

Conjunctivitis: Types, Clinical Manifestation and Management

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ABSTRACT

This narrative review analyses the different types, clinical manifestations, and management strategies for conjunctivitis to facilitate accurate diagnosis and treatment planning. It gathers information on the types of conjunctivitis and their management based on findings from primary and secondary literature sources. Conjunctivitis is broadly categorized into bacterial, viral, allergic, and some less common forms. Each type has unique causes and symptoms. Bacterial conjunctivitis is often characterized by purulent discharge. At the same time, the viral type is characterized by watery discharge. Allergic conjunctivitis typically presents with itchy eyes. The symptoms vary depending on the underlying cause. Common symptoms include redness, irritation, discharge, and photophobia. Many cases of bacterial conjunctivitis require antibiotic therapy, but viral conjunctivitis is generally managed with supportive care. Allergic conjunctivitis responds well to antihistamines and mast cell stabilizers. Accurate diagnosis protects against the development of antibiotic resistance and ensures proper management is delivered. This review emphasises the importance of accurate diagnosis and the development of personalised treatment plans to enhance patient care.

KEYWORDS: Conjunctival inflammation, ocular infection, bacterial conjunctivitis, viral conjunctivitis, allergic conjunctivitis, treatment

INTRODUCTION

Inflammation or infection of the conjunctiva is called "conjunctivitis," but it is often referred to as "pink eye." The conjunctiva, a very thin mucous membrane, lines the inside of the eyelids and the surface of the globe up to the limbus. It is further separated into the bulbar portion that covers the world and the tarsal portion that covers the lids. It is usually clear, but it gets infected and turns pink or red when inflamed, hence the term "pink eye". Conjunctivitis ranges in severity from slight redness to subconjunctival haemorrhage, purulent discharge and edema of conjunctiva or eyelid¹. It is categorized as either infectious or non-infectious, acute or chronic.

In contrast to chronic conjunctivitis, which lasts more than four weeks, acute conjunctivitis typically lasts only one to two weeks after presentation². Ocular allergy is the most common form of non-infectious conjunctivitis, and it can significantly decrease productivity and impact patients' quality of life. In some rare but more severe cases, it can threaten vision. The prevalence of ocular allergy, including seasonal and perennial allergic conjunctivitis, has been increasing worldwide³. Conjunctivitis triggers inflammation in the conjunctiva. This inflammation occurs when the tiny blood vessels within the conjunctiva swell or become inflamed, resulting in a noticeable red or pink appearance in the eyes. Other

symptoms include irritation, burning sensation, pain, swelling, or itchiness. It can affect one or both eyes within a day or two, often causing increased eye discharge or constant tears. The infection can also affect the eyelids, causing them to appear swollen or droopy, although it seldom impacts vision. Occasionally, this condition presents itself with a greenish or yellowish discharge⁴. The causative agents include bacteria, viruses, and allergens like pollen, foreign objects, chemical exposure, or various irritating environmental substances. However, timely detection and precautionary measures can effectively limit the spread of conjunctivitis⁵. Apart from being caused by multiple infectious agents, conjunctivitis may also be associated with certain systemic illnesses, including Stevens-Johnson syndrome, keratoconjunctivitis sicca, nutritional deficiencies (especially vitamin A deficiency), congenital metabolic syndromes such as porphyria and Richner-Hanhart syndrome, and immune-related disorders, such as Reiter syndrome⁶⁻⁷. This review provides a comprehensive analysis of the types, clinical presentations, and management strategies for conjunctivitis, aiming to facilitate accurate diagnosis and optimize treatment planning.

METHODOLOGY

Study Design: This study employed a narrative literature review to gather and analyze research articles, clinical guidelines, and expert opinions about conjunctivitis.

Study Question: What are the different types of conjunctivitis, their clinical manifestations, and the current approaches to management?

Databases Searched: Comprehensive database searches were conducted across platforms like

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PubMed, Google Scholar, Scopus, and Web of Science, utilizing a range of keywords like 'conjunctivitis', 'types of conjunctivitis', 'species', 'causing conjunctivitis', 'complications', 'ocular inflammation', 'bacterial conjunctivitis', 'viral conjunctivitis', 'allergic conjunctivitis', 'toxic conjunctivitis', 'non-specific', 'irritants', 'causes', 'symptoms', 'treatment', and 'prevention'.

