though specific diagnoses like keratitis would have been imprecise, often lumped under general terms for "eye soreness" or "blindness."

Significant progress began with the advent of scientific observation and anatomical studies. The development of the slit lamp in the early 20th century revolutionized ophthalmology, allowing for detailed, magnified examination of the corneal layers and precise localization of inflammatory processes. The discovery of microorganisms and the germ theory of disease in the 19th and 20th centuries by scientists such as Louis Pasteur and Robert Koch provided the critical framework for

understanding infectious causes of keratitis. Subsequent development of antibiotics, antifungals, and antivirals transformed the prognosis of many previously blinding forms of infectious keratitis. Further insights into immunological responses and corneal physiology have continued to refine diagnostic and therapeutic approaches, moving towards more targeted and effective treatments that minimize damage and optimize visual outcomes.

### 3. Key Characteristics (Symptoms)

Patients afflicted with keratitis typically present with a constellation of symptoms reflecting the corneal inflammation and irritation. One of the most common and distressing symptoms is **eye pain**, which can range from a mild ache to severe, debilitating discomfort. This pain is often exacerbated by blinking or eye movement and results from the rich supply of nerve endings within the cornea, which become hypersensitive during an inflammatory process. Another hallmark symptom is **eye redness**, specifically circumcorneal or limbal injection, where the blood vessels surrounding the cornea become dilated and prominent, indicating an inflammatory response in the anterior segment of the eye. This distinct pattern of redness helps differentiate keratitis from other forms of conjunctivitis.

**Impaired vision** is a significant concern for individuals with keratitis. The inflammation can lead to corneal edema, cellular infiltrates, or scarring, all of which disrupt the cornea's transparency and its ability to refract light accurately onto the retina. This can manifest as blurred vision, decreased visual acuity, or even a complete loss of vision in severe, untreated cases. **Light sensitivity**, or photophobia, is another prominent symptom, where exposure to even moderate light levels causes considerable discomfort or pain. This heightened sensitivity is believed to be linked to the irritation of corneal nerves and reflex spasm of the ciliary muscle.

A sensation of a **gritty foreign body in the eye** is also frequently reported, often described as feeling like sand or an eyelash is constantly present. This discomfort arises from the irregular surface of the inflamed cornea and the friction it creates with the inner surface of the eyelid during blinking. Other potential symptoms include excessive tearing (epiphora), discharge from the eye (which can be watery, mucopurulent, or purulent depending on the cause), and difficulty opening the eye due to pain and photophobia. The combination and severity of these symptoms are crucial in guiding diagnosis and immediate management, as keratitis can rapidly progress and threaten sight if not promptly addressed.

### 4. Classification and Causes

Keratitis can be broadly classified into two main categories: **infectious** and **non-infectious**, each encompassing a variety of specific etiologies. Infectious keratitis, which is often more urgent due to its potential for rapid progression and severe visual loss, can be caused by a diverse range of

microorganisms. **Bacterial keratitis** is the most common form, frequently caused by organisms such as *Staphylococcus aureus*, *Pseudomonas aeruginosa* (especially associated with contact lens wear), and *Streptococcus pneumoniae*. These infections often present as a rapidly progressing corneal ulcer, with significant pain and purulent discharge.

Other infectious causes include **fungal keratitis**, which is less common but often more severe and difficult to treat, typically associated with ocular trauma involving plant matter or immunosuppression. Common fungal culprits include *Fusarium*, *Aspergillus*, and *Candida* species. **Viral keratitis** is predominantly caused by Herpes Simplex Virus (HSV), leading to recurrent dendritic ulcers, or Varicella-Zoster Virus (VZV), which can cause shingles of the eye (herpes zoster ophthalmicus). Less common but highly destructive is **Acanthamoeba keratitis**, a parasitic infection typically linked to improper contact lens hygiene, especially exposure to contaminated water. This amoebic infection is notoriously painful and challenging to treat.

