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PREFACE

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CONTENTS

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Chapter 1

NEUROTROPHIC KERATOPATHY

Dilan YILDIZ[1]

1. INTRODUCTION

Neurotrophic keratopathy (NK), also termed *neurotrophic keratitis*, is an uncommon, progressive, and potentially vision-threatening corneal disorder that arises from damage to the trigeminal sensory pathway supplying the cornea. The condition results in impaired epithelial healing, chronic epithelial breakdown, stromal melting, and in severe cases, corneal perforation (1,2).

The cornea possesses one of the highest densities of sensory nerve endings in the body, primarily derived from the ophthalmic branch of the trigeminal nerve. These nerves serve not only to mediate sensation but also to regulate epithelial homeostasis, stimulate tear secretion, and sustain the blink reflex (3-5). Through the release of neurotrophic mediators—such as nerve growth factor (NGF), substance P, and insulin-like growth factor 1 (IGF-1)—they support epithelial proliferation, differentiation, and repair (6,7).

When corneal sensory input is disrupted, epithelial metabolism slows, the blink and tearing reflexes diminish, and the cornea becomes prone to desiccation and mechanical injury. Over time, this leads to persistent epithelial defects (PEDs), ulceration, and vision-threatening complications. Despite these severe outcomes, NK often progresses silently, as corneal anesthesia reduces pain perception, delaying presentation and diagnosis (8).

The rarity of NK—estimated at fewer than five cases per 10,000 individuals—combined with its often subclinical onset contributes to underdiagnosis (1). Early detection and intervention are therefore critical to preserving corneal structure and visual function. This chapter provides a comprehensive review of NK, including its etiopathogenesis, clinical features, diagnostic approaches, management strategies, and future therapeutic perspectives.

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6. PROGNOSIS AND FUTURE DIRECTIONS

The prognosis of NK largely depends on early recognition and intervention. Patients diagnosed in stage 1 generally maintain excellent vision with proper lubrication and avoidance of further insult. In contrast, advanced (stage 3) cases may require keratoplasty or ocular surface reconstruction to restore anatomical integrity(8). Long-term outcomes improve substantially with the availability of rh-NGF therapy and corneal neurotization, though access and cost remain limiting factors (30).

Future research focuses on identifying biomarkers for early nerve damage, developing imaging-based diagnostic algorithms, and refining regenerative strategies such as bioengineered nerve scaffolds and gene-based neurotrophic delivery. Artificial-intelligence-based corneal sensitivity mapping and machine-learning prediction of progression are also being explored.

7. SUMMARY

Neurotrophic keratopathy is a rare but serious corneal disease resulting from trigeminal denervation and loss of neurotrophic support. The condition progresses silently, often without pain, until significant epithelial or stromal damage occurs. Timely recognition using corneal sensitivity testing and confocal imaging is critical.

Management requires a staged approach—beginning with ocular surface protection and lubrication, progressing to biologic therapies such as rh-NGF, and, in refractory cases, surgical re-innervation. Recent advances have transformed the outlook for patients, shifting the focus from merely protecting the cornea to actively restoring neural function and ocular homeostasis.

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Chapter 2

LIMBAL STEM CELL DEFICIENCY (LSCD): DIAGNOSIS, STAGING, AND OCULAR SURFACE RECONSTRUCTION

Bora Deniz ARGON[1]

1. INTRODUCTION

The cornea remains transparent only if its epithelium is continuously renewed by a stable population of limbal epithelial stem cells located at the corneoscleral junction. These cells reside in a specialized microenvironment (the "limbal niche") that provides structural support, signaling cues, immune privilege, and protection from mechanical and oxidative stress. When limbal stem cells are depleted or their niche becomes dysfunctional, the corneal surface loses its ability to maintain a corneal epithelial phenotype. The clinical consequence is limbal stem cell deficiency (LSCD), a disorder characterized by epithelial instability, conjunctival epithelial migration onto the cornea ("conjunctivalization"), superficial vascularization, chronic inflammation, and progressive loss of vision and comfort.(1)

LSCD is not a single disease but a final common pathway caused by diverse insults such as chemical/thermal burns, chronic topical toxicity, contact lens–associated microtrauma, autoimmune cicatrizing conjunctivitis, and congenital disorders such as aniridia-related keratopathy. The spectrum ranges from subtle, sectoral limbal dysfunction to total loss of limbal function and complete conjunctivalization of the cornea. Importantly, LSCD frequently coexists with severe dry eye, eyelid abnormalities, neurotrophic keratopathy, stromal scarring, glaucoma, and cataract, so management often requires a staged, multidisciplinary plan.

