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## The most common contact lens-related complications: A brief review of the literature

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## **Abstract**

### **Introduction and purpose**

Millions of people use contact lenses every day. Their primary and most common use is correcting refractive errors. Despite their beneficial purpose, contact lens use has many complications. It is estimated that 5 to 50% of patients may develop at least a single complication.

### **The state of knowledge**

Contact lens-related complications are multifactorial. One of the main reasons for contact lens discontinuation is contact lens discomfort. Patients most often report dryness, burning, and irritated eyes. Other disorders can be briefly divided into conjunctival and corneal complications. The most common conjunctival and allergic complication of contact lens use is giant papillary conjunctivitis. Other significant conditions involving the conjunctiva can also be superior limbic keratoconjunctivitis or allergic or toxic conjunctivitis. Corneal complications, on the other hand, seemed to be much more severe. These include superficial punctate keratitis, peripheral corneal ulceration, and contact lens-related keratitis. Also,

abrasion can occur due to improper eye hygiene or mechanical damage during lens replacement. It should also be remembered that prolonged use of lenses can lead to hypoxia and corneal edema.

### **Summary**

This paper briefly outlines the possible complications of contact lens use. It is important to remember that despite their appropriate use, sometimes significant complications can occur. Noteworthy, corneal, or conjunctival complications require discontinuation of the lenses and appropriate treatment.

**Keywords:** contact lens, complications, blurred vision, management

## **1. Introduction and purpose**

Contact lenses are widely used around the world. An estimated 140 million people a day use contact lenses for a variety of reasons [1]. They are most commonly used in refractive disorders, especially myopia [1, 2], but they can also play a therapeutic role in many conditions such as dry eye disease (DED), post-refractive surgery rehabilitation, and corneal epithelial defects [3]. Lenses are also used for orthokeratology in children [4].

According to various authors, the contact lens market is estimated to reach 19 billion US dollars by 2024. Currently, the most commonly used lenses are divided into three groups: soft, rigid, and hybrid contact lenses [1].

Contact lenses adhere to the surface of the eyeball and interact with cells of the conjunctiva, cornea as well as components of the tear film. Despite the significant benefits of contact lenses, they can also lead to several complications. It is estimated that one in three people (about 34.6%) has experienced a complication of lens wear at least once [5]. Other authors estimate that as many as 5 to 50% of contact lens users have experienced ocular complications [2]. Hence, proper hygiene and caution in the use of contact lenses is important. This paper will briefly introduce the most common complications of contact lens wear.

## **2. The state of knowledge**

Many factors predispose to contact lens wear complications. These include lens factors such as the material, the length of time the lenses are worn, and the patient's factors [6]. According to Emmanuel Kobia-Acquah et al., complications were most common in those using soft lenses [2].

Furthermore, according to the literature, dry eye disease (DED), allergic factors, or blepharitis also predispose to an increased risk of contact lens-related complications [6]. The following are the most common disorders, complications, or causes that often lead to contact lens withdrawal in patients.

### **2.1. Contact lens-induced dry eye (CLIDE) and contact lens discomfort (CLD)**

Dry eye disease (DED) is much more common in lens users than non-lens users. In addition, Dry eye disease itself is a risk factor for other complications of lens wear [7]. DED is defined by The Tear Film & Ocular Surface Society (TFOS) [8] as “Dry eye is a multifactorial disease of the ocular surface characterized by a loss of homeostasis of the tear film, and accompanied by ocular symptoms, in which tear film instability and hyperosmolarity, ocular surface inflammation and damage, and neurosensory abnormalities play etiological roles” [8]. Patients most commonly report itching, dryness, a feeling of sand under the eyelids, and redness of the eye [9, 10]. The use of artificial tears, or autologous serum, or even anti-inflammatory drops can be effective for DED symptoms [10].

According to the recent definition from Nichols et. Al. (TFOS) [11] contact lens discomfort (CLD) is defined as "Contact lens discomfort is a condition characterized by episodic or persistent adverse ocular sensations related to lens wear, either with or without visual disturbance, resulting from reduced compatibility between the contact lens and the ocular environment, which can lead to decreased wearing time and discontinuation of contact lens wear" [11]. In addition, there are two groups of factors leading to CLD. Contact Lens-related includes lens material, design, fit and wear, or lens care. The second factor is environmental influences, including the patient's or external factors such as humidity [11]. According to Alipour et al., CLD was experienced by 23 to 94% of patients [3]. CLD can lead to subjective discomfort,

which does not always correlate in loss of visual acuity [12]. Patients commonly report dryness, discomfort, or fatigue [4]. Management usually involves artificial tears, eyelid hygiene, and daily disposable CL (DDCL) fitting [13].

## **2.2. Conjunctival complications**

### **2.2.1. Giant papillary conjunctivitis (GPC)**

Giant papillary conjunctivitis (GPC) is a contact allergic reaction directly targeting lens deposits and proteins. It is the most common allergic reaction during contact lens wear and is a significant factor in lens withdrawal [14].