Study Selection Process

Peer-reviewed articles published in English from the earliest available records to the present were included in the review. Unpublished manuscripts, conference abstracts, dissertations and manuscripts published in languages other than English were excluded.

Eligibility Criteria: The eligibility criteria encompassed studies addressing the pathophysiology, clinical signs and symptoms and treatment and prevention strategies of conjunctivitis.

Data Extraction and Synthesis: Data extraction and synthesis were conducted to consolidate key findings, facilitate the identification of emerging trends and gaps in current knowledge, and assess the methodological quality of the included studies to ensure the reliability of the synthesised evidence. It also provides insight into understanding the types, management, and prevention of conjunctivitis.

TYPES OF CONJUNCTIVITIS

Bacterial conjunctivitis

Several bacteria, including *Haemophilus influenzae*, *Moraxella catarrhalis*, and *Streptococcus pneumoniae*, cause a highly infectious eye infection. The most common symptoms of bacterial conjunctivitis include swelling of the eyelids, followed by a greenish or yellowish discharge, redness, and a sticky texture in the eyes. Bacterial infections caused by *Haemophilus influenza* may also result in burning and dryness, accompanied by severe pain. In contrast, *Moraxella catarrhalis* commonly causes eye conditions after an incubation period of 4-5 days. Usually, it is self-limiting, but some types of bacterial conjunctivitis may need specific treatment in severe cases⁸⁻¹¹.

Viral conjunctivitis

Viral conjunctivitis is caused by *Enterovirus 70*, *Coxsackievirus A24*, *Varicella-Zoster virus*, and *Adenovirus*. Any person of any age can be affected, and its contagiousness is moderate. The infection causes redness in one or both eyes, pain, irritation, a greenish or yellowish discharge, and sensitivity to light. *Adenovirus* is a common causative agent of potentially serious ocular infections, including epidemic keratoconjunctivitis and pharyngoconjunctival fever. This infection can result in photophobia, a foreign body sensation, excessive tearing, or even nasal congestion, particularly in cases of virus-induced conjunctivitis. Joint association of the *Rubella virus* has been associated with conjunctivitis, which can pose a significant risk to pregnant women, leading to severe complications. *Herpes Simplex Virus* has also been associated with conjunctivitis, which tends to affect children and adults. Another type of

viral conjunctivitis is acute haemorrhagic conjunctivitis, also known as "diplomats' conjunctivitis," which is likely caused by *Coxsackievirus A24*. This type has an extremely short incubation period characterized by excessive tearing, swelling, and redness. In most cases, patients recover within one to two weeks and have no long-term effects¹¹⁻¹⁴.

Allergic conjunctivitis

The allergens that cause allergic conjunctivitis include pollen, intake of smoke, fragrant smells and air pollution. Allergies caused by seasonal changes, especially in spring, are quite common. Characteristics of allergic conjunctivitis include redness, burning, swelling, and increased tearing. Symptoms such as itching, tearing, and mild redness worsen in the spring due to the increased number of airborne pollutants and can be either chronic or acute. Vernal keratoconjunctivitis is a condition that usually occurs during the warm season and is more commonly seen in countries with hot climates. This type is characterized by sticky discharge, photosensitivity, and cobblestone-like lesions on the eyelids. Atopic keratoconjunctivitis associated with atopic eczema may present with itchiness, discomfort, and severe pain in the eye(s). It can later result in visual impairment. Inflammatory tissue lesions cause giant papillary conjunctivitis, most likely due to the response stimulated in individuals by the biocompatible materials used in the manufacture of contact lenses. This leads to inflammation and swelling of papillae in the upper eyelid, presenting symptoms that can be easily confused with other types of conjunctivitis¹⁵⁻¹⁶.

Irritants/ Chemical splashes

Some potential irritants that can cause conjunctivitis are plant saps, toxic substances, odours, chemical spills, and unpleasant gases. Contact of any of these compounds with the eye(s) causes inflammation of the conjunctiva. This may cause discomfort, irritation and redness in the eyes. It is recommended that the eye be rinsed thoroughly with clean water and that medical assistance be obtained to prevent severe damage¹¹.