Non-infectious keratitis can arise from various factors not involving microbial invasion. One significant cause is **exposure keratitis**, which occurs when the cornea is inadequately protected, leading to excessive drying. This can result from conditions like lagophthalmos (incomplete eyelid closure during blinking or sleep), Bell's palsy, or severe proptosis. Chronic dry eye syndrome can also predispose individuals to sterile keratitis. **Ultraviolet (UV) radiation exposure**, such as from welding arcs or prolonged sun exposure without proper eye protection (e.g., snow blindness), can cause photokeratitis, a painful but usually transient inflammation of the corneal epithelium. Other non-infectious forms include allergic keratitis, neurotrophic keratitis (due to impaired corneal sensation), and sterile inflammatory conditions associated with autoimmune diseases or trauma. Differentiating between infectious and non-infectious causes is paramount, as their treatments differ fundamentally.

## 5. Diagnosis

Accurate diagnosis of keratitis is critical for guiding effective treatment and preventing permanent vision loss. The diagnostic process typically begins with a comprehensive ophthalmological examination. This includes a detailed patient history, inquiring about symptoms, contact lens wear, recent trauma, exposure to irritants, and any underlying systemic conditions. Visual acuity testing is performed to assess the degree of vision impairment. The cornerstone of diagnosis is the slit-lamp biomicroscopy, which allows the ophthalmologist to examine the cornea in high magnification and cross-section. During this examination, fluorescent dyes like fluorescein are often applied to highlight epithelial defects, ulcers, or stromal infiltration, making them more visible.

In cases of suspected infectious keratitis, obtaining a microbiological specimen is crucial. This involves carefully performing a **corneal scraping**, where a sterile spatula or blade is gently used to collect cells and exudate from the base and edges of the corneal lesion. These samples are then

smear onto glass slides for Gram stain (for bacteria), Giemsa stain (for fungi, Chlamydia), or calcofluor white stain (for fungi and Acanthamoeba), and cultured on various media to identify the causative organism. Polymerase chain reaction (PCR) testing can also be employed for rapid and sensitive detection of viral or atypical bacterial pathogens.

Advanced diagnostic techniques, such as **confocal microscopy**, may be used for specific cases, particularly to diagnose fungal or Acanthamoeba keratitis, as it allows for in vivo visualization of microbial structures within the corneal layers. Imaging techniques like anterior segment optical coherence tomography (AS-OCT) can also provide detailed cross-sectional images of the cornea, assisting in assessing the depth and extent of inflammation or scarring. The combination of clinical signs, patient history, and laboratory confirmation helps the ophthalmologist arrive at a precise diagnosis, which is essential for initiating targeted therapy and achieving optimal patient outcomes.

## 6. Treatment Modalities

The treatment for keratitis is highly dependent on its underlying cause, with the primary objective generally being the elimination of the pathogen in infectious cases or addressing the underlying factor in non-infectious forms. For **bacterial keratitis**, broad-spectrum topical antibiotics are typically initiated immediately, often fortified antibiotics (e.g., ceftazidime and tobramycin) or newer fluoroquinolones, until culture and sensitivity results guide more specific therapy. The frequency of antibiotic drops can be as high as hourly initially, gradually tapering as the infection resolves. Systemic antibiotics may be required for severe cases or those with scleral involvement.

**Fungal keratitis** is notoriously challenging to treat and requires specific topical antifungal agents (e.g., natamycin, amphotericin B, voriconazole). Treatment duration is often prolonged, spanning weeks to months, and may involve systemic antifungals in recalcitrant cases. **Viral keratitis**, particularly HSV keratitis, is managed with topical antiviral medications (e.g., ganciclovir gel, trifluridine solution) or oral antivirals (e.g., acyclovir, valacyclovir), especially for stromal involvement or recurrent episodes. Corticosteroids may be used cautiously in specific viral forms (like stromal keratitis) but are contraindicated in active epithelial herpes infections as they can worsen the disease.

**Acanthamoeba keratitis** necessitates a prolonged and aggressive regimen of topical biguanides (e.g., polyhexamethylene biguanide, chlorhexidine) and diamidines (e.g., propamidine isethionate). Treatment can last for several months and often requires significant patient compliance. For **non-infectious keratitis**, treatment focuses on alleviating the cause. Exposure keratitis often requires aggressive lubrication with artificial tears and ointments, eyelid taping at night, or surgical interventions to improve lid closure (e.g., tarsorrhaphy). Photokeratitis typically resolves on its own with supportive care, including topical lubricants and pain relief. In all forms of keratitis, adjunctive treatments such as cycloplegic agents to reduce pain from ciliary spasm, and pain relievers, are

often employed to enhance patient comfort. In cases of severe corneal scarring or perforation, surgical intervention like a corneal transplant (keratoplasty) may be necessary to restore vision or preserve ocular integrity.

