

# Adverse events in allergy sufferers wearing contact lenses

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## Abstract

Allergy is the fifth leading chronic condition in industrialized countries among all ages, and the third most common chronic disease among children under 18 years old. Many of allergic patients also have problems with vision and want to improve their quality of life by wearing contact lenses. They are most frequently young and active individuals, for whom contact lenses provide greater convenience and more satisfying vision correction than spectacles. However, application of high quality and immunologically neutral products do not protect from allergic side reactions. Nowadays, eye-related allergy and contact lens wear concern larger and larger populations worldwide. The purpose of this review is to summarize the studies on ocular complications associated with wearing contact lenses. The article presents indications for allergic patients especially on the care system and wear schedule.

**Key words:** allergic patients, lenses, ocular allergy.

Nowadays we are witnesses of significant development of contactology and an increase in the number of patients wearing contact lenses. This method of correcting vision defects is very effective and as compared to spectacles, contact lenses provide a full field of vision, reduce the number of visual aberrations and reflections. Also, they do not alter the actual image size on the retina, which is of importance in anisometropia correction.

Contact lens wearers are most frequently young and active individuals, for whom contact lenses provide greater convenience and more satisfying vision correction than spectacles.

Some patients visiting an eye care physician for contact lenses prescription have a positive history of allergies. Approximately 15–20% of the world population is affected by some form of allergy, and ocular symptoms are present in 40–60% of allergic patients [1, 2]. Therefore, eye-related allergy and contact lens wear concern larger and larger populations worldwide. The problem aggravates during spring, which is the time of increased exposure to allergens and hence intensified allergic reactions.

The common problem is the use of contacts by atopic individuals. It has been found that the risk of experiencing various external eye symptoms during the use of contact lenses increased 5-fold in patients with a history of an atopic condition [3]. Very often these patients are forced to visit many different kinds of physicians because their problems require a multidisciplinary approach.

The aim of this paper is to provide clarification of basic contactology and to discuss the manifestation of common ocular side effects associated with contact lenses wear by patients with allergy disease. Also the general guidelines of management of this problem is presented.

There are two main categories of contact lenses. Nowadays, the most popular are the so called *soft contact lenses* made of flexible medium- or high-water materials. Regular hydrogel contact lenses have a high water content but allow less oxygen to pass through to the cornea. Silicone hydrogel contact lenses exhibit better oxygen permeability but are more rigid. The other category is *rigid gas permeable contact lenses* fabricated from inflexible “organic glass” (*polymethyl methacrylate* – PMMA).

There are two types of schedules for wearing contact lenses. Daily wear contact lenses can be worn up

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to 14 h a day and need to be removed prior to sleeping. Some brands of extended wear contact lenses can be worn continuously for up to seven days while others can be worn for up to 30 days and nights without removal. A lot of ophthalmologists recommend “flexible wear” of extended wear contacts where the lenses are removed at night before sleep, but can be worn overnight occasionally. Nearly all soft lenses are disposable contact lenses which require proper and meticulous care and are meant to be replaced at 2-week, monthly, bi-monthly, quarterly or even yearly intervals depending on the type of the lenses. Daily disposable contact lenses are also available; they are designed to be worn once and then discarded. These lenses are most often recommended to allergy sufferers.

Despite its undeniable benefits, a contact lens is a foreign material residing on the cornea and, as such, it may lead to numerous adverse events which decrease lens-wearing comfort.

As an irritant, a contact lens may cause damage to the structures of the eyeball. The most common problems are corneal hypoxia, hyperemia, microinjuries, depressed corneal metabolism rate, alterations in the level of the mitotic index and disruption in the integrity of the corneal epithelium [4].

Contact lenses also have a negative effect on the tear film, the basic mechanism for eye surface protection. The aqueous component of the tear film, secreted by the lacrimal gland and accessory glands, contains all water-soluble tear components, i.e. electrolytes, proteins and peptides. Under normal conditions, tears only contain trace levels of cytokines, growth factors and other indicators of inflammatory response. Environmental stress increases the expression of proinflammatory mediators resulting in the tear film dysfunction [5].