Toxic conjunctivitis

Toxic conjunctivitis, also known as toxic keratoconjunctivitis, occurs when ocular tissues are damaged. Prolonged use of the dangerous substances might cause inflammation of the conjunctiva, resulting in either a papillary or follicular reaction. This might cause the conjunctiva to enlarge, turn red, and retain excess moisture. Allergic and toxic conjunctivitis often have similar symptoms, making them difficult to distinguish¹⁷.

Non-specific conjunctivitis

A red eye condition and discharge can occur without being attributed to infection, allergy, or toxicity. Non-specific conjunctivitis typically resolves within a few days without treatment, as the conjunctiva heals rapidly. Lubricants, such as drops or ointments, can help improve eye comfort. Preservative-free treatments are more expensive and only

Table I: Types of Conjunctivitis: Signs, Symptoms and Treatments

Type of Conjunctivitis	Species involved with characteristics	Clinical Signs and Symptoms	Associated complications	Treatment options
Bacterial conjunctivitis	<i>H. influenzae</i> (Gram-negative facultative anaerobe), <i>S. pneumoniae</i> (Gram-positive facultative anaerobe) and <i>M. catarrhalis</i> (Gram-negative obligate aerobe)	Eye redness, mucopurulent discharge, matted and adhered eyes in the morning, foreign body sensations, burning sensation, dryness and severe pain	Corneal ulcers, eyeball perforation, keratitis	Tetracycline, chloramphenicol, 2% of nitrate solution, ceftriaxone, azithromycin, eye drops like gentamycin, ointments like polyfax and ciprofloxacin, Levofloxacin 0.5% (Quixin), Moxifloxacin 0.5% (Vigamox), Ofloxacin 0.3% (Ocuflox), Bacitracin/polymyxin B (Polycin), Erythromycin 0.5%, Gentamicin 0.3% (Gentak), Sulfacetamide 10%, Tobramycin 0.3% (Tobrex), Trimethoprim/polymyxin B
Viral conjunctivitis	<i>Enterovirus 70</i> and <i>Coxsackievirus A24</i> (Single-stranded positive sense RNA), <i>Varicella-Zoster virus</i> , <i>Adenovirus</i> and <i>Herpes Simplex Virus</i> (Double-stranded DNA genome)	Redness, watery discharge, itching, irritation, lid swelling. Less frequent symptoms include pain, sensitivity to light, lid vesicles and ulcers, and blurred vision	Keratitis and iritis/uveitis	2% povidone-iodine, povidone-iodine 0.6% and dexamethasone 0.1% (PVP-I/dexamethasone) vs. povidone-iodine 0.6% vs. vehicle (1:1:1) and cidofovir 1%, artificial tears
Allergic conjunctivitis	-	Itching, foreign body sensation, serous or mucous discharge, conjunctival hyperaemia and tarsal papillary reaction	Corneal scarring, pannus, vision-threatening and the presence of giant tarsal papillae adversely affect the prognosis	Topical antihistamine agents, topical H1-receptor antagonists, azelastine or olopatadine, topical lubricant, antihistamines, and topical steroids, Alcaftadine 0.25% (Lastacast), Bepotastine 1.5% (Bepreve), Epinastine 0.05%, Ketotifen 0.025% (Zaditor),
Irritants/Chemical splashes	-	Eye pain, foreign body sensation, vision loss and sensitivity to light	Corneal abrasions	Ciprofloxacin or gentamicin and topical bacitracin or erythromycin

recommended for patients with severe dry eyes or allergies to preservatives¹⁸.

TREATMENT

Infectious conjunctivitis includes various types, with viral conjunctivitis being the most common, usually not requiring specific treatment. Bacterial conjunctivitis, affecting all age groups, is typically treated with antibiotics. Studies have shown the efficacy of antibiotics like ciprofloxacin and tobramycin in treating bacterial conjunctivitis¹⁹. Viral conjunctivitis lacks specific antiviral treatments, and diagnosing it based solely on common signs and symptoms often leads to unnecessary antibiotics, which are ineffective against viral infections. Proper eyelid hygiene and culture-guided antibiotic application are essential for effective treatment. (Table I) provides a comparison of significant types of conjunctivitis, including bacterial conjunctivitis^{9,20,31} viral conjunctivitis^{11-20,32-44}, Allergic conjunctivitis^{20,45-50} and Irritants/Chemical splashes^{1,51}, species involved in causing conjunctivitis, symptoms, potential complications and treatment methods.