Accurate diagnosis matters because limbal reconstruction is a resource-intensive and potentially high-stakes intervention. Overdiagnosis can lead

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15. CONCLUSION

LSCD is a vision-threatening ocular surface disorder that requires structured diagnosis and staging and a reconstruction plan tailored to laterality and risk. Multimodal assessment—combining clinical examination with IC, IVCM, and/or AS-OCT—improves diagnostic confidence and reduces over- and under-treatment. Autologous approaches (SLET, CLAU, autologous CLET) are preferred for unilateral disease and can restore a stable epithelial phenotype in a substantial majority of appropriately selected patients. Bilateral disease often requires allogeneic transplantation with systemic immunosuppression and carries higher long-term failure and complication risk. Ultimately, durable outcomes depend on meticulous preoperative surface optimization, careful technique, and longitudinal monitoring with staged visual rehabilitation.

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Chapter 3

ELECTROPHYSIOLOGY AND OPHTHALMOLOGY: DIAGNOSTIC PRINCIPLES AND CLINICAL APPLICATIONS

Ozgur EROĞUL[1]
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INTRODUCTION

Ophthalmic electrophysiology serves as a core framework for functional assessment in contemporary ophthalmology by enabling objective measurement of retinal, optic nerve, and post-retinal visual pathway performance (1). Although modern imaging modalities including optical coherence tomography (OCT), OCT angiography, fundus autofluorescence, and adaptive optics provide highly detailed structural information, they do not directly quantify neural visual function (2). Electrophysiological methods, in contrast, record stimulus-evoked bioelectrical responses generated by retinal and cortical visual neurons, thereby offering functional insight that cannot be inferred from anatomy alone (3).

Because of this direct functional specificity, electrophysiological testing supports early detection, disease characterization, prognostic evaluation, and longitudinal monitoring in a broad range of retinal and neuro-ophthalmic conditions, including inherited retinal degenerations, macular disorders, optic neuropathies, demyelinating disease, and glaucomatous damage (4). In parallel, electrophysiological endpoints are increasingly incorporated as objective functional outcomes in interventional trials investigating gene-based therapies, RNA-directed therapeutics, optogenetic strategies, and regenerative cellular treatments (5).

Protocols are internationally harmonized through standards published by the

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MULTIDISCIPLINARY CONSIDERATIONS

Reliable interpretation of electrophysiological data benefits from collaboration among ophthalmologists, clinical electrophysiologists, neurologists, and geneticists (27). In hereditary retinal disorders, coupling electrophysiology with next-generation sequencing is important for precise classification and therapeutic stratification (25). Standardized training, quality assurance, and harmonized normative databases remain essential to minimize inter-center variability and maintain diagnostic reliability (6).

FUTURE PERSPECTIVES

Artificial intelligence assisted signal processing, automated artifact rejection, and machine-learning based pattern recognition are expected to accelerate and standardize electrophysiological interpretation (28). In parallel, portable/wireless ERG platforms, virtual reality-based stimulation paradigms, and pediatric-friendly electrode technologies may broaden access and feasibility in diverse clinical settings (29,30).

CONCLUSION

Ophthalmic electrophysiology remains a foundational component of functional diagnostics in ophthalmology (1). When interpreted alongside advanced imaging and molecular genetic data, it provides objective and reproducible functional insight across retinal and visual pathway disorders (24,25). Continued technical innovation and methodological refinement are expected to further strengthen its clinical and translational relevance within precision ophthalmology (31).