Contact lenses disrupt the tear film, cause its thinning and evaporative water loss from the cornea. Soft contact lenses, especially those made of high-water materials, actually draw water out of the cornea. In the case of an adequate volume and composition of the tear film, contact lenses-related effects on the anterior eye are negligible. However, patients with lacrimal gland dysfunction may develop a dry eye syndrome and severe discomfort, which have been observed in approximately 80% of those wearing rigid contact lenses and 20–30% of soft contact lenses wearers [5]. The discomfort becomes even worse in allergy sufferers who take antihistamine preparations [6]. First and second-generation antihistamines block histamine receptors and thus also decrease the secretion of mucous and aqueous layers of the tear film. Only a new type of antihistamines (e.g., bilastine) seems not to disrupt the tear film [7]. Among other antihistamine drugs cetirizine and levocetirizine have a slight influence on the tear film [8]. Therefore, a very important element of proper contact lenses use is a regular lubrication of the ocular surface with preservative free eye drops.

The most common non-infectious inflammatory reaction to contact lenses is hypersensitivity. Although contact lenses are immunologically neutral products, an allergic reaction might be caused by contact lens care solutions and/or protein, lipid and other compound deposits on the inner surface of the lens. It has been found that the risk of experiencing various external eye symptoms during the use of contact lenses is increased in patients with a history of atopy.

Contact lenses may lead to the development of the following eye conditions:

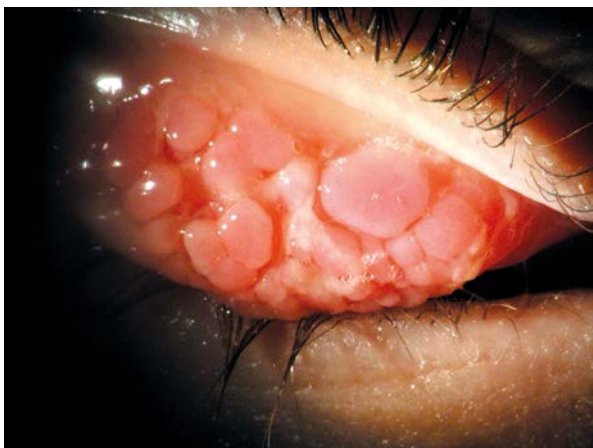
**Contact lens-induced papillary conjunctivitis (CLPC)** (Figure 1) is an immune reaction to contact lenses, typically characterized by tiny papillae and hyperaemia of the whole upper tarsal conjunctiva or its parts. Local papillary conjunctivitis is believed to occur as a result of lens-induced mechanical trauma while its diffuse form evidences hypersensitivity to contact lens deposits or contact lens care solutions. The allergen that causes the reaction is not known. The risk factors of developing of CLPC is soft lens wear, a large diameter of the lens and thick lens edge. Also extended wearing times predispose to the disease. Patients may be asymptomatic or may report symptoms such as excessive lens movement, lens decentration, blurred vision and itching, which can increase after lens removal [9]. Often the severity of the symptoms does not correlate with the clinical signs.

Management of CLPC includes temporary discontinuation of lens wear, lens change to a new one, reducing wear time or changing lenses to daily disposables or rigid gas permeable contact lenses. Symptoms usually subside within a week of lens discontinuation.

**Giant papillary conjunctivitis (GPC)** (Figure 2) is often diagnosed in contact lens wearers, and especially among the users of hydrogel contacts. It is the most common cause of contact lens intolerance and contact lens dissatisfaction and discontinuation. According to epidemiological studies, the disease occurs in 5–15% and



**Figure 1.** Contact lens-induced papillary conjunctivitis (CLPC)



**Figure 2.** Giant papillary conjunctivitis (GPC)

2–5% of soft and rigid contact lens users, respectively [10]. Age and gender do not seem to affect the likelihood of developing GPC while a history of atopic conditions may be of importance.