Insufficient protection and chronic inflammation may lead to conjunctivitis⁵². Itchiness, burning sensation, redness, pain and excessive eye discharge are the most common symptoms of conjunctivitis⁵³⁻⁵⁴. Conjunctivitis-related problems, such as dry eyes, blepharitis, and keratitis, may disrupt the ocular surface⁵⁵⁻⁵⁶. Conjunctivitis may develop into conditions such as corneal scarring, corneal neovascularisation,

and recurrent corneal erosion syndrome, which can require corneal transplantation to prevent blindness⁵⁷⁻⁵⁹. Ketotifen reduces itching, tears, and other signs of conjunctivitis⁶⁰. Topical antibiotics may reduce chronic clinical infection by approximately 25%⁶¹.

CONCLUSION

Conjunctivitis can cause discomfort, but its impact can be minimized with proper prevention and management strategies. Understanding the symptoms and preventive measures of conjunctivitis, whether caused by viruses, bacteria, allergies, or irritants, is essential for maintaining ocular health and reducing the spread of infection. Practicing good hygiene, properly caring for contact lenses, and avoiding allergens and irritants can help reduce the risk of developing conjunctivitis. Early recognition of symptoms and seeking medical attention for proper diagnosis and treatment are essential to prevent complications. Spreading awareness and educating others about conjunctivitis and preventive measures can help reduce its impact on the community. By working together and following these strategies, eye health can be protected, and the effect of conjunctivitis can be reduced.

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AUTHOR CONTRIBUTION

Rubab M: Conceived the idea and participated in its design, and drafted the initial manuscript

Zahoor S: Supervised the write-up and revised the manuscript

Ashraf S: Proofread the manuscript.

All the authors read and approved the final manuscript.