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Chapter 4

DIAGNOSIS, MONITORING, AND GENETIC COUNSELING IN GENETIC EYE DISEASES

Özgür EROĞUL[1]
Kamuran AVCI[2]

INTRODUCTION

Genetic eye diseases constitute a heterogeneous group of diseases that can occur congenitally or later in life, often bilaterally, and can lead to progressive vision loss. These diseases can present clinically across a wide age range from childhood to adulthood. Individuals can face significant challenges in their education, professional lives and social integration due to these diseases. In consideration of the irreversible nature of visual impairment and the paucity of treatment options, genetic ocular diseases occupy a pivotal position within the domain of ophthalmological practice (1,2).

Hereditary retinal dystrophies, congenital cataracts, hereditary glaucomas, optic neuropathies and syndromic ocular diseases are the main examples of this group. Recent years have seen rapid developments in the field of molecular genetics, leading to a deeper understanding of the causes of these diseases. This has also resulted in greater diagnostic options and genetic counselling becoming an integral part of clinical practice (3).

The introduction of next-generation sequencing (NGS) technologies into clinical practice has led to a significant increase in the molecular diagnostic rates of many phenotypically similar but genetically heterogeneous diseases. Recent developments in the field have facilitated not only the diagnosis of the disease but also its prognostication, the creation of personalised follow-up plans, and the selection of suitable patients for novel treatment approaches, including gene therapy (4).

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the provision of accurate diagnoses and facilitates the undertaking of patient and family follow-ups over extended periods (3,8).

FUTURE PERSPECTIVE

The utilisation of gene therapies and targeted molecular therapies is demonstrating significant potential, especially in the context of hereditary retinal diseases. The approval of gene therapies, such as voretigene neparvovec, has served to further underscore the significance of molecular diagnostic procedures within the medical context (11). The prevailing expectation is that, in the future, there will be an increased prevalence of personalised treatment approaches.

CONCLUSION

Early and accurate diagnoses, along with regular monitoring and effective genetic counselling, are pivotal in determining the visual prognosis and life expectancy of individuals affected by genetic eye diseases. It is imperative that there is close collaboration between the disciplines of ophthalmology and genetics if modern patient management is to be achieved (1,3).

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Chapter 5

MULTIDISCIPLINARY COLLABORATION AND CURRENT APPROACHES IN THE TREATMENT OF UVEITIS

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INTRODUCTION

Uveitis is an inflammatory disease affecting the uveal layer of the eye (iris, ciliary body, and choroid), forming a heterogeneous group of diseases that can cause significant morbidity in clinical practice. Uveitis has been defined as an isolated ocular pathology, but it can also manifest as an ocular complication of systemic inflammatory, infectious, autoimmune, or autoinflammatory diseases. Therefore, uveitis should be considered not only as an ophthalmological problem but also as a multidisciplinary clinical picture that offers important clues in the diagnosis and management of systemic diseases (1,2).

Epidemiological studies show that uveitis is one of the leading causes of irreversible vision loss worldwide. Chronic and recurrent uveitis has been demonstrated to result in serious complications, including macular oedema, cataracts, glaucoma, retinal and optic nerve damage. These complications may lead to permanent vision loss (1–3). This potentially devastating effect of uveitis necessitates timely diagnosis, accurate etiological classification, and appropriate treatment strategies. Therefore, a multidisciplinary approach is of great importance in the diagnosis, treatment, and follow-up processes of uveitis.

Recent advances in immunopathogenesis, improvements in imaging technologies, and the clinical introduction of new immunomodulatory and biological therapies have led to significant changes in uveitis management. The current approach aims not only to suppress acute inflammation but also to control the underlying systemic disease, prevent complications, and preserve long-term visual function (3,4).

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FUTURE PERSPECTIVE

The future of uveitis treatment is being shaped by the diversification of biological agents, targeted therapies and personalised medicine approaches. AI-assisted imaging and biomarker-based treatment algorithms will be further integrated into clinical practice in the coming years.

CONCLUSION

Uveitis is a serious inflammatory disease with heterogeneous etiology, closely associated with systemic diseases, and capable of leading to permanent vision loss. The successful management of uveitis is contingent upon accurate diagnosis, a multidisciplinary approach, and the combined application of contemporary treatment strategies. Effective interdisciplinary collaboration significantly improves the visual prognosis and quality of life of patients by ensuring both ocular and systemic disease control.