Giant papillary conjunctivitis represents an immune reaction to mechanical injury caused by the surface of contact lenses. Irritation of upper tarsal conjunctiva brings about changes in conjunctival histology resulting in tissue remodeling and formation of characteristic giant papillae. Although antigens responsible for GPC development have not been identified yet, it has recently been found that chemokines and cytokines including IL-8, IL-6, IL-11, tissue inhibitor of metalloproteinase-2, eotaxin as well as exaggerated proliferation of M cells and B-lymphocytes in conjunctiva-associated lymphoid tissue (CALT) might play a role [11]. Clinical examination shows a number of papillae on the upper tarsal conjunctiva, which may exceed 1 mm in size, increased amount of mucous discharge within the conjunctival sac, excessive lens movement, redness, burning and itching as well as decreased lens tolerance. The symptoms usually develop after months or even years of contact lens use (1.5–2 years for soft contacts and 9–11 years for rigid contacts).

Management consists of irritant elimination and maintaining a high standard of contact lens care. Giant papillary conjunctivitis may also require changing the contact lens type or routine. Switching to daily disposable lenses or temporary cessation of contact lens wear might be helpful.

Pharmacotherapy includes artificial tears, mast cell stabilizers and combination anti-allergy preparations. Sometimes topical steroid therapy might be of use. With proper treatment, the disease usually subsides without any serious complications.

**Contact lens-induced peripheral ulcer (CLPU)** – Infiltrative keratitis associated with hypersensitivity to preservatives contained in the contact lens care solution, e.g.

thiomersal [12]. The reaction may occur immediately after the contact lens is inserted or some time afterwards.

The examination reveals bilateral redness and corneal infiltrates. Symptoms may be absent, but some patients complain of mild eye pain and itching.

Treatment usually involves discontinuation of lens wear until the infiltrates resolve, change of contacts to daily disposable or silicone hydrogel lenses and change of the contact lens care solution. In the case of recurrences, topical non-steroidal anti-inflammatory drugs or steroid preparations may be prescribed.

**Superior limbic keratoconjunctivitis (SLK)** – A chronic bilateral inflammatory condition which involves the tarsal conjunctiva of the upper eyelid and the upper segment of the cornea. Superior limbic keratoconjunctivitis results from anterior segment hypoxia due to long-term soft contact lens wear and allergic reaction to contact lens care solutions [10, 13–15].

Patients with SLK may complain of itching, foreign body sensation and increased lacrimation. Clinical findings usually include injection and edema of the superior cornea and conjunctiva with superficial corneal neovascularization.

Lens wear should be discontinued. Abundant conjunctival sac lubrication is recommended using a preservative-free artificial tears fluid. A preservative-free contact lens care system should also be implemented.

Superficial punctate keratitis (SPK) may result from hypersensitivity to preservatives found in contact lens care solutions or mechanical irritation of the eye surface by damaged or incorrectly fitted contact lenses.

Patients usually complain of a burning sensation and increased lacrimation. An ophthalmic examination reveals tiny punctuate subepithelial infiltrates.

Management includes preservative-free lubricant eye drops; the contact lens care solution should be replaced with another one.

The most irritable ingredient of care solutions is thiomersal, which can cause a serious allergic reaction and even lead to progressive corneal epithelial stem cells damage and therefore corneal neovascularization. At present, thiomersal is excluded from the treaty in the majority of countries.

On the contrary, benzalkonium chloride (BAK) is the most popular preservative of the eye drops. It can cause hypersensitivity reactions and is toxic to the epithelial surface, too. Because it is absorbed by the soft contact lenses it is recommended to avoid use of drops containing BAK in patients wearing contact lenses.

At present, a preferred soft contact lens type is silicone hydrogel contact lenses. The material's physical properties, i.e. high oxygen permeability and low water content, ensure high comfort and safety of use. Hence, the most common adverse effect, i.e. corneal hypoxia, has been eliminated. Nevertheless, contact wearers still suffer from a variety of complications which should always be taken into consideration.