According to Urgacz et al. GPC is experienced by 5-15% of people with soft lenses and 2-5% with rigid lenses [15]. On average, they can occur in as many as 1.5% to 47.6% of patients [16]. A review paper by Kenny et al. cited an interesting comparison by Santodomingo-Rubido et al., which found that GPC is more common in monthly lenses than daily disposable lenses (17.0% vs. 7.4%) [16, 17].

The condition involves warts, which are most commonly found on the upper conjunctival disc. The warts usually reach at least 0.3 mm or more than 1 mm in diameter [16]. In addition, there is thinning of the conjunctiva and loss of the typical tarsal vascular pattern [6]. Symptoms usually appear after a few months, more rapidly in soft than rigid lenses [15]. Symptoms include itching, burning, eye redness, excessive mucus production, and foreign body sensation. Bothersome symptoms often lead to contact lens intolerance [6, 15, 16]. When symptoms are less severe, changing lenses more often, at least once a day, is recommended. On the other hand, when the symptoms are more severe, it is necessary to discontinue the lenses and sometimes use medications [3]. Commonly used are allergy medications, steroids, or immunomodulatory drugs [16].

### **2.2.2. Superior limbic keratoconjunctivitis (SLK)**

Superior limbic keratoconjunctivitis (SLK) is a chronic inflammation of the superior limbus and superior bulbar conjunctiva. It is most often caused by prolonged contact lens wear, which leads to hypoxia of the superficial layer of the cornea or may be due to an allergic reaction to contact lens components [15, 18, 19].

Patients often present with a foreign body sensation under the eyelids, dryness, burning, discomfort, or photophobia. Nevertheless, many patients are asymptomatic [15]. The study by Cheng et al. showed that the most common sign of SLK was superior limbus/conjunctival staining (SCS), which occurred in 98% of eyes [20]. If symptoms are significant, contact lenses should be discontinued [15], and moisturizing or anti-inflammatory drops should be used [19, 21].

### **2.2.3. Allergic and toxic conjunctivitis**

Contact lenses contain antiseptics, preservatives, and moisturizers, and the lenses themselves are constructed of materials that can actively react with the ocular surface [5]. Many of these factors can lead to allergic conjunctivitis or toxic conjunctivitis. Toxicity is most common in soft lenses; in rigid lenses, the solutions are absorbed minimally [6]. Allergic conjunctivitis, on the other hand, is most familiar with thiomersal-containing solutions. Compared to toxic conjunctivitis, patients in the case of hypersensitivity develop symptoms over several months, while in the case of toxic, symptoms often appear suddenly. In both cases, patients may experience pain, redness, itching, foreign body sensation, and conjunctival hyperemia [12, 22]. Chronic allergic conjunctivitis can significantly decrease the quality of life [22]. Discontinuation of lenses and use of moisturizing and/or anti-inflammatory drops are recommended [5, 6, 12, 15, 22, 23].

## **2.3. Corneal complications**

### **2.3.1. Superficial punctate keratitis (SPK)**

According to Li et al., in a study of 141 contact lens-wearing patients - the most common corneal condition was Superficial punctate keratitis (SPK), which occurred in about 36.17% of patients [24]. SPK most often occurs during mechanical damage to the cornea, especially during lens insertion or due to the preservatives' toxic or allergic effects [12, 22].

### **2.3.2. Peripheral Corneal Ulceration (PCU)**

Corneal ulceration occurs when the corneal continuity is breached and the tear biofilm interacts, leading to inflammation and ulcer formation

[25]. In the case of peripheral corneal ulceration (PCU), there is damage to the corneal squamous epithelium, with no breach of Bowman's limiting membrane [3, 12, 26]. In this case, there is localized inflammation, usually up to 1 mm in size, in the peripheral part of the cornea [7].

Usually, patients are asymptomatic, but occasionally, they may complain of redness, burning, and pain in the eye. Treatment usually involves discontinuing the lens or using anti-inflammatory drops (containing NSAIDs or steroids) [15, 27]. Sometimes, drops containing a steroid and an antibiotic can be helpful despite the absence of an infectious component in PCU [7]. On ophthalmologic examination, punctate corneal epithelial defects are seen on fluorescein staining. Patients usually complain of burning and increased tearing. As with previous conditions, lenses are most often discouraged and moisturizing drops are used [15].

### **2.3.3. Contact lens-related keratitis (CLMK)**

Contact lens-related keratitis (CLMK) is usually caused by bacteria, fungi, amoebae or viruses [28]. CLMK is not a common complication of lens wear. According to Carnt et al. CLMK is estimated to occur in about 2-4 people per 10,000 daily soft lens wearers and 20 per 10,000 overnight soft lens wearers [29].