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Chapter 6

CURRENT APPROACHES IN DIAGNOSIS AND TREATMENT IN OCULAR ONCOLOGY

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INTRODUCTION

Ocular oncology, a specialized subfield of ophthalmology, involves the diagnosis, treatment and subsequent monitoring of both benign and malignant neoplasms (tumours) that occur within the eye and the associated structures. The most prevalent malignant ocular tumours in both adult and paediatric age groups are uveal melanoma, retinoblastoma and intraocular metastases (1–3). Significant advances in imaging techniques, genetic analyses and targeted therapies have been made in the management of ocular tumours over the last decade. Consequently, substantial progress has been made in this field (4, 5).

CLASSIFICATION OF OCULAR TUMORS

Ocular tumors are classified as intraocular and ocular adnexal tumors. Intraocular tumors include uveal melanoma, retinoblastoma, and metastatic tumors; while adnexal tumors include lesions originating from the conjunctiva, eyelid, lacrimal gland, and orbit (1,6). The World Health Organization's current classifications also take into account histopathological and molecular features (6).

CURRENT APPROACHES IN DIAGNOSIS

A detailed ophthalmological examination and indirect ophthalmoscopy represent fundamental steps in the diagnosis of ocular tumours. Ultrasonography (A- and B-scans) is considered to be one of the gold standard imaging methods in the

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FOLLOW-UP AND PROGNOSIS

The necessity of conducting long-term follow-ups in ocular tumours is paramount for the timely and effective identification of early signs of local recurrence and systemic metastases. Risk stratification-based follow-up protocols contribute to improving patient prognosis (4, 10, 14).

CONCLUSION

Significant advancements in diagnostic methods, molecular markers, and treatment options have been witnessed over the past decade. These developments have profoundly impacted patient management in the domain of ocular oncology. The application of early diagnosis, a multidisciplinary approach, and contemporary treatment strategies has been demonstrated to enhance both survival and visual outcomes (1, 5).

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Chapter 7

PEDIATRIC OCULAR SURFACE DISORDERS

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INTRODUCTION

The ocular surface functions as a sophisticated, integrated unit that encompasses the cornea, conjunctiva, and the lacrimal and meibomian glands, all governed by a complex neural network. Its integrity is crucial for maintaining clear vision and ocular comfort. In children, the health of the ocular surface is particularly vital for normal visual development. Within the pediatric population, ocular surface disorders (OSD) present a unique set of clinical hurdles. These disorders can arise from a vast array of etiologies, including allergic reactions, infectious pathogens, autoimmune processes, trauma, and congenital factors. The etiologic classification of pediatric ocular surface disorders is summarized in Table 1. The clinical presentation can range from mild, self-limiting irritation to severe, unremitting inflammation with the potential for vision-threatening complications. These conditions carry a high risk of permanent visual impairment if they occur during the critical windows of neurovisual development. A major challenge in treating children is their frequent inability to clearly describe their symptoms. Instead, they often present with subtle or non-specific behaviors like persistent eye rubbing, photophobia, or chronic redness. For the clinician, early detection is not just a goal but a necessity to prevent long-term sequelae such as amblyopia, irreversible corneal scarring, and the significant psychological burden that often accompanies chronic childhood illness. Current epidemiological trends indicate a steady rise in pediatric OSD cases worldwide. This increase is largely attributed to shifting environmental factors, a global rise in atopy, and the ubiquitous use of digital devices among children (1). Fortunately, the management landscape has transformed in recent years. We have moved beyond simple lubrication toward the use of targeted immunomodulators and sophisticated surgical interventions.

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CONCLUSION AND FUTURE PERSPECTIVES

Pediatric ocular surface disorders comprise a heterogeneous group of conditions that require a high index of clinical suspicion, early diagnosis, and sustained multidisciplinary management. The primary aims of care are the preservation of ocular surface integrity, the prevention of visual morbidity, and the maintenance of normal visual development during critical periods of growth. Given the chronic and often progressive nature of many of these disorders, long-term follow-up and individualized treatment strategies are essential. Future advances in the field are increasingly driven by progress in regenerative medicine, molecular diagnostics, and targeted biologic therapies. Innovations such as stem cell–based treatments, gene-modifying approaches for inherited conditions, and precision immunomodulation are reshaping therapeutic paradigms. As the underlying molecular mechanisms, immune pathways, and microbiome interactions involved in pediatric ocular surface disease become better characterized, management strategies are expected to evolve toward more personalized and effective interventions. These developments hold significant potential for improving visual outcomes and long-term ocular health in affected children.