REFERENCES

1. Mahoney MJ, Bekibele R, Notermann SL, Reuter TG, Borman-Shoap EC. Pediatric conjunctivitis: a review of clinical manifestations, diagnosis, and management. *Child*. 2023; 10(5): 808. doi: 10.3390/children10050808.
2. Hashmi MF, Gurnani B, Benson S. Conjunctivitis. In: StatPearls [Internet]. StatPearls Publishing; 2024.
3. Chan VF, Yong AC, Azuara-Blanco A, Gordon I, Safi S, Lingham G et al. A systematic review of clinical practice guidelines for infectious and non-infectious conjunctivitis. *Ophthalmic Epidemiol*. 2022; 29(5): 473-82. doi: 10.1080/09286586.2021.1971262.
4. Shekhawat NS, Shtein RM, Blachley TS, Stein JD. Antibiotic prescription fills for acute conjunctivitis among enrollees in a large United States managed care network. *J Ophthalmol*. 2017; 124(8): 1099-107. doi: 10.1016/j.optha.2017.04.034.
5. Azari AA, Arabi A. Conjunctivitis: a systematic review. *J Ophthalmic Vis Res*. 2020; 15(3): 372. doi: 10.18502/jovr.v15i3.7456.
6. De Laet C, Dionisi-Vici C, Leonard JV, McKiernan P, Mitchell G, Monti L et al. Recommendations for the management of tyrosinaemia type 1. *Orphanet J Rare Dis*. 2013; 8: 1–9. doi: 10.1186/1750-1172-8-8.
7. Sati A, Sangwan VS, Basu S. Porphyria: varied ocular manifestations and management. *Case Rep*. 2013; 2013: bcr2013009496. doi: 10.1136/bcr-2013-009496.
8. Carlson JH, Whitmire WM, Crane DD, Wicke L, Virtaneva K, Sturdevant DE et al. The Chlamydia trachomatis plasmid is a transcriptional regulator of chromosomal genes and a virulence factor. *Infect Immun*. 2008; 76(6): 2273–2283. doi: 10.1128/IAI.00102-08.
9. Hu Y-L, Lee P-I, Hsueh P-R, Lu C-Y, Chang L-Y, Huang L-M et al. Predominant role of Haemophilus influenzae in the association of conjunctivitis, acute otitis media and acute bacterial paranasal sinusitis in children. *Sci Rep*. 2021; 11(1):11. doi:10.1038/s41598-020-79680-6.
10. LaCroce SJ, Wilson MN, Romanowski JE, Newman JD, Jhanji V, Shanks RM et al. Moraxella nonliquefaciens and M. osloensis are important Moraxella species that cause ocular infections. *Microorganisms*. 2019; 7(6): 163. doi: 10.3390/microorganisms7060163.
11. Sahdev AK, Sethi B, Singh A, Sharma N, Purwar S. Conjunctivitis: Types, diagnosis and treatment under different therapies. *Asian J Pharm Pharmacol*. 2018; 4(4): 421-8.
12. González-López J, Morcillo-Laiz R, Muñoz-Negrete F. Adenoviral keratoconjunctivitis: an update. *Arch Soc Esp Oftalmol (Engl Ed)*. 2013; 88(3): 108-15. doi: 10.1016/j.oftale.2012.07.002.
13. Newman H, Gooding C. Viral ocular manifestations: a broad overview. *Rev Med Virol*. 2013; 23(5): 281-94. doi: 10.1002/rmv.1749.
14. Elliott T, Casey A, Lambert PA, Sandoe J. *Med Microbiol Infect*: John Wiley & Sons; 2011.
15. Bielory L, Delgado L, Katelaris CH, Leonardi A, Rosario N, Vichyanoud P. ICON: diagnosis and management of allergic conjunctivitis. *Ann Allergy Asthma Immunol*. 2020; 124(2): 118-34. doi: 10.1016/j.anai.2019.11.014.
16. Friedlaender MH. Ocular allergy. *Curr Opin Allergy Clin Immunol*. 2011; 11(5): 477-82. doi: 10.1186/1824-7288-39-18.
17. Iqbal T, Altaf S. Overview of Pink Eye Infection (Conjunctivitis). *Biological Times*. 2024; 2(12): 70-1.
18. Satish RT, Sayali B, Gajanan AT, Kirti S. A systematic review of conjunctivitis. 2024.
19. Tepedino ME, Heller WH, Usner DW, Brunner LS, Morris TW, Haas W et al. Phase III efficacy and safety study of besifloxacin ophthalmic suspension 0.6% in the treatment of bacterial conjunctivitis. *Curr Med Res Opin*. 2009; 25(5): 1159-69. doi: 10.1185/03007990902837919.
20. Winters S, Frazier W, Winters J. Conjunctivitis: diagnosis and management. *Am Fam Physician*. 2024; 110(2): 134–144.
21. Block SL, Hedrick J, Tyler R, Smith A, Findlay R, Keegan E et al. Increasing bacterial resistance in pediatric acute conjunctivitis (1997–1998). *Antimicrob Agents Chemother*. 2000; 44(6): 1650-4. doi: 10.1128/aac.44.6.1650-1654.2000.
22. Fahey M, Westmoreland S. Nervous system disorders of nonhuman primates and research models. *Nonhuman Primates Biomed Res*. 2012; 733-82.
23. Haidar A, Sharif J, Nadeem A, Perveen A, Muazzam A, Naveed A et al. Bacterial conjunctivitis: clinical features, types and complications; a systematic review. *Adv Res Med Health Sci*. 2024; 2(1): 1-9. doi: 10.57040/atytxc98.