## 7. Complications and Prognosis

Despite advancements in diagnosis and treatment, keratitis can lead to a range of significant complications, particularly if not promptly or effectively managed. The most common and devastating complication is **corneal scarring**. Inflammatory processes, especially those involving the corneal stroma, can result in the deposition of opaque fibrous tissue, leading to irreversible loss of corneal transparency and consequently, reduced visual acuity or even blindness. The extent of scarring is directly related to the severity and duration of the inflammation and the specific causative agent; for instance, fungal and Acanthamoeba keratitis are particularly prone to severe scarring.

Other serious complications include **corneal thinning and perforation**. Extensive inflammation or proteolytic enzyme activity, particularly in bacterial or fungal infections, can weaken the corneal stroma, leading to a descemetocele (herniation of Descemet's membrane) or outright perforation of the globe. This represents an ocular emergency requiring immediate surgical intervention, often with a therapeutic corneal transplant or patch graft, to prevent intraocular infection and preserve the eye. Endophthalmitis, an infection of the intraocular fluids and tissues, is a rare but devastating complication that can occur following corneal perforation, leading to severe vision loss or even loss of the eye itself.

The prognosis for keratitis varies widely depending on several factors, including the etiology, the patient's immune status, the timing of diagnosis, and the promptness and effectiveness of treatment. While many cases of superficial keratitis (e.g., mild bacterial or photokeratitis) resolve without significant sequelae, more severe forms, especially those caused by aggressive pathogens or involving deep stromal layers, carry a higher risk of permanent visual impairment. Recurrent episodes, particularly with viral keratitis, can also lead to progressive corneal damage over time. Early recognition of symptoms, diligent contact lens hygiene, and immediate medical attention for any suspected keratitis are crucial for optimizing the prognosis and minimizing the risk of severe, vision-threatening complications.

## 8. Prevention

Preventing keratitis, particularly infectious forms, relies heavily on meticulous hygiene practices and appropriate ocular care. For contact lens wearers, who represent a significant risk group for several types of infectious keratitis (e.g., bacterial, Pseudomonas, Acanthamoeba), adherence to strict hygiene guidelines is paramount. This includes washing hands thoroughly with soap and

water before handling lenses, using only fresh, sterile contact lens solution for cleaning and storage (never tap water or saliva), and replacing lens cases regularly (typically every 1-3 months). Lenses should never be worn while swimming, showering, or sleeping unless specifically approved for extended wear by an eye care professional, as these activities significantly increase the risk of microbial contamination.

Protection against environmental factors is also critical. Individuals engaged in activities that expose their eyes to dust, debris, or chemical splashes (e.g., construction, gardening, laboratory work) should always wear appropriate safety eyewear. Similarly, prolonged exposure to intense ultraviolet (UV) radiation, such as from tanning beds, welding torches, or sun reflection off snow or water, can cause photokeratitis. Wearing UV-blocking sunglasses or protective goggles is essential in these environments. Prompt treatment of minor ocular trauma, foreign bodies, or other eye infections (like conjunctivitis) can prevent the progression to more severe corneal involvement.

For individuals with underlying conditions that predispose them to non-infectious keratitis, specific preventive measures are necessary. Patients with dry eye syndrome should consistently use artificial tears and follow their ophthalmologist's recommendations for managing their condition. Those with conditions like lagophthalmos (incomplete eyelid closure) may benefit from lubricating ointments at night, eyelid taping, or surgical correction to ensure adequate corneal hydration and protection. Regular eye examinations are also important, especially for those at higher risk, to detect early signs of corneal abnormalities or to reinforce preventive behaviors. Educating the public about ocular hygiene and the dangers of improper contact lens care remains a cornerstone of keratitis prevention efforts.

## Further Reading

[Keratitis - Wikipedia](#)

[What is Keratitis? - American Academy of Ophthalmology](#)

[Keratitis - Centers for Disease Control and Prevention \(CDC\)](#)

[Bacterial Keratitis - StatPearls](#)

[Fungal Keratitis - StatPearls](#)