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Chapter 8

FROM A SERENDIPITOUS DISCOVERY TO A REFRACTIVE REVOLUTION: THE HISTORICAL JOURNEY OF INTRAOCULAR LENSES

Yavuz ORUÇ[1]

THE EMERGENCE OF THE FIRST INTRAOCULAR LENSES

The genesis of contemporary intraocular lens (IOL) architecture is fundamentally anchored in a serendipitous clinical observation by Sir Harold Ridley during World War II, wherein he identified that fragments of polymethyl methacrylate (PMMA) from disintegrated cockpit canopies exhibited remarkable biocompatibility within the ocular tissues of injured aviators. This realization of "immunological inertia" dismantled the prevailing surgical belief that the eye would inherently reject foreign materials, thereby providing the vital empirical framework for the development of the inert polymers and high-precision Toric IOLs utilized in modern refractive cataract procedures. This critical observation of inert biocompatibility challenged existing medical dogmas and provided the empirical catalyst for the development of the world's first artificial lens implants.

He was aware that during World War II, the eyes of fighter pilots were occasionally penetrated by fragments of poly(methyl methacrylate) (PMMA) from shattered aircraft canopies, and that these PMMA fragments were well tolerated in the eye years later (1).

This observation provided a potential solution to the limitations of high-diopter aphakic spectacles used to correct lens absence after cataract surgery at that time. Recognizing the biocompatibility of PMMA, Ridley hypothesized that an artificial lens could be manufactured from this material. As a result of this work, the first successful intraocular lens implantation was performed on November 29, 1949, at St. Thomas' Hospital in London, marking the beginning of the modern era of ophthalmology (2).

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Chapter 9

FROM ANCIENT THEORIES OF VISION TO MODERN OPHTHALMOLOGY

Yavuz ORUÇ[1]

INTRODUCTION

Ophthalmology represents one of the most distinctive disciplines in medicine, integrating metaphysical inquiry, advanced anatomical knowledge, geometric optics, and clinical methodology within a unified scientific framework. Humanity's effort to decipher the phenomenon of vision has not only been a physiological quest but also one of the most profound intellectual journeys in the history of science and philosophy. In this context, the exploration of visual perception from ancient speculative theories to modern neurotechnological applications reflects humanity's fundamental attempt to understand and interpret the external world.

From antiquity to the Middle Ages, theories of vision were closely linked to prevailing metaphysical and natural philosophical paradigms. The fundamental question of whether vision occurred through rays emanating from the eye or through images entering the eye from the external world remained a subject of debate for centuries. With the Renaissance, the expansion of anatomical knowledge and the emergence of experimental methodologies gradually replaced speculative approaches with empirically grounded models. Particularly in the nineteenth century, the development of scientific instruments played a decisive role in establishing ophthalmology as an independent medical specialty.

METHODOLOGY

This study was designed as a historical and conceptual narrative review examining the evolution of ophthalmology and theories of vision. The historical trajectory from antiquity to contemporary neurotechnological approaches was analyzed using a chronological periodization and conceptual analytical framework.

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This historical trajectory illustrates how ancient philosophical inquiries into the nature of vision have been transformed into sophisticated neuroinformatics and biomedical engineering applications. As visual restoration technologies continue to advance, the boundaries of visual function are being extended beyond traditional biological limitations, redefining both the conceptual and clinical horizons of ophthalmology.

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Chapter 10

BLEPHAROPLASTY AND OCULAR SURFACE HEALTH

Burcu IŞIK[1]

1. Introduction

The ocular surface works as a single functional unit made up of the cornea, conjunctiva, tear film, eyelid margins, and the lacrimal system (1,2). Proper eyelid position and effective blinking are necessary for spreading tears, protecting the eye, and removing debris. When these processes are disturbed, ocular surface balance may be lost, leading to dry eye disease.