Contact lens wearers may present with superior epithelial arcuate lesions (SEALs), i.e. archlike epithelial erosions in the upper quadrant of the cornea separated from the limbus by a clear region. The lesions stain intensely with sodium fluorescein. Generally, a mechanical abrasion is believed to cause the lesion; contact lens type (thick, rigid or convex lens) and corneal structure (curvature steepening, tight eyelid) seem to be the predisposing factors [16–18]. In many cases epithelial splits are asymptomatic although some patients may report a mild foreign body sensation. Contact lenses must be discontinued until epithelial erosions heal (1–7 days).

Another adverse event associated with the use of silicone hydrogel (SiHy) contact lenses is the development of the so called mucin balls, i.e. spherical and translucent bodies sandwiched between a contact lens and the anterior corneal surface. Mucin balls probably result from the mechanical interaction of a lens, mucin layer of the tear film and forces exerted on the anterior segment by the upper eyelid while blinking [19, 20]. Due to their size, these translucent entities might cause depressions within the cornea, clearly visualized with fluorescein staining. Eye-related discomfort and/or visual problems are rarely reported [21, 22]. Management strategies include switching to silicon hydrogels and avoiding flat fitting lenses.

All contact lens types may induce corneal epithelial erosions (Figure 3). Clinical examination reveals a well-circumscribed, full-thickness corneal epithelium defect, most frequently located in a lower quadrant. Epithelial erosions are caused by mechanical trauma to the cornea and disruption in the integrity of the corneal epithelium left behind after the removal of a too tightly fitting lens [23, 24]. Corneal hypoxia associated with the use of extended wear contacts may also lead to corneal erosions. Following lens removal, patients complain of discomfort and foreign body sensation. Temporary contact lens discontinuation is recommended as well as intense lubrication of the conjunctival sac (artificial tears, gels).

Contact lens wear may also cause the development of conjunctival epithelial flaps consisting of the delamination of the bulbar conjunctival epithelium from its underlying tissue [25]. The lesion size depends on the wear schedule (daily-wear vs. continuous wear) [26]. Lesions appear in an upper eye quadrant and tend to remain asymptomatic. Since the conjunctival epithelial flap is a recently reported phenomenon, its long-term sequelae have not been investigated yet.

Patients are advised to discontinue contact lens wear until conjunctival healing has been confirmed (a few days up to several weeks).

Forister *et al.* analyzed the types and prevalence of contact lens-related complications among 572 contact lens wearers, and found that approximately 50% of the eyes had at least one contact lens-related complication. The researchers also observed that rigid gas permeable contact lenses yielded a statistically lower average num-

ber of complications than soft contacts. Papillae and giant papillary conjunctivitis were the most prevalent complications in both rigid and soft contact lenses wearers. Silicone soft contact lenses had a slightly lower, although not statistically different, rate of complication than non-silicone soft contact lenses. Extended wear contact lens use had a higher complication rate compared with daily wear. Compared with brand contact lens care solutions, 'other' products, including generic and private label solutions had a higher rate of complications for both soft and rigid contacts [27].

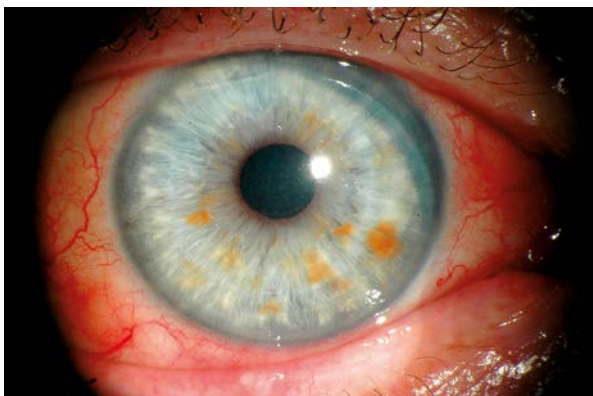
Considering the above mentioned reports, it is highly advisable to carefully fit the lens regarding its structure and composition as well as to instruct the patient how to use and clean the product.

Lens tolerance may be reduced by the accumulation of surface allergens and deposits leading to hypersensitivity reactions. The lens must be regularly cleaned; however, multifunctional contact lens solutions usually contain preservatives which may act as eye irritants. Neglect of proper lens care guidelines increases the risk of developing an eye infection and/or corneal ulceration, which can progress rapidly leading to serious sequelae including blindness.