24. High NJ. Haemophilus influenzae. Mol Med Microbiol. 2002; 1967-88. doi: 10.1016/B978-012677530-3/50312-3.
25. Honkila M, Renko M, Ikäheimo I, Pokka T, Uhari M, Tapiainen T. Aetiology of neonatal conjunctivitis evaluated in a population-based setting. Acta Paediatr. 2018; 107(5): 774-9. doi: 10.1111/apa.14227.
26. Kumar NM, Mah FS. Bacterial, Chlamydial, and Mycobacterial Infections. Albert Jakobiec's Princ Pract Ophthalmol. 2022; 281-307. doi: 10.9734/ijtdh/2024/v45i61552.
27. Mallika P, Asok T, Faisal H, Aziz S, Tan A, Intan G. Neonatal conjunctivitis—a review. Malays Fam Physician. 2008; 3(2): 77.
28. Martin M, Turco JH, Zegans ME, Facklam RR, Sodha S, Elliott JA, et al. An outbreak of conjunctivitis due to atypical *Streptococcus pneumoniae*. N Engl J Med. 2003; 348(12): 1112-21. doi: 10.1056/NEJMoa022521.
29. Mazumder P. Impact of sunlight on chloramphenicol mediated synthetic and herbal eye drops in terms of antimicrobial activity. BRAC Univ. 2017.
30. Rietveld RP, van Weert HC, ter Riet G, Bindels PJ. Diagnostic impact of signs and symptoms in acute infectious conjunctivitis: systematic literature search. BMJ. 2003; 327(7418): 789. doi: 10.1136/bmj.327.7418.789.
31. Wang W, Kinkel T, Martens-Habbena W, Stahl DA, Fang FC, Hansen EJ. The Moraxella catarrhalis nitric oxide reductase is essential for nitric oxide detoxification. J Bacteriol. 2011; 193(11): 2804-13. doi: 10.1128/jb.00139-11.
32. Darougar S, Wishart M, Viswalingam N. Epidemiological and clinical features of primary herpes simplex virus ocular infection. Br J Ophthalmol. 1985; 69(1):2-6. doi: 10.1136/bjo.69.1.2.
33. Davison AJ, Scott JE. The complete DNA sequence of varicella-zoster virus. J Gen Virol. 1986; 67(9): 1759-816. doi: 10.1099/0022-1317-67-9-1759.
34. Dolan A, Jamieson FE, Cunningham C, Barnett BC, McGeoch DJ. The genome sequence of herpes simplex virus type 2. J Virol. 1998; 72(3): 2010-21. doi: 10.1128/jvi.72.3.2010-2021.1998.
35. Ebner K, Pinsker W, Lion T. Comparative sequence analysis of the hexon gene in the entire spectrum of human adenovirus serotypes: phylogenetic, taxonomic, and clinical implications. J Virol. 2005; 79(20): 12635-42. doi: 10.1128/jvi.79.20.12635-12642.2005.
36. Fonseca MC, Pupo-Meriño M, García-González LA, Resik S, Hung LH, Muné M, et al. Molecular evolution of coxsackievirus A24v in Cuba over 23-years, 1986–2009. Sci Rep. 2020; 10(1): 13761. doi: 10.1038/s41598-020-70436-w.
37. Gordon YJ, Naesens L, DeClercq E, Maudgal PC, Veckeneer M. Treatment of adenoviral conjunctivitis with topical cidofovir. Cornea. 1996; 15(5): 546.
38. Gordon YJ, Romanowski EG, Araullo-Cruz T. Topical HPMPC inhibits adenovirus type 5 in the New Zealand rabbit ocular replication model. Invest Ophthalmol Vis Sci. 1994; 35(12): 4135-43.
39. Jhanji V, Chan TC, Li EY, Agarwal K, Vajpayee RB. Adenoviral keratoconjunctivitis. Surv Ophthalmol. 2015; 60(5): 435-43. doi: 10.1016/j.survophthal.2015.04.001.
40. Pepose JS, Ahuja A, Liu W, Narvekar A, Haque R. Randomized, controlled, phase 2 trial of povidone-iodine/dexamethasone ophthalmic suspension for treatment of adenoviral conjunctivitis. Am J Ophthalmol. 2018; 194: 7-15. doi: 10.1016/j.ajo.2018.05.012.
41. Skevaki CL, Galani IE, Pararas MV, Giannopoulou KP, Tsakris A. Treatment of viral conjunctivitis with antiviral drugs. Drugs. 2011; 71: 331-47. doi: 10.2165/11585330-000000000-00000.
42. Trinavarat A, Atchaneeyasakul L-o. Treatment of epidemic Keratoconjunctivitis with 2% povidone-iodine: a pilot study. J Ocul Pharmacol Ther. 2012; 28(1): 53-8. doi: 10.1089/jop.2011.0082.
43. Wang G. Enteroviruses and rhinoviruses. Mol Med Microbiol. 2024; 2451-75. doi: 10.1016/B978-0-12-818619-0.00062-9.
44. Yawn BP, Wollan PC, Sauver JLS, Butterfield LC, editors. Herpes zoster eye complications: rates and trends. Mayo Clin Proc. 2013; doi: 10.1016/j.mayocp.2013.03.014.
45. Addis H, Jeng BH. Vernal keratoconjunctivitis. Clin Ophthalmol. 2018; 119-23. doi: 10.2147/OPTH.S129552.
46. Berger WE, Granet DB, Kabat AG, editors. Diagnosis and management of allergic conjunctivitis in pediatric patients. Allergy Asthma Proc. 2017. doi: 10.2500/aap.2017.38.4003.
47. Bonini S. Allergy and the eye. His Allergy. 2014; 100: 105-8. doi: 10.1159/000358615.
48. Castillo M, Scott NW, Mustafa MZ, Mustafa MS, Azuara-Blanco A. Topical antihistamines and mast cell stabilizers for treating seasonal and perennial allergic conjunctivitis. Cochrane Database Syst Rev. 2015(6). doi: 10.1002/14651858.CD009566.pub2.
49. De Smedt S, Wildner G, Kestelyn P. Vernal keratoconjunctivitis: an update. Br J Ophthalmol. 2013; 97(1): 9-14. doi: 10.1136/bjophthalmol-2011-301376.
50. Palmares J, Delgado L, Cidade M, Quadrado MJ, Filipe HP. Allergic conjunctivitis: a national cross-sectional study of clinical characteristics and quality of life. Eur J Ophthalmol. 2010; 20(2): 257-64. doi: 10.1177/112067211002000201.
51. Loporchio D, Mukkamala L, Gorukanti K, Zarbin M, Langer P, Bhagat N. Intraocular foreign bodies: a review. Surv Ophthalmol. 2016;61(5): 582-96. doi: 10.1016/j.survophthal.2016.03.005.