Blepharoplasty is widely performed for both medical and cosmetic reasons. However, changing the eyelids surgically also alters their structure and movement, which can affect tear film behavior and surface stability (3). In practice, postoperative complaints are more common in patients with undiagnosed surface disease or after excessive tissue removal. Research also shows higher complication rates when aggressive techniques are used (4,5).

For this reason, modern blepharoplasty focuses on conservative, anatomy-preserving approaches with attention to ocular surface protection. Success today is measured not only by cosmetic improvement but also by maintaining eyelid function and surface health (3,6).

2. EYELID ANATOMY AND FUNCTIONAL

Integration with the Ocular Surface

The eyelids protect the ocular surface both mechanically and physiologically. Full eyelid closure protects the cornea from exposure and prevents drying during sleep (1). Blinking spreads the tear film evenly and helps release meibomian gland oils that stabilize the lipid layer (6).

The lower eyelid is important for holding the tear meniscus and controlling tear drainage. If lid tone or position is altered, patients may experience excessive tearing or faster tear evaporation, both of which harm the ocular surface (5).

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and ocular surface balance. Conservative methods, careful assessment, and active postoperative care reduce complications while preserving cosmetic results (3–7).

Long-term success depends on protecting eyelid function and surface stability rather than removing the maximum amount of tissue.

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Chapter 11

ANATOMY AND PHYSIOLOGY OF THE CORNEA AND THE OCULAR SURFACE

Tahsin UZUNDEDE[1]

OCULAR SURFACE COMPLEX

The ocular surface complex can be defined as an integrated system composed of functionally interrelated structures that play a critical role in maintaining a properly functioning visual axis. This complex includes the cornea, conjunctiva, lacrimal gland, accessory lacrimal glands, eyelashes, meibomian glands, and all associated eyelid structures.(1)

CORNEAL EMBRYOLOGY

The cornea is a transparent tissue that forms the anterior boundary of the globe and allows light to reach the retina, which is primarily responsible for visual function. As the first structure encountered by light as it enters the eye and travels toward the retina, the cornea also represents the most important component of the eye's refractive power.(2,3)

During the process of gastrulation, each embryo differentiates into three primary germ layers: ectoderm, mesenchyme, and endoderm. In addition to these layers, specialized cells differentiating from the neuroectoderm in proximity to the neural tube are referred to as neural crest cells .(3)Throughout development, each corneal layer originates from a distinct embryological source.(2,3)

Corneal development begins in the second month following the formation of the optic vesicle. The surface ectoderm covers the lens pit, after which corneal epithelial formation commences. The development of the lens vesicle stimulates corneal development and facilitates the formation of a transparent and avascular cornea. A fundamental aspect of this process involves the migration of the lens

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pathogenesis of ocular surface disorders and for developing targeted therapeutic strategies.(12,13)

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Chapter 12

OCULAR SURFACE HERPETIC DISEASE

Tuğçe DURSUN YILMAZŞAMLI[1]

HERPESVIRUSES

All herpesviruses have a similar structure: a core of linear double-stranded DNA surrounded by an icosahedral protein capsid, which is contained within an envelope studded with viral glycoproteins.[1] The human herpesviruses that affect the eye: herpes simplex virus types 1 and 2 (HSV-1 and HSV-2), cytomegalovirus (CMV), varicella-zoster virus (VZV), Epstein–Barr virus (EBV), and Kaposi sarcoma-associated herpesvirus (KSHV).[2] All herpesviruses establish latency in their natural hosts, but the latency site varies. HSV, the main topic of this section, for example, causes latent infections in neurons of sensory ganglia, such as the trigeminal ganglion. [3]

HERPES SIMPLEX VIRUS EYE DISEASES

HSV infections are estimated to affect roughly one-third of the world's population, representing a substantial global public health burden.[4] In developed countries, herpetic eye disease remains the leading infectious cause of corneal blindness.[5]

Individuals of all ages who present with symptoms (e.g., photophobia, pain, redness, and a clear discharge; those with central lesions also may present with decreased vision) and signs (e.g., corneal epithelial and stromal ulcers and infiltrates, corneal edema, keratic precipitates, and anterior chamber inflammation) suggestive of HSV keratitis should be referred to an ophthalmologist.[6]

GOALS OF THE CHAPTER

1. Recognise the risk factors that may predispose patients to HSV keratitis and an increased frequency and/or severity of recurrences.