Nevertheless, it is an acute, often severe complication that can lead to deterioration of visual acuity. It is a multifactorial condition that is influenced by, among other factors, the hygiene of contact lens wear [30], prolonged lens wear, or microbial contamination [31]. In all cases of microbial keratitis, contact lenses should be discontinued, and treatment depends on the causative agent and the patient's condition [3].

#### **2.3.3.1. Bacterial keratitis**

It is most often characterized by focal infiltration with a strong inflammatory reaction. It may also be accompanied by corneal edema [29]. The inflammatory reaction develops over several days. Loss of visual acuity and local deterioration can occur quickly. On physical examination, a whitish-yellow infiltrate, an inflammatory reaction in the

anterior chamber and hypopyon may be found [32]. Silicone hydrogel lenses are more likely to be colonized with *Pseudomonas aeruginosa* and *Staphylococcus aureus* bacteria [31, 33].

Treatment usually involves intensive topical antibiotic therapy with two antibiotics. Thermoablation can be used in large amounts of necrotic tissue [32]. An antibiotic monotherapy can be used for superficial, limited keratitis [3].

#### **2.3.3.2. Acanthamoeba keratitis**

*Acanthamoeba* keratitis most often occurs with lens contamination [3], especially when swimming in natural bodies of water [5]. Compared to bacterial keratitis in *acanthamoeba* infection, symptoms develop much more slowly. Characteristically, the reported symptoms are incommensurable compared to the ophthalmologic examination [32].

Due to the presence of spore cysts, treatment of this infection is demanding. Hence, long-term use of biguanides (chlorhexidine and polyhexamethylene biguanide) or diamine-based antimicrobial agents (propamidine isethionate and hexamidine) is recommended [5, 34].

#### **2.3.3.3. Fungal keratitis**

Fungal keratitis is characterized by a much slower onset than previously described. It is most often caused by lens contamination by *Candida* spp., *Aspergillus* spp., and *Fusarium* spp. [32]. When contact lenses are worn, the risk of fungal infection increases to almost 30% [35]. Fungal keratitis is characterized by corneal infiltrates with feathery edges and/or raised surfaces, and importantly, there is no improvement after antibiotic drops. These features often suggest a fungal infection, which is essential in the prompt introduction of antifungal treatment [36].

The treatment of Fungal keratitis is lengthy, and results are often questioned. Medications including natamycin, triazoles, clotrimazole,



fluconazole and others can be used [3, 35]. Some cases even require therapeutic corneal transplantation [32].

#### **2.3.4. Other corneal complications**

##### **2.3.4.1. Corneal abrasion**

Corneal abrasions are caused by mechanical damage to the corneal epithelium. When this happens, the superficial layers of the epithelium are lost, and corneal erosion is produced [37]. Sometimes, during improper contact lens replacement techniques, the corneal epithelium can be damaged, and abrasion can occur [5].

Typically, small erosions are treated effectively, with moisturizing drops, antibiotic drops and moisturizing ointment (Nighttime ointment) being used first. Paradoxically, contact lenses, which are referred to as bandage contact lenses (BCLs), can also be used in those treated without success [38].

##### **2.3.4.2. Corneal edema**

As a result of long-term contact lens use, gas exchange between the superficial layers of the cornea can be impaired. It can then lead to corneal edema. In that case, it is necessary to discontinue contact lenses and apply treatment depending on the patient's local condition [6, 12, 39].

##### **2.3.4.3. Corneal warpage syndrome**

Occasionally, corneal warpage can occur during prolonged contact lens wear, disrupting corneal curvature and causing corneal astigmatism [6].

A study conducted by Rayess et al. found that about 29% of patients presented with corneal warpage. The authors compared hydrogel (H) vs silicone-hydrogel (SH) soft contact lenses. In patients,

warpage resolution averaged  $11.2 \pm 6.26$  days in the first group and  $17.20 \pm 3.56$  days in the second group [40].

### **3. Summary**

This paper briefly outlines the most critical issues regarding complications of lens wear. Contact lens wearers should care for eye hygiene [30, 41], the duration of lens wear, and their correct application. It is important to remember that improper use can lead to complications such as disorders of the conjunctiva [15, 23], cornea, and other eyeball parts [42].

### **4. Author's contribution**

Conceptualization, WM, and BR; methodology, WM, BR, and MP; software, ŁM, DB, ZC, BR, JO and BK; check, WM, MS and WK; formal analysis, WM, BK, JO, WK, ŁM, DB; investigation, ŁM, ZC, and BR; resources, WM, and BR; data curation, WM, ZC; writing - rough preparation, WM, WK, BK, MP, BR, JO; writing - review and editing, WM, BR, BK, MP, ŁM, MS, ZC, DB; visualization, MS, DB; supervision, WM and DB; project administration, WM, BR; All authors have read and agreed with the published version of the manuscript.

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