52. Hung N, Kang EY-C, Lee T-W, Chen T-H, Shyu Y -C, Sun C-C. The risks of corneal surface damage in aqueous-deficient dry eye disease: A 17-year population-based study in Taiwan. *Am J Ophthalmol*. 2021; 227: 231-9. doi: 10.1016/j.ajo.2021.03.013.
53. Mikhail E, Azizoglu S, Gokhale M, Suphioglu C. Questionnaires assessing the quality of life of ocular allergy patients. *J Allergy Clin Immunol Pract*. 2020; 8(9): 2945-52. doi: 10.1016/j.jaip.2020.04.023.
54. Zhang S-y, Li J, Liu R, Lao HY, Fan Z, Jin L et al. Association of allergic conjunctivitis with health-related quality of life in children and their parents. *JAMA Ophthalmol*. 2021; 139(8): 830-7. doi: 10.1001/jamaophthalmol.2021.1708.
55. Suzuki T. Inflamed obstructive meibomian gland dysfunction causes ocular surface inflammation. *Invest Ophthalmol Vis Sci*. 2018; 59(14): DES94-DES101. doi: 10.1167/iovs.17-23345.
56. Singh RB, Das S, Chodosh J, Sharma N, Zegans ME, Kowalski RP et al. Paradox of complex diversity: Challenges in the diagnosis and management of bacterial keratitis. *Prog Retin Eye Res*. 2022; 88: 101028. doi: 10.1016/j.preteyeres.2021.101028.
57. Kang EY-C, Chen H-T, Hsueh Y-J, Chen H-C, Tan H-Y, Hsiao C-H et al. Corneal sensitivity and tear function in recurrent corneal erosion syndrome. *Invest Ophthalmol Vis Sci*. 2020; 61(3): 21. doi: 10.1167/iovs.61.3.21.
58. Feizi S, Javadi MA, Alemzadeh-Ansari M, Arabi A, Shahraki T, Kheirkhah A. Management of corneal complications in vernal keratoconjunctivitis: A review. *Ocul Surf*. 2021; 19: 282-9. doi: 10.1016/j.jtos.2020.10.005.
59. Nicholas MP, Mysore N. Corneal neovascularization. *Exp Eye Res*. 2021; 202: 108363. doi: 10.1016/j.exer.2020.108363.
60. Dou XY, Zhang W. Topical ketotifen treatment for allergic conjunctivitis: a systematic review and Meta-analysis. *Int J Ophthalmol*. 2023; 16(2): 286. doi: 10.18240/ijo.2023.02.17.
61. Chen YY, Liu ASH, Nurmatov U, van Schayck OC, Kuo IC. Antibiotics versus placebo for acute bacterial conjunctivitis. *Cochrane Database Syst Rev*. 2023; 3. doi: 10.1002/14651858.CD001211.pub4.