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Chapter 13

DRUG-INDUCED OCULAR SURFACE DISORDERS

Emine Betül AKBAŞ ÖZYÜREK[1]

1.INTRODUCTION

The ocular surface primarily formed by the cornea, conjunctiva, and tear film. This compact layer serves as the primary barrier between the external environment and the sensitive intraocular structures. Maintaining the integrity and homeostasis of this complex system is essential for optimal visual function and ocular comfort. However, this dynamic interface is continuously affected from environmental factors. Topical and systemic medications are among these important factors. Therapeutic management of both ophthalmic and systemic diseases frequently necessitates the use of pharmacological agents but, that can compromise epithelial integrity, tear film stability, and local immune balance of ocular surface. As a result, conditions arise that we can categorize under the name of drug-induced ocular surface disorders (DIOSDs).

Clinical significance of DIOSDs has increased substantially over recent decades, paralleling the widespread use of chronic topical medications—particularly for glaucoma management—and the introduction of novel systemic therapies, including biologic agents and targeted cancer treatments. Epidemiological studies suggest that up to 50% of patients receiving long-term preserved antiglaucoma medications with preservatives, particularly benzalkonium chloride (BAK), develop signs and symptoms of ocular surface disease (1-4). Also systemic agents such as isotretinoin and dupilumab have emerged as important causes of meibomian gland dysfunction and conjunctivitis and affecting a significant proportion of treated patients (5, 6).

The pathophysiology of DIOSDs involves many factors, including direct cytotoxic effects on the cornea and conjunctiva, tear film disruption, and immunological mechanisms (7-9). These pathogenic processes give rise to a

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vigilance must intensify. Through systematic risk assessment, preferential use of ocular surface-friendly formulations, multidisciplinary collaboration, and patient-centered care balancing benefits against adverse effects, clinicians can minimize DIOSD burden while preserving medical therapy benefits. Continued research into pathophysiologic mechanisms, predictive biomarkers, and innovative treatments will further improve outcomes for patients navigating medication-related ocular surface complications.

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Chapter 14

OCULAR SURFACE DISEASES AND ARTIFICIAL INTELLIGENCE

Elvin HALİLİ ÇELENK[1]

INTRODUCTION

Ocular surface diseases are important ophthalmological problems that directly affect visual quality and can lead to a significant decrease in quality of life. Pathologies such as dry eye disease, infectious and inflammatory keratitis, conjunctivitis, and meibomian gland dysfunction constitute a large part of clinical practice(1,2). Slit-lamp examination, vital staining methods, and imaging techniques are widely used in the diagnosis and follow-up of these diseases. However, the evaluation of these methods is largely dependent on the clinician's experience and may show subjective differences(3).

Recent years have seen rapid advances in artificial intelligence and machine learning technologies, leading to significant progress in the field of medical image analysis. Deep learning-based algorithms, in particular, have begun to be used with high accuracy rates in the diagnosis of retinal diseases in ophthalmology (4,5). These developments have also brought to the fore the potential of artificial intelligence-based systems in the evaluation of ocular surface diseases.

Artificial intelligence-supported analysis methods enable the objective evaluation of high-volume clinical data and offer significant advantages in early diagnosis, disease classification, and monitoring treatment response(5). In particular, the automatic analysis of slit-lamp photographs, meibography images, and ocular surface photographs contributes to the development of clinical decision support systems(6).

This section will comprehensively address the current status of artificial intelligence applications in ocular surface diseases, the methods used, clinical benefits, limitations, and potential future applications.

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advances should be viewed as complementary elements that reinforce the physician-centered approach.

In conclusion, artificial intelligence applications in ocular surface diseases are evolving towards offering more integrated, personalized, and accessible solutions in the coming period. Scientific validation, ethical awareness, and multidisciplinary collaboration will continue to be key determinants for these developments to translate into clinical benefits.

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