The most essential are proper cleaning and disinfection of the lens as well as faithful adherence to wearing schedules. It is also important to follow the instructions of lens manufacturers regarding the use of lens care solutions. Following removal, the lens should be thoroughly rinsed using a clearing solution; the back surface should be rubbed to eliminate a build-up of micro-organisms and deposits. It should then be placed in a contact lens case filled with a storage solution. Since contact lens storage cases can be a source of contamination and infection, they should be cleaned, rinsed, and allowed to air dry each time the lenses are inserted into the eye. Contact lenses must not be exposed to non-sterile liquids (boiled water, tap water, swimming pools, lakes, etc.) as these carry a significantly increased risk for treatment-resistant acanthamoeba keratitis.



Figure 3. Corneal epithelial erosion



**Figure 4.** Red eye

An alarming sign that requires specialist examination is the so called *red eye* (Figure 4). The patient may complain of discomfort, pain, blurred vision and lacrimation. Contact lenses should be removed and kept available in case bacterial culture would be necessary. The patient should be referred to an ophthalmologist on an emergency basis.

Contact lens wearers who develop allergic reactions are frequently forced to discontinue lens use. Also, older forms of anti-allergic eye drops must be instilled several times during the day which leads to cessation of contact lens wear. Eye drop preservatives (e.g. benzalkonium chloride) cause damage to contact lenses and corneal epithelium. There are some cases when contact lens wear is strictly contraindicated e.g. chronic blepharitis, severe dry eye and AKC, VKC (except treatment contact lenses).

Newer-generation antihistamines, e.g. olopatadine hydrochloride, azelastine, epinastine, ketotifen are much more convenient to use. They are instilled twice daily, at least 15 min prior to lens insertion and after its removal [28, 29].

Allergen avoidance has been the cornerstone of all allergy therapies. However, this is not always possible. During seasonal allergy exacerbations patients are recommended to reduce wear time and rinse the conjunctival sac with preservative-free lubricant eye drops. Lens surface deposits and coatings are mostly formed at night when the natural cleansing mechanisms (lubrication and blinking) are stopped. Extended contact lenses are therefore strictly contraindicated in patients suffering from eye-related allergies. The comfort of contact lens wear depends on the wear schedule. Hayes *et al.* observed that 1-day disposable lenses provided improved comfort in 67% of study participants compared to the lenses they wore prior to the study [30].

In 2011, Wolffsohn *et al.* carried out investigations to compare allergy symptoms in patients wearing two types of daily disposable lenses (including the type with enhanced lubricating agents) to those with no contact

**Table 1.** Practical guidelines to avoid contact lens wear problems in allergic patients

The best choice of lenses for allergic patients are daily disposables
The extended wear contact lenses are strictly contraindicated
The regular lubrication of the ocular surface with preservative free eye drops is very important (min. 3 times a day)
Allergen avoidance
Topical newer-generation antihistamines e.g. olopatadine, azelastine, epinastine, ketotifen ordered twice daily at least 15 min prior to the lens insertion and after its removal
If oral antihistamines are necessary it is better to prescribe a new type (bilastine)
If there is any sign of the "red eye", the patient should be referred to an ophthalmologist

lenses. Corneal staining and symptoms of burning and eyelid redness were significantly reduced in severity by the lens with enhanced lubricating agents compared to the other two groups suggesting that this type of lens provides an additional barrier against allergen penetration. Overall allergy symptoms were significantly reduced in duration [31].

It can be concluded that at present, patients may safely use contact lenses even in the course of an exacerbated allergy reaction. Satisfactory co-operation between the patient, allergologists and ophthalmologists is of crucial importance. The patient should be advised to use daily disposables, reduce wear time, instill new-generation anti-allergic eye drops twice daily and regularly consult an ophthalmologist (Table 1). The conjunctival sac should be rinsed with preservative-free lubricant eye drops. However, in the case of a severe allergic reaction or corneal pathology, temporary discontinuation of contact lens wear is strongly recommended.

### Conflict of interest

The authors declare no conflict of interest.

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